

# ACADEMIC REGULATIONS – 2018

## UNDERGRADUATE DEGREE PROGRAMMES

Bachelor of Technology

(B.Tech. - Four Years)

(Choice Based Flexible Credit System)



**SRM**

INSTITUTE OF SCIENCE & TECHNOLOGY  
(Deemed to be University u/s 3 of UGC Act, 1956)

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SRM INSTITUTE OF SCIENCE & TECHNOLOGY  
(Deemed to be University u/s 3 of UGC Act, 1956)  
Kattankulathur, Kancheepuram District 603203,  
Tamil Nadu, India

### **i. Regulations for B.Tech. (Common to all Programmes)**

These regulations are applicable to the students admitted from the Academic Year 2018-19 onwards.

As per the recommendation of National Knowledge Commission, University Grants Commission (UGC) and All India Council for Technical Education (AICTE), institutions of higher education need to carry out academic reforms in all areas including admission policy, uniform academic calendar, introduction of Choice Based Flexible Credit System, continuous assessment and grading system. In keeping with these recommendations, SRM Institute of Science and Technology (SRMIST) had adopted the Choice Based Flexible Credit System (CBFCS) in the faculty of Engineering and Technology in the year 2013 which was improved upon in 2015 and now it is being further refined and implemented from 2018-19 onwards.

### **Preliminary Definitions and Nomenclature**

In these regulations, unless the context otherwise requires:

- i. **'Degree'** means that academic award conferred upon a student on successful completion of a four-year programme designed to achieve the defined attributes. It is referred to as Under-Graduate (UG) Degree, that is "Bachelor of Technology" also known as "B.Tech. Degree".
- ii. **'Programme'** means cohesive arrangement of courses, co-curricular and extracurricular activities to accomplish predetermined objectives leading to the awarding of a degree. It also means branch or discipline of B.Tech. Degree programme like Civil Engineering, Mechanical Engineering, etc. Some Degree programmes also provide options to specialize in a specific domain of interest. Such B.Tech. Degree programmes are titled as the *Degree along with its specializations* like Biotechnology with specialization in Regenerative Medicine, etc.,
- iii. **'Course'** means a combination of theory, tutorials and practice sessions of a subject studied in a semester, like Mathematics, Physics, etc.,
- iv. **'Minor'** is an optional secondary concentration of courses that often complements the Degree Programme.

### **R.1.0 Admission for B.Tech. (Regular) Programme**

R 1.1 **Number of Seats:** The number of seats in each branch of the B.Tech. programme for which admission is to be made in the Faculty of Engineering and Technology will be decided by the Board of Management, SRMIST.

- R 1.2 **Minimum Eligibility:** The minimum eligibility for Admission to B.Tech. degree programmes (Regular) shall be based on the following two essential criteria:
- (a) A pass in the 10+2 (Higher Secondary) examination or any other equivalent examination of any authority, recognized by SRMIST, with a minimum aggregate of marks in Mathematics / Biology / Biotechnology, Physics and Chemistry to be specified by the Admissions Committee.
  - (b) Qualification in SRM Joint Entrance Examination - Engineering (SRMJEEE) (or) any other Entrance Examination conducted by central/state entrance examination body for the purposes of admission to an engineering degree programme for the respective year of admission.
- R 1.3 **Eligibility for SRMJEEE:** The eligibility for appearing for SRMJEEE and the format shall be mentioned in the Application form and would be decided by the Admissions Committee for the respective year of admission.
- R 1.4 **Seat Allocation and Admission:** The Admission Committee will prepare a merit list based on the marks scored by the candidates in the SRMJEEE and call the applicants in the merit order for counselling. Seats are allotted based on applicant's interest and seat availability. Only those candidates who have scored the minimum aggregate of marks as specified in R.1.2 (a). will be included in the merit list.
- R 1.5 **Admissions under Lateral Entry Scheme:** Under the Lateral entry scheme of Admissions, the following categories of candidates are eligible for admission directly to the 3rd semester of any B.Tech. programme offered by SRMIST.

**Minimum Eligibility:** A pass in Diploma in Engineering/Technology through:

- (i) A minimum of three years of institutional study, after the 10<sup>th</sup> (SSLC) examination, recognized by SRMIST. (or)
- (ii) A minimum of 2 years of institutional study, after the 10+2 (Higher Secondary) examination, recognized by SRMIST. (or)
- (iii) ABachelor's degree in Mathematics/Physics/Chemistry, after the 10+2 (Higher Secondary) examination, recognized by SRMIST. (or)
- (iv) Any other equivalent degree through a minimum of 3 years of institutional study, after the 10+2 (Higher Secondary) examination, recognized by SRMIST.

- R 1.6 **Medical Standards for Admission:** Candidates have to fulfil the medical standards required for admission as set out by the Admission Committee.
- R 1.7 **Fees for Admission:** The selected candidate will be admitted to the B.Tech. programme after he/she fulfils all the admission requirements as indicated in the letter of admission after making the payment of the prescribed fees within the due date announced.
- R 1.8 **Authority for Admission:** Any matter related to admission to the B.Tech. programme, the decision of the Admission Committee is final.
- R 1.9 If, at any time after admission, it is found that a candidate has not fulfilled the requirements stipulated in the offer of admission, the Director (Eng. & Tech.) may revoke the admission of the candidate and report the matter to the Vice Chancellor.
- R 1.10 In Addition to the above, admissions will be based on the rules and regulations of the UGC/Competent authorities in force at the time of admissions.

## **R.2.0 Structure of B.Tech. Programme (Common to all Programmes)**

R 2.1 **List of Programmes:** The B.Tech. Degree Programmes offered by SRMIST are as follows:

1	Aerospace Engineering (AS)
2	Automobile Engineering (AU)
3	Automobile Engineering with specialization in Automotive Electronics (AE)
4	Biotechnology (BT)
5	Biotechnology with specialization in Regenerative Medicine (RM)
6	Biotechnology with specialization in Genetic Engineering (GE)
7	Chemical Engineering (CH)
8	Civil Engineering (CE)
9	Computer Science and Engineering (CS)
10	Computer Science Engineering with specialization in Artificial Intelligence and Machine Learning (AI)
11	Computer Science Engineering with specialization in Big Data Analytics (BD)
12	Computer Science Engineering with specialization in Cloud Computing (CC)
13	Computer Science Engineering with specialization in Computer Networking (CN)

14	Computer Science Engineering with specialization in Cyber Security (SC)
15	Computer Science Engineering with specialization in Information Technology (IT)
16	Computer Science Engineering with specialization in Internet of Things (IO)
17	Computer Science Engineering with specialization in Software Engineering (SE)
18	Electrical and Electronics Engineering (EE)
19	Electronics and Communication Engineering (EC)
20	Electronics and Communication Engineering with specialization in Biomedical Engineering (BM)
21	Electronics and Communication Engineering with specialization in Instrumentation Engineering (IE)
22	Mechanical Engineering (ME)
23	Mechatronics Engineering (MH)
24	Mechatronics Engineering with specialization in Robotics (RO)
25	Nanotechnology (NT)

R 2.2 **Category of Courses:** The Programme of study will consist of 8 categories of courses distributed over eight semesters (6 semesters for lateral entry students) with two semesters per year as listed below:

No.	Category Code	Course Category
1	H	Humanities and Social Sciences including Management courses
2	B	Basic Science courses
3	S	Engineering Science courses
4	C	Professional Core courses (Compulsory courses)
5	E	Professional Elective courses (Optional courses relevant to chosen branch/specialization)
6	O	Open Elective courses (Optional courses from other technical and/or emerging subjects)
7	P	Project Work, Seminar and Internship in industry or higher institutions
8	M	Mandatory Courses (non-credit courses)

R 2.3 **Outcome Based Education:** The B.Tech. programmes follow the Outcome Based Education (OBE) guidelines and have well defined:

1	Program Educational Objectives (PEO)
2	Program Learning Outcomes (PLO) which includes Program Specific Outcomes (PSO)
3	Mission of the Department to Program Educational Objectives (PEO) Mapping
4	Program Educational Objectives (PEO) to Program Learning Outcomes (PLO) Mapping

5	Structure of Undergraduate Engineering Programme
6	Categorization of Courses (for all four years)
7	Program Articulation Matrix (for all four years)

And, every course has well defined:

1	Course Learning Rationale (CLR)
2	Course Learning Outcomes (CLO) – (Outcome based Objectives)
3	Learning Plan with session-wise Session Learning Outcomes (SLO)
4	Learning Assessment Scheme
5	Course Designer Details

These details are proposed by the respective Board of Studies and approved by the Academic Council.

R 2.4 **Learning Curriculum:** B.Tech. Programmes have a learning curriculum comprising of appropriate combinations of learning from Theory, Tutorials and Practice sessions.

R 2.5 **Learning Credits:** Learning Credits are earned by the learner based on the following pattern:

Learning Environment	Learning Credit (C)
1 Hour* Learning from a Lecture Session per week (L)	1
1 Hour* Learning from a Tutorial Session per week (T)	1
1 Hour* Learning from a Practice Session per week (P)	0.5

(\* 1Hour of Learning is usually a 50-60 minute period)

R 2.6 **Minimum Learning Credits for the award of Degree:** For the award of B.Tech. Degree, a student has to acquire a maximum of 160 learning credits by learning and practising the various courses prescribed in the curriculum within the stipulated time duration.

(a) **Learning Credit Requirement for Lateral Entry Students:** For the award of B.Tech Degree for a student who has joined through the Lateral Entry Scheme, the number of learning credits to be acquired will be in accordance with the curriculum of the program concerned and the credit standing at the point of entry (Second year, third semester) to the B.Tech. Program.

For instance, assuming the total credits stipulated for a particular specialisation of first year B.Tech. is 42, and the aggregate of bridge courses – mathematics (2 credits), Physics (2 credits) and Chemistry (2 credits) is 6 credits, then the credit standing would work out to  $42-6= 36$  credits. In this case the student, has

to earn [160 – 36 = 124 credits, including the credits of bridge courses to receive his/her B.Tech. degree.

Lateral entry students, on admission, shall have to undergo 'Bridge Courses' prescribed by the SRMIST, which they have to pass and the learning credits acquired from these courses are added towards their qualifying degree requirements.

**R 2.7 Classification and Numbering of courses:** The 9 digit Course Code Structure is provided below:

For Example : 18LEH101J

YY DD C L SS A					
YY	DD	C	L	SS	A
2 digits	2 digits	1 digit	1 digit	2 digits	1 digit
Year of Regulation	Course Offering Department	Type of Course	Level of the Course	Serial No. of the Course	Additional Qualifier
2018 Regulations	LE – English PY – Physics CY – Chemistry MA – Mathematics MB – Management Sciences PD – Career Development Centre AS – Aerospace Engineering AU – Automobile Engineering BT – Biotechnology CH – Chemical Engineering CE – Civil Engineering CS – Computer Science & Eng., EE – Electrical & Electronics Eng., EC – Electronics & Commn. Eng., ME – Mechanical Engineering MH – Mechatronics Engineering NT – Nanotechnology	<b>H</b> – Humanities, Social Sciences including Mgt. Courses <b>B</b> – Basic Science Courses <b>S</b> – Engineering Science Courses <b>C</b> – Professional Core Courses <b>E</b> – Professional Elective Courses <b>O</b> – Open Elective Courses <b>P</b> – Project Work, Seminar, Internship etc., <b>M</b> – Mandatory Courses (non-credit)	1 - 1 <sup>st</sup> Level Course 2 - 2 <sup>nd</sup> Level Course 3 - 3 <sup>rd</sup> Level Course 4 - 4 <sup>th</sup> Level Course	01 02 etc.,	T - Theory L - Laboratory I - Industry B - Bridge J - Joint

R 2.8 **Medium of Instruction:** The medium of instruction, examination and project reports will be in English.

### **R.3.0 Registration / Enrolment for Courses**

The process of signing-up for courses is called 'Registration'. Students are enrolled after they pay the prescribed fees. For a student to attend classes he/she has to necessarily complete both registration and enrolment. All students shall formally register for the courses every semester to undergo their learning course work.

R 3.1 **Course Enrolment Requirements:** Enrolment for all courses prescribed as per the curriculum is mandatory.

- (a) Registration of any course will be controlled by the respective Heads of Department.
- (b) The registration sheet contains the course code, course title, number of credits earned till date, number of credits opted for the current semester, and the remaining number of credits to earn for the award of the degree. The student will make the choice of courses on his own or in consultation with his/her Faculty Advisor.
- (c) For the first semester (and III semester in the case of lateral entry students) registration shall be completed within a week prior to the commencement of classes.
- (d) For all other semesters, the registration will be done during a specified week immediately after the end semester examination of the previous semester.
- (e) Late enrolment would not be encouraged. In case of a late enrolment, special permission is required from the respective Heads of Department.

R 3.2 **Break in Studies:** A student will not be allowed to enrol for current semester and has to undergo a year of break in studies if he/she:

- (a) Does not have a minimum of 75 % attendance in at least 3 or more courses in the previous semester
- (b) Has not cleared any pending fee dues to SRMIST, Hostel, Library, NCC etc., in the previous semester
- (c) Has been 'Debarred from study' due to any stipulated reason in the previous semester.
- (d) Has any 'Pending Disciplinary Actions' against him/her from the previous semesters
- (e) Has not registered for previous end semester examinations

R 3.3 **During the Break of Studies,** a student:



- (a) Cannot attend any regular classes
- (b) Will not be permitted to stay in the 'Hostel' facility provided by SRMIST
- (c) Will not be permitted to participate in any of the SRMIST's activities inside the campus.
- (d) Can register for 'Compensatory courses' for such courses in which he/she might have obtained an 'I' grade.
- (e) Can reappear for the 'End Semester Final Examination' for such courses in which he/she might have obtained 'F' / 'Ab' grade.

**R 3.4 Enrolment After Break in Studies:** A student who undergoes a break in studies in the current semester (odd/even) can 'Enrol Back to Study' into the B.Tech. Programme only in the subsequent corresponding (odd/even) semester in the next academic year only. And 'Enrol Back from Study' is subject to the approval from Director (Eng. & Tech.).

**R 3.5 Detention in Courses and Compensatory Courses:**

The system of compensatory courses is meant for those students who are unable to cope up with the academic vigour and hence fails to secure 75% attendance in a few courses in a semester. Such students can not appear for end semester examinations of the courses in which their attendance percentage is less than 75% and are deemed to be detained in such courses and awarded 'I' grade in the same (Refer R.8.3). However, such students can register under Compensatory Courses in the next semester subject to the following conditions:

- (a) Compensatory courses are conducted only for a student who is 'Detained from Study' due to lack of attendance of 75% minimum.
- (b) Compensatory courses may be announced after the publication of results, by the respective School/Department, by the Deans/HODs, with the approval of the Director (Eng. & Tech.)
- (c) Student has to register for the Compensatory Course and pay the prescribed fee for the Compensatory Courses within the specified time limit.
- (d) A maximum of two Compensatory Courses alone will be permitted to be registered by a student during the semester next to the semester of detainment.
- (e) Withdrawal from Compensatory courses is not permitted
- (f) These courses will be conducted only for 75% of the hours prescribed in the curriculum and would be held either during weekends or in evenings after the regular class duration.
- (g) A student has to obtain a minimum of 75% attendance in each of these courses.

- (h) There will be only one end semester final examination, and no continuous learning assessments. The internal marks scored in the detained course will be ignored.
  - (i) A student has to score the minimum passing criterion to be declared 'Pass' in that course.
  - (j) Students cannot demand a compensatory course for a course in any semester as a matter of right. Compensatory courses will be conducted subject to availability of faculty, class rooms and logistics.
  - (k) Students who have done a Compensatory Course will not be considered for rank, medal or distinction.
- a. **Adding and dropping courses:** This is applicable only to Professional Elective and Open Elective courses.
- (a) A student may withdraw from an elective course without academic penalty only during the first 2 weeks of the semester only.
  - (b) A course having a Co-requisite course will not be permitted to be dropped. Similarly registering for a new elective course is permitted only during the first two weeks of the semester.
  - (c) If an elective course is dropped within the first two weeks of the commencement of classes, it does not appear on the academic transcript. In case, the course is dropped any time after 2 weeks unilaterally by the student, for reasons whatsoever, it will be recorded with a mark of "Ab" or "I".
  - (d) When a course is added within the permissible timeframe, the attendance will be calculated from the date of registering the newly added course. No make-up classes need be conducted for the individual student to compensate for the missed classes.
  - (e) **Registration in graduate level courses by undergraduate students:** Exceptional undergraduate students who are in the fourth year of study and who possess CGPA of not less than 9.0 may enrol in a graduate (Masters) course. In order to do so, students must receive a strong recommendation from the academic advisor and prior approval of the Director (Eng. & Tech.). The according of approval lies solely with the Director (Eng. & Tech.). In any case only ONE master's level course will be permitted. The assessment procedure will remain the same as applicable for the master's level course.

#### **R.4.0 Maximum and Minimum Duration of the Programme**

- R 4.1 **Semester Duration:** Each semester of study shall normally consist of 90 working days or 450 hours. A student is ordinarily expected to complete the B.Tech. programme in eight semesters for regular programme and in 6

semesters under lateral entry scheme. However, a student may complete the programme at a slower pace by taking more time as specified below:

**Regular students:** within the time duration of 12 semesters (As per the UGC Norms) for students admitted in a particular year.

**Lateral Entry students:** within the time duration of 10 semesters (As per the UGC Norms) for students admitted in a particular year.

The above-mentioned time duration is counted excluding semesters withdrawn on medical grounds etc.

R 4.2 In compliance with the rules and norms of UGC, no student will be allowed to complete the B.Tech. degree in less than 8 full-semester.

**R.5.0 Temporary withdrawal from the programme**

R 5.1 A student may be permitted by the Director (Eng. & Tech.) to withdraw from the programme for a semester or longer for reasons of ill health or other valid reasons. Normally a student will be permitted to discontinue from the programme only for a maximum continuous period of two semesters or the aggregate of individual discontinuation not exceeding two semesters.

**R.6.0 Academic Advising :** In order to provide academic assistance and individualized attention to students, different levels of advising/attention will be provided by three types of officers. (1) Academic Class Advisors (2) Student Counsellor (3) Faculty Advisors

R 6.1 **Academic Class Advisors:** For every 60 to 70 students, an Academic Class Advisor would be allocated to help the student evaluate and realize educational and career options. The basic responsibilities of the Academic Class Advisor are:

- (a) To assist the student in career planning and to refer student to campus resources for such assistance.
- (b) To be knowledgeable about the program(s) for which he/she is advising and be familiar with published academic rules and regulations of SRMIST.
- (c) To inform the student of the various aspects of degree requirements.
- (d) To approve the course registration of the student at the department level
- (e) To consider and approve the application for adding / dropping / auditing of courses
- (f) To guide the students while applying for readmission / transfer etc.

- (g) To help student plan a suitable schedule of classes, at least one semester in advance.

In all of these matters, the Academic Class Advisor or the advisement team must judge whether the student's request is in order, is in the student's best interest, and is feasible under existing regulations.

R 6.2 **Student Counsellors & Faculty Advisors:** In order to motivate the students personally and provide counselling on academic and non-academic matters, a faculty member called Student Counsellor shall be assigned for every 25-30 students. In addition, Faculty Advisors also would advise students time to time.

### R.7.0 **Conduct and Discipline**

R 7.1 **Expected Conduct and Discipline:** Every student is required to:

- (a) Demonstrate ethical, professional and exemplary conduct and decorous behaviour both inside and outside SRMIST campus and not to indulge in any activity that will tend to bring down the prestige of the SRMIST.
- (b) Be self-motivated and to be self-disciplined
- (c) Make the most of their ability and to contribute to the happiness and well-being of SRMIST community by supporting others.
- (d) Treat others in the way that they would wish to be treated themselves
- (e) Abide by the orders of the Honourable Supreme Court of India, and not to get involved in any acts of ragging in any form. Ragging is absolutely and completely prohibited in SRMIST.
- (f) Avoid Plagiarism, cut and paste jobs, malpractices of any kind in learning assignments including project work and its reports.

R 7.2 **Act of Indiscipline:** A student who does not conduct in the manner expected and as stated above is considered to be performing an act of Indiscipline.

- (a) Acts of Indiscipline are dealt with at zero tolerance
- (b) Any acts of Indiscipline of a student is first to be considered by the Discipline and Welfare Committee of the Department/School for necessary action. If the issue demands more serious consideration, the act of indiscipline will be reported to the Director (Eng. & Tech.) and he will refer it to the Discipline and Welfare Committee of SRMIST, constituted by the Vice Chancellor. The Committee will enquire into the charges and recommend suitable action if the charges are substantiated. The Director (Eng. & Tech.) will take appropriate

action on the recommendation of the Discipline and Welfare Committee of SRMIST.

- (c) Anyone found indulging in ragging or any such acts is liable to be dismissed forthwith.

R 7.3 **Suspension:** Director (Eng. & Tech.) may suspend a student pending inquiry depending upon the prima facie evidence.

R 7.4 **Appeal:** The aggrieved student may appeal to the Vice Chancellor whose decision will be final and binding.

### R.8.0 Attendance

R 8.1 Attendance is the physical presence and active learning participation of a student in the class / laboratory / field work etc., It is a well-observed fact that the students who score good grades are those who attend and participate in all the assigned learning activities in the class / laboratory / field work, regularly. Therefore, the students must strive to attend and sincerely participate in all the assigned learning activities without fail.

R 8.2 Every faculty member facilitating a course will take notice of student attendance and their learning participation till the last instruction day in the semester. The percentage of attendance, calculated up to this point, will be indicated by a code number/letter as follows:

Attendance rounded to	Code
95% and above	H
85 to 94%	9
75 to 84%	8
Below 75%	L

R 8.3 A student must maintain an attendance record of at least 75% in individual courses, *exclusive of leave of absence due to medical reasons, on-duty, extra-curricular / extramural activities, permitted assignments such as job interviews, unforeseen emergencies etc.* Without the minimum attendance of 75%, in any course, students become ineligible to appear for the end semester examination in that course. His / Her registration for that course will be treated as cancelled, and he/she shall be awarded 'I' grade (I stands for Incomplete or registration cancelled for want of minimum attendance) in that course. This grade shall appear in the grade card until the course is successfully completed. A student shall register under "Compensatory Courses (R.3.1)" for the courses in which he/she has attendance less than 75% and complete the same.

R 8.4 A student must strive to attend all the classes without fail. However, the minimum attendance requirement of 75% allows a student the facility to use the balance 25% to account for illnesses, permitted assignments such as job interviews, inter university sports meets, inter-collegiate/inter-university competitions, accidents, unforeseen emergencies etc. An attendance of 75% in a course (except in cases governed by R.8.6) is considered to be the minimum required for a student to get just enough input on the course syllabus through class room contact hours to make him / her eligible to appear in the end semester examination for that course.

It is the responsibility of each and every student to keep track / monitor his / her percentage of attendance for each course and ensure that he / she satisfies the attendance norms prescribed by SRMIST. If the student finds any discrepancy / error in the attendance status, he /she should immediately bring it to the attention of the concerned faculty member and seek redressal.

R 8.5 The teacher shall prepare the particulars of all students who have attendance less than 75% in his / her course. Copies of the same should also be sent to the Director (Eng. & Tech.), and Heads of Schools/ Departments concerned.  
***The students who have less than 75% attendance will not be permitted to appear in end semester examination, and the same will be informed to the student's parents.***

R 8.6 **Condonation of Attendance:** In rare and genuine cases, a committee consisting of Director and Head of the Department of the concerned department will examine the case, based on the documents submitted by the student, facts and circumstances. Assessment will be done, by the committee, on the merit of the case and spell out their recommendation to the Vice Chancellor. The Vice Chancellor, based on the recommendation of the committee may then give condonation of attendance, only if the Vice Chancellor deems it fit and deserving but in any case, the condonation cannot exceed 10%.

### **R.9.0 Learning Assessment Procedure**

R 9.1 The learning of a student is assessed and evaluated in-house by the course facilitating faculty member/ department except in the case of project work where an external examiner shall be nominated for conducting the viva-voce. All assessments are designed based on Revised Bloom's Taxonomy levels of thinking and learning.

(Anderson, Lorin W, Krathwohl, David R, "A Taxonomy for Learning, Teaching and Assessing: a revision of Bloom's Taxonomy", Longman Publishing, NewYork, 2001)

R 9.2 The student's learning in each course, in general, is assessed (formative) and evaluated (summative) based on *in-semester continuous learning assessment* (internal assessment) and *end-semester final examination*. An *in-semester continuous learning assessment* (also known as internal assessment / comprehensive assessment) is spread through the duration of course and is done by the faculty member facilitating the course. In order to verify the different skills acquired in a student, the continuous learning assessments are (as appropriately) performed through:

- (a) Oral Learning Assessments
- (b) Written Learning Assessments
- (c) Demonstrative Learning Assessments

The end-semester final examination shall have learning assessments from the following perspectives with respect to all courses:

- (a) Evaluation with respect to knowledge
- (b) Evaluation with respect to Understanding
- (c) Evaluation with respect to skill
- (d) Evaluation with respect to Applications and/or
- (e) Higher Order Thinking Skills

a. The learning assessment weightage in percentages for every course is provided for each course in the respective course syllabus, and follows the template:

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA-1 (10%)		CLA-2 (15%)		CLA-3 (15%)		CLA-4 (10%)	Final Examination (50% weightage)		
		Theory	Practice	Theory	Practice	Theory	Practice		Theory	Practice	
Level 1	Remember	%	%	%	%	%	%	%	%	%	
Level 2	Understand	%	%	%	%	%	%	%	%	%	
	Apply	%	%	%	%	%	%	%	%	%	
Level 3	Analyze	%	%	%	%	%	%	%	%	%	
	Evaluate	%	%	%	%	%	%	%	%	%	
	Create	%	%	%	%	%	%	%	%	%	
	Total	100 %		100 %		100 %		100 %	100 %		

Note : For a Pure Theory Course, the Practice Part would be zero and similarly for a Pure Practice Course, the theory part would be appropriately zero.

- (a) The ratio between Continuous Learning Assessments and Final Examinations for all courses is 50:50.
- (b) A student should definitely attend the Final Examination to be eligible to Pass the course.

- (c) For a student to PASS in a course, a student has to score a minimum of 50 marks aggregate.
- (d) For the Theory Part of a course or a pure theory course; Continuous Assessments CLA-1 (normally in two learning units / modules or as prescribed by the Course Coordinator), CLA-2 (in two learning units / modules not covered in CLA-1 or as prescribed by the Course Coordinator) and CLA-3 (in all the five learning units / modules) are generally conducted as Written Tests of duration 100 minutes, 100 minutes and 180 minutes respectively each and the final examination is conducted for 180 minutes.
- (e) For the Practice Part of a course or a pure Practice course; Continuous Learning Assessments CLA-1, CLA-2 and CLA-3 are generally conducted at periodic intervals, and for certain courses that needs learning verification of oral and skill demonstrative abilities, there would be appropriate oral tests and tests for demonstrations respectively.
- (f) CLA-4 is generally a combination from among one or more of these options:

Assignments	Surprise Tests	Seminars	Multiple Choice Quizzes
Tech. Talks	Field Visits	Self-Study	NPTEL/MOOC/Swayam
Mini-Projects	Case-Study	Group Activities	Online Certifications
Presentations	Debates	Conference Papers	Group Discussions

- (g) Student learning from the theory and practice portions in a course shall be assessed separately for 100 marks each and consolidated by assigning a weightage of 50% for theory component and 50% for practical component. Grading shall be done for this consolidated mark.
- (h) For the Practice Part (Laboratory/Practical) of a course or a pure Practice (Laboratory/Practical) course; due weightage for carrying out experiments, such as observations, collection of data, analysis, interpretation of results, inferences and also timely submission of record work done would all carry due weightage based on the type of laboratories and the course and constitute the CLA-1, CLA-2, CLA-3. The nature of the end semester final examination shall be informed to the students at the commencement of the course.
- (i) The Final examination (both theory and practice(Laboratory/Practicals)) would be conducted only after the last working day of the semester.
- (j) Final Semester Project Work: The projects undertaken as far as possible should be socially relevant and product oriented. B.Tech. projects can be carried out by individual students or by a group of students with a maximum of five students in a group.
- (k) The assessment method for the project work consists of in-semester and end semester evaluations as detailed below:



	Continuous Learning Assessment (50% weightage)			Final Evaluation (50% weightage)	
	Review – 1	Review – 2	Review – 3	Project Report	Viva-Voce
Project Work / Full Internship	5 %	20 %	25 %	20 %	30 %

R 9.3 Whenever there is a deviation from procedures stated under 15.3, as warranted by the unique nature of the course, the same will be specified by the concerned Course Coordinator and approved by the Director (Eng. & Tech.).

#### **R.10.0 Re-appearing for Examination**

- (a) Students who have secured 'F'(Fail)'/Ab' (Absent) grade in a particular course can reappear when the end semester examination for that course is again conducted provided they satisfy other eligibility conditions such as lack of attendance overcome by attending Compensatory courses and minimum credit / appearance in end semester examinations requirements,
- (b) Temporary withdrawal from the programme and Discipline.
- (c) For the first two attempts, the internal marks obtained in the first attempt will only be considered and it will be combined with the marks obtained in the end semester examinations for the award of appropriate grade.
- (d) The first attempt is that which corresponds to the first registration for the course. If a student gets 'F' or 'Ab' in an attempt that is treated as an attempt.
- (e) However, if a student obtains 'F'(Fail)'/Ab' (Absent) grade in a course in the first two attempts, from the third attempt onwards, full weightage (100%) shall be assigned to marks scored in the end semester examinations and the internal assessment marks they have scored during the regular course of study will be ignored.
- (f) If a student obtains "F" grade or "Ab" grade or "I" grade in a course for which only internal assessment is applicable like (i) Seminars (ii) Industrial training (iii) and other notified courses from time to time he/she should register for compensatory courses for such courses and earn the internal marks as he/she would have earned normally.
- (g) Similarly, for project work, if a student gets a 'F' or 'Ab' or 'I' grade he/she should register under compensatory course, earn marks for reviews and project report as applicable and then appear for the final viva. Under the compensatory course the student shall choose a new project topic (other than the one he/she had been associated with earlier) under the guidance of the allotted faculty member.

- (h) If a course has both theory and practical component, then the student shall appear in the end semester examinations of both the theory and practical components.
- (i) All applicable fees charged for the purpose of examination will apply for re-appearance courses as well.

**R.11.0 Course Wise Grading of Students**

R 11.1 Letter Grades and Grade Points (GP) Based on the aggregate of marks obtained through internal assessment and external assessment, each student is awarded a final letter grade at the end of the semester, in each Course. The letter grades and the corresponding grade points, as recommended by UGC, are as follows:

Letter Grade	Grade Points	Mark Range
O (Outstanding)	10	91 - 100
A+ (Excellent)	9	81 - 90
A (Very Good)	8	71 - 80
B+ (Good)	7	61 - 70
B (Above Average)	6	56 - 60
C (Average)	5	50 - 55
F (Fail)	0	<50 Failure due to insufficient marks in the course
Ab (Absent)	0	Failure due to non-appearance in examination
I (Incomplete)	0	Failure due to insufficient attendance in the course.

R 11.2 A student is considered to have successfully completed a course and earned the credits if he / she secured a letter grade other than F or Ab or I in that course. A letter grade F or Ab or I in any course implies a failure in that course.

R 11.3 A course successfully completed cannot be repeated.

**R.12.0 Method of Awarding Letter Grades**

R 12.1 The internal marks awarded to the students are first normalized and combined with the normalized marks of end semester examination. Subsequently letter grades are awarded for the normalized marks as indicated in the table under section R16.1: The detailed methodology of

normalization of internal marks as well as marks in the end-semester final examinations shall be formulated by the Controller of Examinations.

- R 12.2 To pass in a course with earnable credits a student has to score a minimum of 50% of the total normalized marks secured in both the internal and end semester examination. Grades Ab and I will be as per R. 16.1

### **R.13.0 Declaration of Results**

- R 13.1 Normalized marks are referred to the Result Passing Board for the finalization of results. Controller of Examinations assigns letter grades and announces the results.
- R 13.2 The Ab / I grade once awarded stays in the record of the student and is deleted when he/she completes the course successfully later The grade acquired by the student will be indicated in the grade card of the appropriate academic year with an indication of the month and the year of passing of that course.
- R 13.3 'F' grade obtained by a student will be deleted in the grade card once that course is successfully completed. The pass grade acquired by the student will be indicated in the grade card of the appropriate year with an indication of the month and the year of passing. The CGPA will be accordingly revised.

### **R.14.0 Re-view of answer scripts**

In case any student feels aggrieved on the final outcome of the learning assessment in any course, the student shall apply to the Controller of Examinations, along with the prescribed fee, for the review of end semester examination answer script, within the stipulated time after the announcement of the results of the examinations. The Controller of Examinations shall facilitate the review of the answer script jointly to be carried out by the student and the faculty detailed for this purpose. If any discrepancy is noticed during review the same shall be rectified and the originally awarded grade accordingly amended.

### **R.15.0 Grade Card**

- R 15.1 The grade card issued by the Controller of Examinations to each student, after the announcement of the results will contain the following:
- (a) The credits for each course registered for that semester.
  - (b) The letter grade obtained in each course

- (c) The attendance code in each course
- (d) The total number of credits earned by the student up to the end of that semester in each of the course categories
- (e) The Cumulative Grade Point Average (CGPA) of all the courses taken from the I semester onwards for regular students and from III semester onwards for lateral entry students. For lateral entry students, the grades awarded in the bridge courses shall also be taken into consideration.

R 15.2 Computation of Semester Grade Point Average (SGPA) and Cumulative Grade Point Average (CGPA)

- (a) **SGPA** will be calculated according to the formula:  $SGPA = \frac{\sum_1^n C_i \times (GP)_i}{\sum_1^n C_i}$

Where  $C_i$  = credit for the  $i^{th}$  course,  $(GP)_i$  = the grade point obtained for the  $i^{th}$  course (refer R.5.0),  $n$  = total number of courses and the sum is over all the courses taken in that semester, including those in which the student has secured F grades.

- (b) **CGPA** (Cumulative Grade Point Average) is calculated using:  $CGPA = \frac{\sum_1^r S_i \times (SGPA)_i}{\sum_1^r S_i}$

where  $S_i$  = Sum of credits in  $i^{th}$  semester,  $(SGPA)_i$  = Semester Grade Point Average earned in  $i^{th}$  semester and  $r$  = number of semesters and the sum is over all the semesters under consideration.

- (c) The SGPA and CGPA shall be rounded off to 2 decimal points and reported in the transcripts.

R 15.3 Class/Distinction will be awarded to the students after they successfully complete the B.Tech. programme as per the norms stipulated in the following table:

**Regular Student:**

Category	CGPA (From I - VIII semesters including bridge courses)	Class / Distinction
Students who successfully complete the B.Tech. programme within the time duration of 8 semesters (R.4.1)	$\geq 5.0$ & $< 5.5$	Pass
	$\geq 5.5$ & $< 6.0$	Second Class
	$\geq 6.0$ & $< 8.0$	First Class
	$\geq 8.0$ (without 'Ab' or 'F' or 'I' or 'temporary withdrawal' in any Semester)	First Class with Distinction
	$\geq 8.0$ (with 'Ab' or 'F' or 'I' in any Semester but obtained pass grade ('O' to 'P') subsequently)	First Class
Students who cannot complete the B.Tech. program in 8 semesters but complete it successfully within the time duration of 9 semesters (R.4.1)	$\geq 5.0$ & $< 5.5$	Pass
	$\geq 5.5$ & $< 6.0$	Second Class
	$\geq 6.0$	First Class
Students who cannot complete the B.Tech. program in 9 semesters but complete it successfully within the time duration of 12 semesters (R.4.1)	$\geq 5.0$ & $< 5.5$	Pass
	$\geq 5.5$	Second Class

### Lateral Entry Student:

Category	CGPA (From III - VIII semesters including bridge courses)	Class / Distinction
Students who successfully complete the B.Tech. programme within the time duration of 6 semesters (R.4.1)	$\geq 5.0$ & $< 5.5$	Pass
	$\geq 5.5$ & $< 6.0$	Second Class
	$\geq 6.0$ & $< 8.0$	First Class
	$\geq 8.0$ (without 'Ab' or 'F' or 'I' or 'temporary withdrawal' in any Semester)	First Class with Distinction
	$\geq 8.0$ (with 'Ab' or 'F' or 'I' in any Semester but obtained pass grade ('O' to 'P') subsequently)	First Class
Students who cannot complete the B.Tech. program in 6 semesters but complete it successfully within the time duration of 7 semesters (R.4.1)	$\geq 5.0$ & $< 5.5$	Pass
	$\geq 5.5$ & $< 6.0$	Second Class
	$\geq 6.0$	First Class
Students who cannot complete the B.Tech. program in 7 semesters but complete it successfully within the time duration of 10 semesters (R.4.1)	$\geq 5.0$ & $< 5.5$	Pass
	$\geq 5.5$	Second Class

#### **R.16.0 Academic Dishonesty**

When a student is found responsible for a violation of the SRMIST code of conduct pertaining to academic dishonesty (Malpractice in Examinations), the Office of Controller of Examinations will initiate action based on the pre-approved procedures. Appropriate penalty or punishment will be awarded to the student and communication sent to the concerned Head of the Department. The matter will be informed to the students parents duly.

### **R.17.0 Eligibility for Award of the B.Tech. Degree**

A student shall be declared to be eligible for the award of the B.Tech degree, if he/she has

- (a) Registered and successfully completed the courses and projects as per the curriculum and obtaining an aggregate of learning credit totalling 160.
- (b) Successfully acquired the required learning credits as specified in the curriculum corresponding to the branch of his/her study within the stipulated time duration.
- (c) No disciplinary action is pending against him/her.

### **R.18.0 Eligibility for Award of the Minor Certificate :**

A student to become eligible for the Award of the Minor Certificate in the chosen area of specialization, he/she has to acquire an additional of 20 credits in the chosen Minor subject area, over and above the credits required for the award of the B. Tech Degree

### **R.19.0 Change of Regulations**

R 19.1 Any regulation can be modified by the Academic Council of SRMIST.

# **ACADEMIC CURRICULA**

## **UNDERGRADUATE DEGREE PROGRAMMES**

### **Bachelor of Technology**

**(B.Tech. - Four Years)**

**(Choice Based Flexible Credit System)**

**Regulations 2018**

**Volume - 1**

**(Revised in March 2019)**



**SRM INSTITUTE OF SCIENCE AND  
TECHNOLOGY**

**(Deemed to be University u/s 3 of UGC Act, 1956)**

**Kattankulathur, Kancheepuram District 603203, Tamil Nadu,  
India**



## 18. B.Tech. in Computer Science and Engineering with Specialization in Internet of Things

### 18. (a) Mission of the Department

Mission Stmt - 1	To impart knowledge in cutting edge Computer Science and Engineering technologies in par with industrial standards.
Mission Stmt - 2	To collaborate with renowned academic institutions to uplift innovative research and development in Computer Science and Engineering and its allied fields to serve the needs of society
Mission Stmt - 3	To demonstrate strong communication skills and possess the ability to design computing systems individually as well as part of a multidisciplinary teams.
Mission Stmt - 4	To instill societal, safety, cultural, environmental, and ethical responsibilities in all professional activities
Mission Stmt - 5	To produce successful Computer Science and Engineering graduates with personal and professional responsibilities and commitment to lifelong learning

### 18. (b) Program Educational Objectives (PEO)

PEO - 1	Graduates will be able to perform in technical/managerial roles ranging from design, development, problem solving to production support in software industries and R&D sectors.
PEO - 2	Graduates will be able to successfully pursue higher education in reputed institutions.
PEO - 3	Graduates will have the ability to adapt, contribute and innovate new technologies and systems in the key domains of Computer Science and Engineering.
PEO - 4	Graduates will be ethically and socially responsible solution providers and entrepreneurs in Computer Science and other engineering disciplines.
PEO - 5	Graduates will possess skills to design computing systems based on Internet of Things
PEO - 6	Graduates will have the ability to develop tools incorporating the skills acquired in Internet of Things domain.

### 18. (c) Mission of the Department to Program Educational Objectives (PEO) Mapping

	Mission Stmt. - 1	Mission Stmt. - 2	Mission Stmt. - 3	Mission Stmt. - 4	Mission Stmt. - 5
PEO - 1	H	H	H	H	H
PEO - 2	L	H	H	H	H
PEO - 3	H	H	M	L	H
PEO - 4	M	H	M	H	H
PEO - 5	H	H	H	H	H
PEO - 6	H	H	H	H	H

H – High Correlation, M – Medium Correlation, L – Low Correlation

### 18. (d) Mapping Program Educational Objectives (PEO) to Program Learning Outcomes (PLO)

	Program Learning Outcomes (PLO)												Program Specific Outcomes (PSO)		
	Graduate Attributes (GA)														
	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3
PEO - 1	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H
PEO - 2	H	H	H	H	H	L	L	H	L	H	L	H	H	H	H
PEO - 3	H	H	H	H	H	L	L	L	L	H	H	H	H	H	H
PEO - 4	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H
PEO - 5	H	L	L	H	H	L	L	L	L	H	H	H	H	H	H
PEO - 6	L	L	L	L	H	L	L	L	L	H	H	H	H	H	H

H – High Correlation, M – Medium Correlation, L – Low Correlation

### PSO – Program Specific Outcomes (PSO)

PSO - 1	Ability to Utilize Hardware / Core CS Principles
PSO - 2	Ability to Create Software & Programming
PSO - 3	Ability to Develop Internet of Things based systems

18. (e) Program Structure: B.Tech. in Computer Science and Engineering with Specialization in Internet of Things

1. Humanities & Social Sciences including Management Courses (H)					
Course Code	Course Title	Hours/ Week			
		L	T	P	C
18LEH101J	English	2	0	2	3
18LEH102J	Chinese				
18LEH103J	French				
18LEH104J	German	2	0	2	3
18LEH105J	Japanese				
18LEH106J	Korean				
18PDH101T	General Aptitude	0	0	2	1
18PDH102T	Management Principles for Engineers	2	0	0	2
18PDH103T	Social Engineering	2	0	0	2
18PDH201T	Employability Skills & Practices	0	0	2	1
<b>Total Learning Credits</b>					<b>12</b>

2. Basic Science Courses (B)					
Course Code	Course Title	Hours/ Week			
		L	T	P	C
18PYB103J	Physics: Semiconductor Physics	3	1	2	5
18CYB101J	Chemistry	3	1	2	5
18MAB101T	Calculus and Linear Algebra	3	1	0	4
18MAB102T	Advanced Calculus and Complex Analysis	3	1	0	4
18MAB201T	Transforms and Boundary Value Problems	3	1	0	4
18MAB204T	Probability and Queueing Theory	3	1	0	4
18MAB302T	Discrete Mathematics for Engineers	3	1	0	4
18BTB101T	Biology	2	0	0	2
<b>Total Learning Credits</b>					<b>32</b>

3. Engineering Science Courses (S)					
Course Code	Course Title	Hours/ Week			
		L	T	P	C
18MES101L	Engineering Graphics and Design	1	0	4	3
18EES101J	Basic Electrical and Electronics Engineering	3	1	2	5
18MES103L	Civil and Mechanical Engineering Workshop	1	0	4	3
18CSS101J	Programming for Problem Solving	3	0	4	5
18CSS201J	Analog and Digital Electronics	3	0	2	4
18CSS202J	Computer Communications	2	0	2	3
<b>Total Learning Credits</b>					<b>23</b>

4. Professional Core Courses (C)					
Course Code	Course Title	Hours/ Week			
		L	T	P	C
18CSC201J	Data Structures and Algorithms	3	0	2	4
18CSC202J	Object Oriented Design and Programming	3	0	2	4
18CSC203J	Computer Organization and Architecture	3	0	2	4
18CSC204J	Design and Analysis of Algorithms	3	0	2	4
18CSC205J	Operating Systems	3	0	2	4
18CSC206J	Software Engineering and Project Management	3	0	2	4
18CSC207J	Advanced Programming Practice	3	0	2	4
18CSC301T	Formal Language and Automata	3	0	0	3
18CSC302J	Computer Networks	3	0	2	4
18CSC303J	Database Management Systems	3	0	2	4
18CSC304J	Compiler Design	3	0	2	4
18CSC305J	Artificial Intelligence	3	0	2	4
18CSC350T	Comprehension	0	1	0	1
18CSC208L	Competitive Professional Skills-I	0	0	2	1
18CSC306L	Competitive Professional Skills-II	0	0	2	1
18CSC307L	Competitive Professional Skills-III	0	0	2	1
<b>Total Learning Credits</b>					<b>51</b>

5. Professional Elective Courses (E) (Any 6 Elective Courses)					
Course Code	Course Title	Hours/ Week			
		L	T	P	C
18CSE377T	Data Centric Networks	3	0	0	3
18CSE345T	Internet of Things Architecture and Protocols	3	0	0	3
18CSE392T	Machine Learning-I	3	0	0	3
18CSE388T	Artificial Neural Networks	3	0	0	3
18CSE346T	Network Programming	3	0	0	3
18CSE451T	Wireless Sensor Networks	3	0	0	3
18CSE456T	Software Defined Networks	3	0	0	3
18CSE445T	Internet of Things Security	3	0	0	3
18CSE458T	Wireless and Mobile Communication	3	0	0	3
18CSE446T	Advanced Database Systems	3	0	0	3
18CSE447T	Edge Computing	3	0	0	3
18CSE448T	Energy Management for Internet of Things devices	3	0	0	3
18CSE490T	Big Data Visualization	3	0	0	3
<b>Total Learning Credits</b>					<b>18</b>

6. Open Elective Courses (O)					
Course Code	Course Title	Hours/ Week			
		L	T	P	C
18CSO101T	IT Infrastructure Management	3	0	0	3
18CSO102T	Mobile Application Development	3	0	0	3
18CSO103T	System Modeling and Simulation	3	0	0	3
18CSO104T	Free and Open Source Softwares	3	0	0	3
18CSO105T	Android Development	3	0	0	3
18CSO106T	Data Analysis using Open Source Tool	3	0	0	3
18CSO107T	IOS Development	3	0	0	3
<b>Total Learning Credits</b>					<b>12</b>

7. Project Work, Seminar, Internship In Industry / Higher Technical Institutions (P)					
Course Code	Course Title	Hours/ Week			
		L	T	P	C
18CSP101L	Massive Open Online Course - I				
18CSP102L	Industrial Training-I	0	0	2	1
18CSP103L	Seminar - I				
18CSP104L	Massive Open Online Course - II				
18CSP105L	Industrial Training-II	0	0	2	1
18CSP106L	Seminar - II				
18CSP107L	Minor Project	0	0	6	3
18CSP108L	Internship (4-6 weeks)				
18CSP109L	Project	0	0	20	10
18CSP110L	Semester Internship				
<b>Total Learning Credits</b>					<b>15</b>

8. Mandatory Courses (M)					
Code	Course Title	Hours/ Week			
		L	T	P	C
18PDM101L	Professional Skills and Practices	0	0	2	0
18PDM201L	Competencies in Social Skills				
18PDM203L	Entrepreneurial Skill Development	0	0	2	0
18PDM202L	Critical and Creative Thinking Skills				
18PDM204L	Business Basics for Entrepreneurs	0	0	2	0
18PDM301L	Analytical and Logical Thinking Skills	0	0	2	0
18PDM302L	Entrepreneurship Management				
18LEM101T	Constitution of India	1	0	0	0
18LEM102J	Value Education	1	0	1	0
18GNM101L	Physical and Mental Health using Yoga	0	0	2	0
18GNM102L	NSS				
18GNM103L	NCC	0	0	2	0
18GNM104L	NSO				
18LEM109T	Indian Traditional Knowledge	1	0	0	0

8. Mandatory Courses (M)					
Course Code	Course Title	Hours/ Week			
		L	T	P	C
18LEM110L	Indian Art Form	0	0	2	0
18CYM101T	Environmental Science	1	0	0	0

18. (f) Program Articulation: B.Tech. in Computer Science and Engineering with Specialization in Internet of Things

Course Code	Course Name	Program Learning Outcomes (PLO)														
		Graduate Attributes											PSO			
		Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3
18CSS101J	Programming for Problem Solving	H	H	M	M	H	L	L	M	H	M	L	H	L	H	H
18CSC201J	Data Structures and Algorithms	H	H	H	H	M	L	L	M	H	M	M	H	L	H	H
18CSC202J	Object Oriented Design and Programming	H	H	H	H	H	M	L	M	H	H	M	H	L	H	H
18CSC203J	Computer Organization and Architecture	H	M	H	M	L	L	L	M	L	L	M	H	M	M	M
18CSC204J	Design and Analysis of Algorithms	H	H	H	H	M	M	L	M	M	M	M	H	L	H	H
18CSC205J	Operating Systems	H	H	H	H	H	M	L	M	H	M	M	H	H	H	M
18CSC206J	Software Engineering and Project Management	H	H	H	H	H	H	H	H	H	H	H	H	L	H	M
18CSC207J	Advanced Programming Practice	H	H	M	M	H	L	L	M	H	M	L	H	L	H	H
18CSC301T	Formal Language and Automata	H	H	H	H	L	L	L	L	M	M	L	H	H	H	H
18CSC302J	Computer Networks	H	H	H	H	H	M	L	M	H	M	M	H	H	H	M
18CSC303J	Database Management Systems	H	H	H	H	H	M	L	M	H	M	M	H	H	H	M
18CSC304J	Compiler Design	H	H	H	H	M	L	L	L	M	M	L	H	H	H	H
18CSC305J	Artificial Intelligence	H	H	H	H	M	M	L	L	M	M	L	H	H	H	H
18CSC208L	Competitive Professional Skills-I	H	H	H	H	H	L	L	M	H	H	M	H	H	H	H
18CSC306L	Competitive Professional Skills-II	H	H	H	H	H	L	L	M	H	H	M	H	H	H	H
18CSC307L	Competitive Professional Skills-III	H	H	H	H	H	L	L	M	H	H	M	H	H	H	H
18CSE377T	Data Centric Networks	H	H	H	H	H	M	M	M	H	M	M	H	H	H	H
18CSE345T	Internet of Things Architecture and Protocols	H	H	H	H	H	M	H	H	M	H	H	M	H	H	H
18CSE392T	Machine Learning-I	H	H	H	M	H	M	L	M	H	M	L	H	L	H	H
18CSE388T	Artificial Neural Networks	H	H	H	M	H	M	L	M	H	M	L	H	L	H	H
18CSE346T	Network Programming	H	H	H	H	H	M	M	M	M	H	H	H	H	H	H
18CSE347T	Cloud Computing and Architecture	H	H	H	H	H	M	H	H	M	H	H	M	H	H	H
18CSE451T	Wireless Sensor Networks	H	H	H	H	M	M	M	M	M	H	L	H	H	H	H
18CSE456T	Software Defined Networks	H	H	H	H	H	M	M	M	M	H	M	H	H	H	H
18CSE445T	Internet of Things Security	H	H	H	H	H	M	M	H	H	H	M	H	H	H	H
18CSE458T	Wireless and Mobile Communication	H	H	H	H	M	H	H	H	M	H	M	H	H	H	H
18CSE446T	Advanced Database Systems	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H
18CSE447T	Edge Computing	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H
18CSE448T	Energy Management for Internet of Things Devices	H	H	H	H	H	H	H	H	M	H	M	H	H	H	H
18CSE449T	Data Analysis and Visualization	M	H	H	H	H	M	M	H	H	H	H	H	M	H	H
18CSP101L	Massive Open Online Course - I	H	M	M	M	M	M	M	M	H	H	H	M	H	H	H
18CSP102L	Industrial Training-I	H	M	M	M	M	M	M	M	H	H	H	M	H	H	H
18CSP103L	Seminar - I	H	M	M	M	M	M	M	M	H	H	H	M	H	H	H
18CSP104L	Massive Open Online Course - II	H	M	M	M	M	M	M	M	H	H	H	M	H	H	H
18CSP105L	Industrial Training-II	H	M	M	M	M	M	M	M	H	H	H	M	H	H	H
18CSP106L	Seminar - II	H	M	M	M	M	M	M	M	H	H	H	M	H	H	H
18CSP107L	Minor Project	H	H	H	H	H	M	M	H	H	H	H	H	M	M	M
18CSP108L	Internship (4-6 weeks)	H	H	H	H	H	M	M	H	H	H	H	H	M	M	M
18CSP109L	Project	H	H	H	H	H	M	M	H	H	H	H	H	M	M	M
18CSP110L	Semester Internship	H	H	H	H	H	M	M	H	H	H	H	H	M	M	M
	Program Average	H	H	M	H	M	L	M	L	M	M	M	H	M	M	M

18. (g) Implementation Plan: B.Tech. in Computer Science and Engineering with Specialization in Internet of Things

Semester - I					Semester - II						
Code	Course Title	Hours/ Week			C	Code	Course Title	Hours/ Week			C
		L	T	P				L	T	P	
18LEH101J	English	2	0	2	3	18LEH10XJ	Chinese / French / German / Japanese/ Korean	2	0	2	3
18MAB101T	Calculus and Linear Algebra	3	1	0	4	18MAB102T	Advanced Calculus and Complex Analysis	3	1	0	4
18PYB103J	Physics: Semiconductor Physics	3	1	2	5	18CYB101J	Chemistry	3	1	2	5
18MES101L	Engineering Graphics and Design	1	0	4	3	18CSS101J	Programming for Problem Solving	3	0	4	5
18EES101J	Basic Electrical and Electronics Engineering	3	1	2	5	18MES103L	Civil and Mechanical Engineering Workshop	1	0	4	3
18PDM101L	Professional Skills and Practices	0	0	2	0	18PDH101T	General Aptitude	0	0	2	1
18LEM101T	Constitution of India	1	0	0	0	18LEM102J	Value Education	1	0	1	0
18GNM101L	Physical and Mental Health using Yoga	0	0	2	0	18GNM102L	NSS	0	0	2	0
<b>Total Learning Credits</b>					<b>20</b>	18GNM103L	NCC				
						18GNM104L	NSO				
						<b>Total Learning Credits</b>					<b>21</b>
Semester - III					Semester - IV						
Code	Course Title	Hours/ Week			C	Code	Course Title	Hours/ Week			C
		L	T	P				L	T	P	
18MAB201T	Transforms and Boundary Value Problems	3	1	0	4	18MAB204T	Probability and Queueing Theory	3	1	0	4
18BTB101T	Biology	2	0	0	2	18CSS202J	Computer Communications	2	0	2	3
18CSS201J	Analog and Digital Electronics	3	0	2	4	18CSC204J	Design and Analysis of Algorithms	3	0	2	4
18CSC201J	Data Structures and Algorithms	3	0	2	4	18CSC205J	Operating Systems	3	0	2	4
18CSC202J	Object Oriented Design and Programming	3	0	2	4	18CSC206J	Software Engineering and Project Management	3	0	2	4
18CSC203J	Computer Organization and Architecture	3	0	2	4	18CSC207J	Advanced Programming Practice	3	0	2	4
18PDH102T	Management Principles for Engineers	2	0	0	2	18CSC208L	Competitive Professional Skills-I	0	0	2	1
18PDM201L	Competencies in Social Skills	0	0	2	0	18PDH103T	Social Engineering	2	0	0	2
18PDM203L	Entrepreneurial Skill Development	0	0	2	0	18PDM202L	Critical and Creative Thinking Skills	0	0	2	0
<b>Total Learning Credits</b>					<b>24</b>	18PDM204L	Business Basics for Entrepreneurs				
						18CYM101T	Environmental Science	1	0	0	0
						<b>Total Learning Credits</b>					<b>26</b>
Semester - V					Semester - VI						
Code	Course Title	Hours/ Week			C	Code	Course Title	Hours/ Week			C
		L	T	P				L	T	P	
18MAB302T	Discrete Mathematics for Engineers	3	1	0	4	18CSC303J	Database Management Systems	3	0	2	4
18CSC301T	Formal Language and Automata	3	0	0	3	18CSC304J	Compiler Design	3	0	2	4
18CSC302J	Computer Networks	3	0	2	4	18CSC305J	Artificial Intelligence	3	0	2	4
18CSC306L	Competitive Professional Skills-II	0	0	2	1	18CSC350T	Comprehension	0	1	0	1
	Professional Elective – 1	3	0	0	3	18CSC307L	Competitive Professional Skills-III	0	0	2	1
	Professional Elective – 2	3	0	0	3		Professional Elective – 3	3	0	0	3
	Open Elective – 1	3	0	0	3		Professional Elective – 4	3	0	0	3
18CSP101L	Massive Open Online Course - I	0	0	2	1		Open Elective – 2	3	0	0	3
18CSP102L	Industrial Training-I									18CSP104L	Massive Open Online Course - II
18CSP103L	Seminar - I									18CSP105L	Industrial Training-II
18PDM301L	Analytical and Logical Thinking Skills	0	0	2	0	18CSP106L	Seminar - II	0	0	2	1
18PDM302L	Entrepreneurship Management					18PDH201T	Employability Skills and Practices				
18LEM109T	Indian Traditional Knowledge	1	0	0	0	18LEM110L	Indian Art Form	0	0	2	0
<b>Total Learning Credits</b>					<b>22</b>	<b>Total Learning Credits</b>					<b>25</b>
Semester - VII					Semester - VIII						
Code	Course Title	Hours/ Week			C	Code	Course Title	Hours/ Week			C
		L	T	P				L	T	P	
	Professional Elective – 5	3	0	0	3	18CSP109L	Project	0	0	20	10
	Professional Elective – 6	3	0	0	3	18CSP110L	Semester Internship				
	Open Elective – 3	3	0	0	3						
18CSP107L	Minor Project	0	0	6	3						
18CSP108L	Internship (4-6 weeks)										
<b>Total Learning Credits</b>					<b>12</b>	<b>Total Learning Credits</b>					<b>10</b>

# **ACADEMIC CURRICULA**

**Humanities and Social Sciences  
including Management Courses**

**Regulations - 2018**



**SRM**  
INSTITUTE OF SCIENCE & TECHNOLOGY  
(Deemed to be University u/s 3 of UGC Act, 1956)

**SRM INSTITUTE OF SCIENCE AND TECHNOLOGY**

**(Deemed to be University u/s 3 of UGC Act, 1956)**

Kattankulathur, Kancheepuram, Tamil Nadu, India

Course Code	18PDH102T	Course Name	MANAGEMENT PRINCIPLES FOR ENGINEERS	Course Category	H	Humanities and Social Sciences including Management	L	T	P	C
							2	0	0	2

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Career Development Centre		Data Book / Codes/Standards	Nil	

Course Learning Rationale (CLR):	<i>The purpose of learning this course is to:</i>			Learning			Program Learning Outcomes (PLO)														
CLR-1 :	<i>Acquire knowledge about the fundamental concepts of organization and management</i>			1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CLR-2 :	<i>Make decision strategies, planning process, tools and techniques</i>			Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3
CLR-3 :	<i>Inculcate the traits needed to be an effective leader and familiarize with the organizational structures and design</i>																				
CLR-4 :	<i>Gain valuable insights into strategic process, formulation and implementation</i>																				
CLR-5 :	<i>Utilize the intricacies involved in cultural and ethical issues of people</i>																				
CLR-6 :	<i>Utilize the dimensions of the planning-organizing-leading-controlling (P-O-L-C) framework</i>																				
Course Learning Outcomes (CLO):	<i>At the end of this course, learners will be able to:</i>																				
CLO-1 :	<i>Observe and evaluate the various influencing factors on the current practice of organization and management</i>			3	80	75	-	H	-	-	-	L	-	H	H	M	-	M	-	-	-
CLO-2 :	<i>Use the techniques and tools of planning and make prudent decisions</i>			2	80	75	-	M	-	-	-	H	-	H	H	M	-	H	-	-	-
CLO-3 :	<i>Identify how organizations adapt to uncertain environment, identify techniques managers use to influence and control the internal environment</i>			2	80	75	-	L	-	-	-	M	-	H	H	H	-	M	-	-	-
CLO-4 :	<i>Apply and execute management goals</i>			2	80	75	-	L	-	-	-	M	-	H	M	H	-	M	-	-	-
CLO-5 :	<i>Manage people and deal with cultural and ethical issues</i>			3	80	75	-	H	-	-	-	H	-	H	H	H	-	H	-	-	-
CLO-6 :	<i>Utilize the basic fundamentals of managing organizations and utilize optimal resources</i>			3	80	75	-	H	-	-	-	M	-	M	M	H	-	M	-	-	-

Duration (hour)	6		6		6		6		6	
S-1	SLO-1	Organization	Information technology and the new workplace	Organisational control	Strategic management	People Management				
	SLO-2	The Individual and the Organization	Precautions Measures	Control in the Business Setting	Role of Strategy in Management	Importance of people				
S-2	SLO-1	Management	Information and decision making	Motivation	Evaluating the Business Environment	Attracting a Quality Workforce				
	SLO-2	Primary Functions of Management	Styles of Decision Making	Importance of Employee Motivation	Common Frameworks for Situational Analysis	Recruiting process				
S-3	SLO-1	Role of management in organisation	The decision-making process	Leadership	Goals and Process	Employee Diversity				
	SLO-2	Advantages of Managing People Well	Barriers to Individual Decision Making	Effective Leader	strategic competitiveness	Conflict Management				
S-4	SLO-1	Types of Managers	Planning	Organising	Different Strategies	Organisational Culture				
	SLO-2	Role of managers	Planning and Mission	Purpose of Organization	Stages and Types of Strategy	Influences on Organizational Culture				
S-5	SLO-1	management Thought	The planning process	organisational design	Strategy formulation	Initiating and Fostering Cultural Change				

	SLO-2	Management Roles	The Planning Cycle	Common Organizational Structures	Bridging the Gaps	Putting It Together: Culture and Diversity
S-6	SLO-1	Environmental Factors	tools, techniques and processes	Factors Impacting Organizational Design	Strategy implementation	Ethics
	SLO-2	Internal and External Factors	Putting It Together: Planning and Mission	Contingencies	Overcoming Hindrances	Cultural Issues

Learning Resources	1. Schermerhorn, J.R., <i>Introduction to Management</i> , 13 <sup>th</sup> ed., Wiley; 2017	3. Stephen Robbins, Mary Coulter, <i>Fundamentals of Management</i> , 9 <sup>th</sup> ed., Pearson Education, 2016
	2. Harold Koontz, Heinz Wehrich, <i>Essentials of management: An International &amp; Leadership Perspective</i> , 10 <sup>th</sup> ed., Tata McGraw -Hill Education, 2015	4. Samuel C. Certo, Tervis Certo, <i>Modern management: concepts and skills</i> , 12 <sup>th</sup> ed., Pearson, 2012 5. Charles W. L. Hill, Steven Mcshane, <i>Principles of Management</i> McGraw Hill Education, 2017

Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#		Theory	Practice
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice		
Level 1	Remember Understand	40%	-	30%	-	30%	-	30%	-	30%	-
Level 2	Apply Analyze	40%	-	40%	-	40%	-	40%	-	40%	-
Level 3	Evaluate Create	20%	-	30%	-	30%	-	30%	-	30%	-
	Total	100 %		100 %		100 %		100 %		100 %	

# CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Mr. Pratap Iyer, Study Abroad Mentors, Mumbai, pratap.iyer30@gmail.com	1. Dr. A.K. Sheik Manzoor, Anna University, sheikmanzoor@annauniv.edu	1. Mr. Mohamed Ibrahim. A. U., SRMIST
2. Mr. Ajay Zenner, Career Launcher, ajay.z@careerlauncher.com	2. Dr. Devamainthan, University of Madras	2. Mr. Muthu Manivannan, SRMIST

Course Code	18PDH103T	Course Name	SOCIAL ENGINEERING	Course Category	H	Humanities and Social Sciences including Management	L	T	P	C
							2	0	0	2

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Career Development Centre		Data Book / Codes/Standards	Nil	

Course Learning Rationale (CLR):	The purpose of learning this course is to:			Learning			Program Learning Outcomes (PLO)															
CLR-1 :	create personal awareness and responsibility			1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
CLR-2 :	learn about environment and approach towards social issues			Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3	
CLR-3 :	train students on social competencies to become self reliant, resourceful and industrious																					
CLR-4 :	understand social entrepreneurship																					
CLR-5 :	develop a mindset to contribute to the society																					
CLR-6 :	apply knowledge, passion and skills in the pursuit of humanitarian goals																					
Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:																					
CLO-1 :	identify and addresses needs of social responsibilities			3	80	75	-	-	-	-	-	H	L	M	H	M	-	-	-	-	-	
CLO-2 :	resolve social problems			2	80	75	-	-	-	-	-	M	L	L	H	H	-	-	-	-	-	
CLO-3 :	understand social responsibility competencies and CSR activities			3	80	75	-	-	-	-	-	M	L	H	H	M	-	-	-	-	-	
CLO-4 :	build a business plan to meet social needs			3	80	75	-	-	-	-	-	M	L	H	H	M	-	-	-	-	-	
CLO-5 :	gain real time experience through student social responsibility project and presentation			3	80	75	-	-	-	-	-	H	M	H	H	M	-	-	-	-	-	
CLO-6 :	possess an in-depth knowledge of social engineering and effect a social change in the society			3	80	75	-	-	-	-	-	H	M	M	M	M	-	-	-	-	-	

Duration (hour)	6		6		6		6		6	
S-1	SLO-1	Introduction	Environment and society	Social responsibility competencies	Social entrepreneurship	Student Social responsibility				
	SLO-2	Importance of Social Engineering	Contribution towards environment	Social responsibility competencies	Social entrepreneurship	Student Social responsibility				
S-2	SLO-1	Personal awareness	Social issues	Social responsibility competencies- Profiles	Social Entrepreneur	Project Presentation				
	SLO-2	Types of responsibilities	Social issues	Social responsibility competencies- Facets	Types of Social Entrepreneurs	Project Presentation				
S-3	SLO-1	Social Change	Group discussion on social Issues	Contributing to community	Success stories of social entrepreneur	Project Presentation				
	SLO-2	Social Change	Group discussion on social Issues	Contributing to community	Impact of social entrepreneurs in society	Project Presentation				
S-4	SLO-1	Vision towards society	Group discussion on social Issues	Value diversity and Building relationships	Business Plan	Project Presentation				
	SLO-2	Mission towards society	Group discussion on social Issues	Value diversity and Building relationships	Business Plan	Project Presentation				
S-5	SLO-1	Individual social responsibility(ISR)	Social Marketing	Corporate social responsibility	Business Plan	Report Analysis				
	SLO-2	Individual social responsibility(ISR)	Social Marketing	Types of CSR	Business Plan	Report Analysis				



S-6	SLO-1	Case study	Non profitable organizations	Government Policies on CSR	Business Plan	Report Analysis
	SLO-2	Case study	Types of NGO	Government Policies on CSR	Business Plan	Report Analysis

Learning Resources	<ol style="list-style-type: none"> <li>1. Joel Makeower, <i>Beyond The Bottom Line: Putting Social Responsibility to work for your Business and the World</i>, Oct, 1995</li> <li>2. Simen Sinek, <i>Start with Why, How great leaders Inspire Everyone to Take Action</i>, Penguin UK, 2011</li> <li>3. Adam Grant, <i>Give and Take: Why Helping others drives our success</i>, Orion Publishing Group, 2014</li> <li>4. David Bornstien, <i>How to change the world</i>, Oxford University Press, 2007</li> </ol>	<ol style="list-style-type: none"> <li>5. Nicholls, Alex, ed., <i>Social Entrepreneurship – New Models of Sustainable Social Change</i>, Oxford University Press, 2008</li> <li>6. Ronald R. Sims, <i>Ethics and Corporate Social Responsibility: Why Giants fall</i>, 2003</li> <li>7. Robert A. Rohm, <i>Positive Personality Profiles</i>, Personality Insights, Inc, 2006</li> </ol>
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Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#		Theory	Practice
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice		
Level 1	Remember Understand	40%	-	30%	-	30%	-	30%	-	30%	-
Level 2	Apply Analyze	40%	-	40%	-	40%	-	40%	-	40%	-
Level 3	Evaluate Create	20%	-	30%	-	30%	-	30%	-	30%	-
	Total	100 %		100 %		100 %		100 %		100 %	

# CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Mr. Vijay Nair – Director, Education Matters, vijayn@edmat.org	1. Dr. A.K. Sheik Manzoor, Anna University, sheikmanzoor@annauniv.edu	Mrs. Kavitha Srisaran, SRMIST
2. Mr. Ajay Zenner, Career Launcher, ajay.z@careerlauncher.com	2. Dr Vanitha. J., Loyola College, vanithaj@loyolacollege.edu	Mr. Priyanand P., SRMIST

# ACADEMIC CURRICULA

## Basic Science Courses

Regulations - 2018

**SRM INSTITUTE OF SCIENCE AND TECHNOLOGY**

**(Deemed to be University u/s 3 of UGC Act, 1956)**

Kattankulathur, Kancheepuram, Tamil Nadu, India

Course Code	18BTB101T	Course Name	BIOLOGY	Course Category	B	Basic Sciences	L	T	P	C
							2	0	0	2

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Biotechnology		Data Book / Codes/Standards	Nil	

Course Learning Rationale (CLR):	<i>The purpose of learning this course is to:</i>			Learning			Program Learning Outcomes (PLO)																																
CLR-1 :	<i>Recall the cell structure and function from its organization</i>			1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15																		
CLR-2 :	<i>Discuss molecular and biochemical basis of an organism</i>			Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3																		
CLR-3 :	<i>Compare enzyme reaction and photosynthesis</i>																					L	H	H	H	-	M	L	H	H	H	-	H	L	H	H			
CLR-4 :	<i>Explain different types of biosensors</i>																					2	85	75	M	H	M	M	-	M	H	L	H	-	H	L	H	H	
CLR-5 :	<i>Analyze the different types of bioremediation</i>																					2	75	80	M	H	M	H	M	M	-	M	H	H	-	H	L	H	H
CLR-6 :	<i>Relate the concept of nervous and immune system pertaining to diseases</i>																					2	85	80	L	H	H	H	-	-	H	L	L	H	-	H	M	H	H
																						3	85	75	L	H	H	M	-	M	H	H	H	L	-	H	H	H	H
Course Learning Outcomes (CLO):	<i>At the end of this course, learners will be able to:</i>			2	80	80	M	H	H	H	L	H	M	M	H	H	-	H	H	H	H																		
CLO-1 :	<i>Describe the cell growth, metabolism and reproduction.</i>																																						
CLO-2 :	<i>Explain the concepts and experiments in biochemistry</i>																																						
CLO-3 :	<i>Recognize the significance of photosynthesis</i>																																						
CLO-4 :	<i>Discuss the different methods in enzyme catalytic functions</i>																																						
CLO-5 :	<i>Analyze the role of biosensors and its applications</i>																																						
CLO-6 :	<i>Explain the concepts of nervous system disorder and the diseases associated with it</i>																																						

Duration (hour)	6		6		6		6		6	
S-1	SLO-1	<i>Basics of cell biology: Relevance to Engineers</i>	<i>Biochemistry: Macromolecules, Biodiversity and its importance</i>	<i>Bioenergetics and metabolism</i>		<i>Molecular machines and motors</i>		<i>Nervous system:History of neuroscience</i>		
	SLO-2	<i>Cell basic unit of life, Evidence for cell theory</i>	<i>Chemistry of life</i>	<i>Enzymes as biological catalysts, Significance of enzymes</i>		<i>Properties of ATP based protein molecular machines</i>		<i>Glial cells, Neurons</i>		
S-2	SLO-1	<i>Cell structure and function</i>	<i>Biochemistry and human biology, DNA replication</i>	<i>Thermodynamics of enzymes</i>		<i>F0F1 ATP synthase motors, Coupling and coordination of motors</i>		<i>Action potential, Organization of nervous system</i>		
	SLO-2	<i>Genetic Information, Protein structure</i>	<i>Transcription, Protein synthesis</i>	<i>Factors affecting enzyme activity, Effect of inhibitors on enzyme activity</i>		<i>Bacterial flagellar motor, Cytoskeleton</i>		<i>Central Nervous system, Peripheral nervous system</i>		
S-3	SLO-1	<i>Cell metabolism</i>	<i>Eukaryotic and prokaryotic protein synthesis difference</i>	<i>Mechanism of enzyme action</i>		<i>Microtubules</i>		<i>Diseases of nervous system</i>		
	SLO-2	<i>Carbohydrate metabolism, Fatty acid metabolism</i>	<i>Concept of genetic code, Stem cells</i>	<i>Enzyme strategies, Restriction enzymes</i>		<i>Microfilaments, Intermediate filaments</i>		<i>Computer- based neural networks</i>		
S-4	SLO-1	<i>Homeostasis</i>	<i>Source of stem cells, Classification of stem cells</i>	<i>NMP kinases, Photosynthesis</i>		<i>Kinesin linear motor, Dynein motor</i>		<i>Immune system</i>		
	SLO-2	<i>Pathways that alter homeostasis, Cell growth</i>	<i>Human embryonic stem cell, Importance and applications of stem cells</i>	<i>Light reactions, Photosystems</i>		<i>Biosensor</i>		<i>Fluid systems of the body, Innate immune system</i>		
S-5	SLO-1	<i>Reproduction</i>	<i>Therapeutic cloning</i>	<i>ATP synthesis in chloroplasts</i>		<i>Resonant biosensors, Glucose biosensors</i>		<i>Cells of innate immune system, Adaptive immunity</i>		

	SLO-2	Eukaryotic cell division, Mitosis	Regenerative medicine	Calvin cycle	Bio detectors, Biosensor detection in pollutants	Diseases of immune system, Immune engineering
S-6	SLO-1	Meiosis, Cell differentiation	Bone tissue engineering	Significance of photosynthesis	Bioremediation	Cell signaling
	SLO-2	Neural crest	Gene therapy	Metabolism, Glycolysis	Bioventing and bio augmentation	Cell- surface receptors

Learning Resources	1. S. Thyagarajan, N.Selvamurugan, R.A.Nazeer et al., <i>Biology for engineers McGraw Hill Education. 2012</i>	2. Norman Lewis, Gabi Nindl Waite, Lee R. Waite et al., <i>Applied Cell and Molecular Biology for Engineers. McGraw-Hill Education. 2007</i>
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Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#		Theory	Practice
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice		
Level 1	Remember Understand	40%	-	30%	-	30%	-	30%	-	30%	-
Level 2	Apply Analyze	40%	-	40%	-	40%	-	40%	-	40%	-
Level 3	Evaluate Create	20%	-	30%	-	30%	-	30%	-	30%	-
	Total	100 %		100 %		100 %		100 %		100 %	

# CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Dr. C. N. Ramchand, Saksin Life sciences, ramchand@saksinlife.com	1. Dr. K Subramaniam, IITM Chennai, subbu.iitm.ac.in	Dr. S. Thyagarajan, SRMIST
2. Dr. Karthik Periyasamy, Aurobindo Pharma Limited, Hyderabad, karthikmpk@gmail.com	2. Dr. R. B. Narayanan, SVCE Chennai, rbn@svce.ac.in	Dr.S.Barathi, SRMIST

Course Code	18BTB103T	Course Name	HUMAN PHYSIOLOGY AND HEALTH	Course Category	B	Basic Sciences	L	T	P	C
							3	0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	18BTC102J -Cell biology, 18BTC106J -Immunology
Course Offering Department	Biotechnology		Data Book / Codes/Standards	Nil	

Course Learning Rationale (CLR):	The purpose of learning this course is to:			Learning			Program Learning Outcomes (PLO)																	
CLR-1 :	Devise understanding of human physiological systems for a better comprehension of the problems faced by human			1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15			
CLR-2 :	Create an understanding about nervous system that controls and maintains homeostasis			Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life-Long Learning	PSO - 1	PSO - 2	PSO - 3	H	H	H
CLR-3 :	Analyze about circulatory and respiratory system																					H	H	H
CLR-4 :	Analyze about digestive and excretory system																					H	H	H
CLR-5 :	Create an understanding about endocrine and reproductive system																					H	H	H
CLR-6 :	Create an understanding about how human body functions																					H	H	H
Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:																					1	80	70
CLO-1 :	Describe the structure and function of cell, communication and gene expression and homeostasis			2	80	70	M	H	H	H	-	H	M	H	H	H	-	H	H	H	H			
CLO-2 :	Describe the classification of nervous system, function and diseases associated with it			2	80	70	M	H	M	H	M	M	M	H	H	H	-	H	H	H	H			
CLO-3 :	Discuss the structure and function of heart, lung, abnormal functioning			2	80	70	H	H	H	H	-	L	H	L	H	H	-	H	H	H	H			
CLO-4 :	Describe anatomy and function of digestive system and urinary system and its disturbances			2	80	70	H	H	H	H	-	M	H	H	H	L	-	H	H	H	H			
CLO-5 :	Describe the types of endocrine system, its role in maintaining homeostasis and reproductive biology			2	80	70	H	H	H	H	L	M	M	M	M	H	H	-	H	H	H			
CLO-6 :	Explain how human body function and reproduce with maintaining homeostasis			2	80	70	H	H	H	H	L	M	M	M	H	H	-	H	H	H	H			

Duration (hour)	6		6		6		6		6	
S-1	SLO-1	Cell structure and function	Classification of Nervous System	Heart: Structure, Chambers, valve	Anatomy of Digestive system	Endocrine organs and structure				
	SLO-2	Adaptation, Degeneration and aging	Neuron structure and function	Cardiac cycle and Electro cardio gram	Mouth and Salivary glands	Pituitary gland: Parts				
S-2	SLO-1	Cell junctions – Gap, Tight and contact	Nerve fibers classification and properties.	chronotropic, ionotropic agents, dromotropic, bathmotropic agents	Stomach: Parts, Structure, Glands, Functions, Properties	Pituitary gland: Regulation, Histology				
	SLO-2	Active, Passive transport	Glial cells types, structure and function	Blood vessels – thromboembolism	composition and functions of gastric juice	Pituitary gland: Hormones secreted, functions				
S-3	SLO-1	Types of transport	Synapse – Classification	atherosclerosis and arteriosclerosis	Pancreas, Liver	Thyroid gland: Histology and function				
	SLO-2	Special type of transport of molecules across biological membranes	Synapse - Anatomy	Septal and valvular defects.	Gall bladder – Role in digestive system	Thyroid gland: Hormones				
S-4	SLO-1	Homeostasis– Chemical equilibrium	Synapse - Functions (IPSP and EPSP	Circulation – Systemic and Pulmonary	Small intestine, large intestine	Synthesis of Thyroxine				
	SLO-2	Tonicity and osmolality	Synapse - properties	Properties of cardiac muscle: Excitability – electrical potential and action potential	Digestion of Biomolecules	Parathyroid gland structure and function				
S-5	SLO-1	control of homeostasis	Neurotransmitters synthesis	Rhythmicity – Natural and artificial pacemakers	Movements of gastrointestinal tracts and disorders	Mode of action and function - disorders				

	SLO-2	Role of ions in homeostasis	Neurotransmitters – Types and function	Conductivity, Contractility and Refractory period	Digestion of carbohydrates protein and lipid.	Adrenal gland structure
S-6	SLO-1	Positive feedback regulation of Homeostasis	Action potential	Cardiac cycle and heart sounds and Heart disease	Gastrointestinal hormones	Cortical and medullary - functions
	SLO-2	Negative feedback regulation of Homeostasis	graded potential	Respiratory system: Introduction	Digestive system disorders	Endocrine functions of pancreas
S-7	SLO-1	Acid-Base Balance: Hydrogen Ion and pH.	Brain anatomy and function	Types – external and internal respiration	Kidney structure and function	Insulin and glucagon
	SLO-2	Regulation by buffer systems	Spinal cord anatomy– Grey and White matter	Inspiration and expiration, Anatomy, functional unit	nephron structure	Diabetes
S-8	SLO-1	Acidosis	Limbic system: Autonomic Nervous System	Non-respiratory functions of respiratory tract	Role of hormone in urinary system.	Male reproduction organ structure
	SLO-2	Alkalosis.	Effects on various organ systems.	Mechanics of respiration, Pulmonary function tests: Lung volume – Tidal	Juxtaglomerular apparatus functions	Female reproduction organ structure
S-9	SLO-1	Regulation of gene expression	Nervous system disease and disorders	Inspiratory, Expiratory, Residual volumes; Lung capacities	Process of urine formation	Oogenesis
	SLO-2	Cell signaling and Signal transduction	Parkinson's disease,	Inspiratory, vital, Functional residual, Total lung capacities.	Factors affecting urine formation	Spermatogenesis

Learning Resources	1. K. Sembulingam, Prema Sembulingam, Essentials of Medical Physiology, Jaypee brothers medical publishers, 7th ed., 2016	2. Guyton and Hall, Textbook of Medical Physiology, (Guyton Physiology), Saunders, 13 <sup>th</sup> ed., 2015)
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Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#		Theory	Practice
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice		
Level 1	Remember Understand	40%	-	30%	-	30%	-	30%	-	30%	-
Level 2	Apply Analyze	40%	-	40%	-	40%	-	40%	-	40%	-
Level 3	Evaluate Create	20%	-	30%	-	30%	-	30%	-	30%	-
	Total	100 %		100 %		100 %		100 %		100 %	

# CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Dr. C. N. Ramchand, Saksin Life sciences, ramchand@saksinlife.com	1. Dr. K Subramaniam, IITM Chennai, subbu.iitm.ac.in	Dr. S. Thyagarajan, SRMIST
2. Dr. Karthik Periyasamy, Aurobindo Pharma Limited, Hyderabad, karthikmpk@gmail.com	2. Dr. Tamil Selvan, Anna University, Chennai, tamilselvan@annauniv.edu	Dr. S. Nageswaran, SRMIST

Course Code	18MAB201T	Course Name	TRANSFORMS AND BOUNDARY VALUE PROBLEMS	Course Category	B	Basic Sciences	L	T	P	C
							3	1	0	4

Pre-requisite Courses	18MAB102T	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Mathematics	Data Book / Codes/Standards	Nil		

Course Learning Rationale (CLR):	The purpose of learning this course is to:			Learning			Program Learning Outcomes (PLO)														
CLR-1 :	Describe types of Partial differential equations interpret solutions relate PDE to the respective branches of engineering			1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CLR-2 :	Relate Fourier series expansion in solving problems under RMS value and Harmonic Analysis.			Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3
CLR-3 :	Infer the most general form to the PDE and relate to half range sine and cosine series, as the case may be																				
CLR-4 :	Evaluate the various types of integral transforms																				
CLR-5 :	Conclude that the purpose of studying z transform is to solve linear difference equations having constant coefficients																				
CLR-6 :	Predicting the importance of PDE, Fourier series, Boundary value problems and Fourier ,Z – transform applications																				
Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:																				
CLO-1 :	Determine Partial differential equation			2	85	80	M	H	L	-	-	-	-	-	M	-	-	H	-	-	-
CLO-2 :	Explain the expansion of a discontinuous function as an infinite form of trigonometric sine and cosine series.			2	85	80	M	H	-	M	M	-	-	-	M	L	-	H	-	-	-
CLO-3 :	Decide a proper form of solution for the differential equations which are of hyperbolic and parabolic type			2	85	80	M	H	-	-	-	-	-	-	M	-	-	H	-	-	-
CLO-4 :	justify the relationship between aperiodic signals and linear combination of exponentials.			2	85	80	M	H	-	M	-	-	-	-	M	L	-	H	-	-	-
CLO-5 :	Relate signal analysis with that of z transform			2	85	80	M	H	L	-	-	-	-	-	M	-	-	H	-	-	-
CLO-6 :	Relate PDE, Fourier series, Boundary value problems, Fourier and Z transforms			2	85	80	L	L	L	H	H	H	L	H	H	H	-	H	-	-	-

Duration (hour)	12		12		12		12		12	
S-1	SLO-1	Formation of partial differential equation by eliminating arbitrary constants	Introduction of Fourier series - Dirichlet's conditions for existence of Fourier Series	Classification of second order partial differential equations	Introduction of Fourier Transforms	Introduction of Z-transform				
	SLO-2	Formation of partial differential equation by eliminating two or more arbitrary constants	Fourier series –related problems in $(0,2\pi)$	Method of separation of variables	Fourier Transforms- problems	Z-transform-elementary properties				
S-2	SLO-1	Formation of partial differential equation by eliminating arbitrary functions	Fourier series –related problems in $(-\pi, \pi)$	One dimensional Wave Equation and its possible solutions	Properties of Fourier transforms	Z-transform- change of scale property, shifting property				
	SLO-2	Formation of partial differential equation by eliminating two or more arbitrary functions	Change of interval Fourier series –related problems in $(0,2L)$	One dimensional Wave Equation-initial displacement with zero initial velocity-type 1 Algebraic function	Standard results of Fourier transform	Z-transform of $a^n, \frac{1}{n}, \frac{1}{n+1}$				
S-3	SLO-1	Formation of partial differential equation by eliminating arbitrary functions of the form $\phi(u, v) = 0$	Fourier series –related problems in $(-l, l)$	One dimensional Wave Equation-initial displacement with zero initial velocity-type 2 Trigonometric function	Fourier Sine Transforms - problems	Z-transform of $\frac{1}{n^2}, \frac{1}{(n+1)^2}$				
	SLO-2	Solution of first order non-linear partial differential equations-standard type I $F(p,q)=0$	Fourier series –half range cosine series related problems $(0, \pi)$	One dimensional Wave Equation-initial displacement with zero initial velocity-type 3 – Midpoint of the string is displaced	Fourier Cosine Transforms - problems	Z-transform of $r^{n\theta} \cos n\theta$				
S-4	SLO-1 SLO-2	Problem solving using tutorial sheet 1	Problem solving using tutorial sheet 4	Problem solving using tutorial sheet 7	Problem solving using tutorial sheet 10	Problem solving using tutorial sheet 13				

S-5	SLO-1	Solution of first order nonlinear partial differential equations-standard type –II Clairaut's form	Fourier series –half range cosine series related problems(0, l)	One dimensional Wave Equation-initial displacement with non-zero initial velocity Type 1 Algebraic function	Properties of Fourier sine Transforms	Z-transform of $r^n \sin n\theta$
	SLO-2	Solution of first order non-linear partial differential equations-standard type III $F(z, p, q)=0$	Fourier series –half range sine series related problems(0, $\pi$ )	One dimensional Wave Equation-initial displacement with non-zero initial velocity Type 2 Trigonometric function	Fourier sine Transforms applications	Initial value theorem
S-6	SLO-1	Solution of first order non-linear partial differential equations-standard type-IV separation of variable $f(x, p) = g(y, q)$	Fourier series –half range sine series related problems(0, l)	Wave Equation-initial displacement with non-zero initial velocity Type 3 split function	Properties of Fourier cosine Transforms	Final value theorem
	SLO-2	Lagrange's linear equation: Method of grouping	Parseval's Theorem (without proof)-related problems in Fourier series	One dimensional heat equation and its possible solutions	Fourier cosine Transforms applications	Inverse Z-transform- long division method
S-7	SLO-1	Lagrange's linear equation: Method of multipliers	Parseval's Theorem (without proof)-related problems in cosine series	One dimensional heat equation related problems	Convolution of two function	Inverse Z-transform, related problems, long division method
	SLO-2	More problems in Lagrange's linear equation: Method of multipliers	Parseval's Theorem (without proof)-related problems in sine series	One dimensional heat equation -Steady state conditions	Convolution Theorem	Inverse Z-transform, Partial fraction method
S-8	SLO-1 SLO-2	Problem solving using tutorial sheet 2	Problem solving using tutorial sheet 5	Problem solving using tutorial sheet 8	Problem solving using tutorial sheet 11	Problem solving using tutorial sheet 14
S-9	SLO-1	Linear Homogeneous partial differential equations of second and higher order with constant coefficients-CF and PI Type 1: $e^{ax+by}$	Introduction to Harmonic Analysis	One dimensional heat equation -Steady state conditions more problems	Parseval's Identity for Fourier transform	Inverse Z-transform, Partial fraction method related problems
	SLO-2	PI Type2.: $\sin(ax+by)$ or $\cos(ax+by)$	Harmonic Analysis for finding harmonic in $(0, 2\pi)$	One dimensional heat equation -Steady state conditions with zero velocity	Parseval's Identity for Fourier sine & cosine transforms	Inverse Z-transform - residue theorem method
S-10	SLO-1	Type 3: PI of polynomial	Harmonic Analysis for finding harmonic in $(0, 2l)$	One dimensional heat equation -Steady state conditions with zero velocity more problems	Parseval's Identity for Fourier sine & cosine transforms applications	Inverse Z-transform - residue theorem method-problems
	SLO-2	Type 4 Exponential shifting $e^{ax+by} f(x, y)$	Harmonic Analysis for finding harmonic in periodic interval $(0, T)$	One dimensional heat equation -Steady state conditions with zero velocity more related problems	Fourier Transforms Using Differentiation property	Convolution theorem (without proof)
S-11	SLO-1	Linear Homogeneous partial differential equations of second and higher order with constant coefficients type 5 General rule	Harmonic Analysis for finding cosine series	Steady state conditions and Non-zero boundary conditions- related problems	Solving integral equation	Convolution theorem applications
	SLO-2	Applications of Partial differential equations in Engineering	Harmonic Analysis for finding sine series	Steady state conditions and Non-zero boundary conditions- more problems	Self-reciprocal using Fourier Transform, sine and cosine transform	Solution of linear difference equations with constant coefficients using Z-transform
S-12	SLO-1	Problem solving using tutorial sheet 3	Problem solving using tutorial sheet 6	Problem solving using tutorial sheet 9	Problem solving using tutorial sheet 12	Problem solving using tutorial sheet 15
	SLO-2	Problem solving using tutorial sheet 3	Problem solving using tutorial sheet 6	Problem solving using tutorial sheet 9	Problem solving using tutorial sheet 12	Problem solving using tutorial sheet 15

Learning Resources	<ol style="list-style-type: none"> <li>1. B. H. Erwin kreyszig, Advanced Engineering Mathematics, 10th Edition, John Wiley &amp; Sons, 2006</li> <li>2. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 43<sup>rd</sup> Edition, 2015</li> <li>3. Veerarajan T., Transforms and Partial Differential Equations, Tata McGraw-Hill, New Delhi, 2012</li> </ol>	<ol style="list-style-type: none"> <li>4. Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 3<sup>rd</sup> Edition, 2010</li> <li>5. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, for third semester, Laxmi Publications, 3<sup>rd</sup> Edition, 2014</li> </ol>
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Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember Understand	40 %	-	30 %	-	30 %	-	30 %	-	30%	-
Level 2	Apply Analyze	40 %	-	40 %	-	40 %	-	40 %	-	40%	-
Level 3	Evaluate Create	20 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Total	100 %		100 %		100 %		100 %		100 %	

# CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Mr. V. Maheshwaran, CTS, Chennai, maheshwaranv@yahoo.com	1. Dr. K. C. Sivakumar, IIT, Madras, kcskumar@iitm.ac.in	1. Dr. A. Govindarajan, SRMIST
2. Dr. Sricharan Srinivasan, Wipro Technologies, sricharanms@gmail.com	2. Dr. Nanjundan, Bangalore University, nanzundan@gmail.com	2. Prof. Ganapathy Subramanian K S, SRMIST

Course Code	18MAB202T	Course Name	NUMERICAL METHODS FOR ENGINEERS	Course Category	B	Basic Sciences	L	T	P	C
							3	1	0	4

Pre-requisite Courses	18MAB102T	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Mathematics	Data Book / Codes/Standards	Nil		

Course Learning Rationale (CLR):	The purpose of learning this course is to:			Learning			Program Learning Outcomes (PLO)														
CLR-1 :	Acquire ability in solving mathematical problems numerically as applied to the respective branches of Engineering			1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CLR-2 :	Apply the concept of interpolation for finding intermediate values of a well-known data			Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3
CLR-3 :	Study the concept of numerical differentiation and integration																				
CLR-4 :	Apply the numerical techniques for solutions of ordinary differential equations																				
CLR-5 :	Apply the numerical techniques for solutions of partial differential equations																				
CLR-6 :	Acquire analytical ability in solving mathematical problems numerically applied to the respective branches of Engineering																				
Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:																				
CLO-1 :	Solve the algebraic, transcendental and simultaneous equations.			2	85	80	L	-	L	-	-	-	-	-	M	-	-	H	-	-	-
CLO-2 :	Find the finite differences and interpolation.			2	85	80	L	-	-	M	M	-	-	-	-	-	-	-	-	-	-
CLO-3 :	Solve numerical Differentiation and integration.			2	85	80	-	M	-	-	-	-	-	-	M	-	-	H	-	-	-
CLO-4 :	Solve the numerical solutions of ordinary differential equations.			2	85	80	L	M	-	M	-	-	-	-	M	-	-	H	-	-	-
CLO-5 :	Solve the numerical solutions of partial differential equations			2	85	80	-	M	L	-	-	-	-	-	M	-	-	H	-	-	-
CLO-6 :	Solve the problems numerically in science and engineering			2	85	80	H	-	H	-	-	-	-	-	H	-	-	H	-	-	-

Duration (hour)	12		12		12		12		12	
S-1	SLO-1	Method of Least Squares – Curve fitting.	First and Higher order differences.	Numerical Differentiation.	Numerical solutions for ordinary differential equations.	Numerical solutions for partial differential equations.				
	SLO-2	Fitting a straight line.	Forward differences and backward differences.	Newton's forward difference formulae to compute first and higher order derivatives.	Solution by Taylor's series method.	Classification of partial differential equations.				
S-2	SLO-1	Fitting a parabola.	Central Differences.	Newton's backward differences formulae to compute first and higher order derivatives.	Solutions of First order simultaneous differential equations by Taylor's series method.	Solution of Elliptic Equations.				
	SLO-2	Calculation of the sum of the squares of the residuals of straight line and parabola.	Operators– Relations between the operators.	Problems by Newton's forward and backward differences formulae.	Euler's method.	Solution of Laplace Equations by Leibmann's Iterative process.				
S-3	SLO-1	Solution of Algebraic and Transcendental equations.	Interpolation – Newton-Gregory Forward Interpolation formulae.	Applications of Newton's forward difference formulae to compute first and higher order derivatives.	Applications of Euler's method.	Solution of Laplace Equations by Leibmann's Iterative process.				
	SLO-2	Newton-Raphson method.	Interpolation – Newton-Gregory Backward Interpolation formulae.	Applications of Newton's backward difference formulae to compute first and higher order derivatives.	Improved Euler's method.	Solution of Poisson Equations.				
S-4	SLO-1	Problem solving using tutorial sheet 1.	Problem solving using tutorial sheet 4.	Problem solving using tutorial sheet 7.	Problem solving using tutorial sheet 10.	Problem solving using tutorial sheet 13.				
	SLO-2						Modified Euler's method			

S-5	SLO-1	Bisection method and its applications.	Additional problems using Newton-Gregory Forward Interpolation formulae.	Additional problems for Newton's forward formulae to compute the application problems.	Applications of Improved and Modified Euler's method.	Problems for Poisson Equations.
	SLO-2	Problems using bisection method.	Additional problems using Newton-Gregory Backward Interpolation formulae.	Additional problems for Newton's backward formulae to compute the application problems.	Runge-Kutta method of fourth order.	Additional problems for Poisson Equations.
S-6	SLO-1	Regula-Falsi method.	Divided differences.	Numerical Integration.	Solution by Runge-Kutta method of fourth order.	Solution of Parabolic equations.
	SLO-2	Problems using false position method.	Formation of divided difference table.	Trapezoidal rule.	Additional problems using Runge-Kutta method of fourth order.	Bender-Schmidt formula
S-7	SLO-1	Solution of system of equations Direct Method - Gauss Elimination method.	Properties of Divided differences.	Simpson's one third rule.	Predictor-Corrector Methods.	Bender-Schmidt formula
	SLO-2	Solution of system of equations Direct Method – Gauss-Jordan method.	Properties of Divided differences.	Simpson's three eighth rule.	Milne-Thomson Method.	Bender-Schmidt formula
S-8	SLO-1 SLO-2	Problem solving using tutorial sheet 2.	Problem solving using tutorial sheet 5.	Problem solving using tutorial sheet 8.	Problem solving using tutorial sheet 11. Problems for Milne-Thomson Method.	Problem solving using tutorial sheet 14.
S-9	SLO-1	Solution of system of equations Iterative Method – Gauss- Jacobi method.	Newton's Divided difference formula.	More problems using Trapezoidal rule.	Application of Milne-Thomson Method.	Crank-Nicolson formula.
	SLO-2	Problems using Gauss-Jacobi method.	Problems by Newton's Divided difference formula.	More problems using Simpson's one third rule.	Adam's Bashforth method.	Crank-Nicolson formula.
S-10	SLO-1	Solution of system of equations Iterative Method – Gauss-Seidal method.	Additional problems by Newton's Divided difference formula.	More problems using Simpson's three eighth rule.	Problems using Adam's Bashforth method.	Crank-Nicolson formula.
	SLO-2	Problems using Gauss- Seidal method.	Lagrange's Interpolation formula.	Applications of Trapezoidal rule – Simpson's one third rule and Simpson's three eighth rules.	Application of Adam's Bashforth method.	Solution of Hyperbolic equations.
S-11	SLO-1	Power method.	Problems by Lagrange's Interpolation formula.	Application problems for Trapezoidal rule – Simpson's one third rule and Simpson's three eighth rules.	Additional problems for Milne-Thomson Method.	Solution of Hyperbolic equations by Explicit formula.
	SLO-2	Finding Eigen values by power method.	Inverse interpolation.	Applications problems for Trapezoidal rule – Simpson's one third rule and Simpson's three eighth rules.	Additional problems for Adam's Bash forth Method	More problems in Hyperbolic equations using Explicit formula.
S-12	SLO-1	Problem solving using tutorial sheet 3.	Problem solving using tutorial sheet 6.	Problem solving using tutorial sheet 9.	Problem solving using tutorial sheet 12.	Problem solving using tutorial sheet 15.
	SLO-2	Applications of numerical techniques to solve algebraic, transcendental and simultaneous equations	Application of interpolation for finding intermediate values of a well-known data	Applications of Numerical integration.	Applications of ordinary differential equation.	Applications of partial differential equation.

Learning Resources	<ol style="list-style-type: none"> <li>1. B.S. Grewal, Numerical Methods in engineering and science, Khanna Publishers, 42nd edition, 2012</li> <li>2. S.S. Sastry, Introductory Methods of Numerical Analysis, PHI, 4th edition, 2005</li> <li>3. E. Balagurusamy, Computer Oriented Statistical and Numerical Methods – Tata McGraw Hill., 2000</li> </ol>	<ol style="list-style-type: none"> <li>4. M.K.Jain, SRK Iyengar and R.L.Jain, Numerical Methods for Scientific and Engineering Computation, Wiley Eastern Ltd., 4th edition, 2003</li> <li>5. Dr. M.K. Venkataraman, Numerical Methods in Science and Engineering, National Publishing Co., 2005</li> </ol>
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Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember Understand	40 %	-	30 %	-	30 %	-	30 %	-	30%	-
Level 2	Apply Analyze	40 %	-	40 %	-	40 %	-	40 %	-	40%	-
Level 3	Evaluate Create	20 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Total	100 %		100 %		100 %		100 %		100 %	

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2. Dr. Sricharan Srinivasan, Wipro Technologies, sricharanms@gmail.com	2. Dr. Nanjundan, Bangalore University, nanzundan@gmail.com	2. Dr. Sundarammal kesavan, SRMIST

Course Code	18MAB203T	Course Name	PROBABILITY AND STOCHASTIC PROCESSES			Course Category	B	Basic Sciences				L	T	P	C											
												3	1	0	4											
Pre-requisite Courses	18MAB102T		Co-requisite Courses	Nil		Progressive Courses	Nil																			
Course Offering Department	Mathematics			Data Book / Codes/Standards	Nil																					
Course Learning Rationale (CLR):	The purpose of learning this course is to:					Learning			Program Learning Outcomes (PLO)																	
CLR-1 :	Describe the applications on discrete and continuous random variables.					1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15			
CLR-2 :	Assess the applications of two dimensional random variables.					Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge																	
CLR-3 :	Infer the various modes of convergence of random variables and their limit theorems.								Problem Analysis	M	H	L	-	-	-	-	-	-	M	L	-	H	-	-	-	-
CLR-4 :	Relate the specialized knowledge in random processes in signals and systems.								Design & Development	M	H	-	-	M	M	-	-	-	M	-	-	H	-	-	-	-
CLR-5 :	Determine the applications of spectral density functions and linear time invariant systems								Analysis, Design, Research	M	H	-	-	-	-	-	-	-	M	L	-	H	-	-	-	-
CLR-6 :	Interpret random variables and stochastic processes in the application of practical engineering problems.								Modern Tool Usage	M	H	L	-	-	-	-	-	-	M	-	-	H	-	-	-	-
									Society & Culture	M	H	-	-	-	-	-	-	M	-	-	H	-	-	-	-	-
						Environment & Sustainability	M	H	-	-	-	-	-	-	M	-	-	H	-	-	-	-	-			
						Ethics	M	H	-	-	-	-	-	-	M	-	-	H	-	-	-	-	-			
						Individual & Team Work	M	H	-	-	-	-	-	-	M	-	-	H	-	-	-	-	-			
						Communication	M	H	-	-	-	-	-	-	M	-	-	H	-	-	-	-	-			
						Project Mgt. & Finance	M	H	-	-	-	-	-	-	M	-	-	H	-	-	-	-	-			
						Life Long Learning	M	H	-	-	-	-	-	-	M	-	-	H	-	-	-	-	-			
						PSO - 1	M	H	-	-	-	-	-	-	M	-	-	H	-	-	-	-	-			
						PSO - 2	M	H	-	-	-	-	-	-	M	-	-	H	-	-	-	-	-			
						PSO - 3	M	H	-	-	-	-	-	-	M	-	-	H	-	-	-	-	-			
Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:					3	85	80																		
CLO-1 :	Compare the fundamentals between discrete and continuous random variables.					3	85	80																		
CLO-2 :	Choose the model and analyze systems using two dimensional random variables.					3	85	80																		
CLO-3 :	Describe limit theorems using various inequalities.					3	85	80																		
CLO-4 :	Interpret the characteristics of random processes.					3	85	80																		
CLO-5 :	Evaluate problems on spectral density functions and linear time invariant systems.					3	85	80																		
CLO-6 :	Explain how random variables and stochastic processes can be described and analyzed.					3	85	80																		
Duration (hour)	12		12		12		12		12		12		12		12		12		12		12		12			
S-1	SLO-1	One dimensional random variable: Discrete Case-Probability function, Cumulative Distribution Function	Two dimensional random variables- Discrete case	Limit theorems--Markov's inequality	Random Processes-Introduction	Power spectral density function- properties																				
	SLO-2	Continuous random variable-Probability density function	Probability function of (X,Y)-Marginal probability distribution	Chebyshev's inequality without proof	Classification of random processes	Proof of properties																				
S-2	SLO-1	Cumulative distribution function-properties	Conditional probability distribution of (X,Y)	Chebyshev's inequality - Applications	Distribution of the process	Problems on power spectral density function																				
	SLO-2	Problems on one dimensional random variables	Problems on discrete random variables	Chebyshev's inequality – Applications using Binomial distribution	Averages of the process	Problems on power spectral density function																				
S-3	SLO-1	Expectation, variance	Continuous random variables-Joint PDF	Chebyshev's inequality– Applications using Exponential distribution	Stationary, SSS,WSS processes	Power density spectrum																				
	SLO-2	Moments-raw and central moments	Marginal Probability distributions	The weak law of large numbers	Problems on stationary and SSS processes	Problems based on power density spectrum																				
S-4	SLO-1	Problem solving using tutorial sheet 1	Problem solving using tutorial sheet 4	Problem solving using tutorial sheet 7	Problem solving using tutorial sheet 10	Problem solving using tutorial sheet 13																				
	SLO-2																									
S-5	SLO-1	Characteristic function - properties	Conditional probability distribution of (X,Y)	Central limit theorem without proof	Problems on WSS process	Linear system with random inputs																				
	SLO-2	Characteristic function	Problems on continuous two dimensional random variables	Central limit theorem - Applications	Problems on WSS process	Representation of system in the form of convolution																				
S-6	SLO-1	Binomial distribution -moments	Independent random variables	Central limit theorem- Applications using Poisson random variables	Autocorrelation function -properties	Unit impulse response of the system																				

	SLO-2	Binomial distribution-Applications	Cumulative distribution function-properties of $F(x,y)$	Central limit theorem- Applications using Exponential random variables	Proof of properties	Properties
S-7	SLO-1	Poisson distribution-moments	Expected values of two dimensional random variables	The strong law of large numbers	Problems on autocorrelation function	Applications of unit impulse function
	SLO-2	Poisson distribution -Applications	Covariance and correlation	The strong law of large numbers	Application of autocorrelation function	Einstein Weiner- Khinchine Relationship
S-8	SLO-1 SLO-2	Problem solving using tutorial sheet 2	Problem solving using tutorial sheet 5	Problem solving using tutorial sheet 8	Problem solving using tutorial sheet 11	Problem solving using tutorial sheet 14
S-9	SLO-1	Exponential distribution-moments	Conditional expected values	One sided Chebychev's inequality	Cross correlation- properties	Problems on Khinchine relationship
	SLO-2	Exponential distribution-Applications	Problems on uncorrelated random variables	Cauchy Schwartz inequality	Proof of properties	Cross power density spectrum-properties
S-10	SLO-1	Normal Distribution-moments	Functions of two dimensional random variables	Chernoff bounds	Problems on cross correlation function	Properties of Power Spectral Density
	SLO-2	Normal Distribution-Applications	Probability density functions of the type $Z=XY$	Chernoff bounds for the standard normal variate	Ergodicity	Cross power density spectrum-problems
S-11	SLO-1	Function of a random variable	Probability density functions of the type $Z=X-Y$	Chernoff bounds for the Poisson random variate	Mean ergodic process	Cross power density spectrum
	SLO-2	Function of a random variable	Probability density functions of the type $Z=X/Y$	Jenson's inequality	Mean ergodic theorem	Cross power density spectrum
S-12	SLO-1	Problem solving using tutorial sheet 3	Problem solving using sheet 6	Problem solving using tutorial sheet 9	Problem solving using tutorial sheet 12	Problem solving using tutorial sheet 15
	SLO-2	Applications of random variables in engineering	Application of two dimensional random variables in Engineering	Applications of Central limit Theorem in engineering	Applications of random process in engineering	Applications of Power spectral density functions in engineering

Learning Resources	1. A. Papoulis, S. Unnikrishna Pillai, Probability, Random Variables and Stochastic Processes 4 <sup>th</sup> ed., McGraw Hill, 2002	4. S.C. Gupta, V.K. Kapoor, Fundamentals of Mathematical Statistics, Sultan Chand & Sons, 11 <sup>th</sup> ed., 2015
	2. Henry Stark, Probability and Random Processes with Applications to Signal Processing, 3 <sup>rd</sup> ed., Pearson, 2002	
	3. Sheldon Ross, A first course in Probability, 6 <sup>th</sup> ed., 2011	5. Veerarajan T., Probability, Statistics and Random Processes with Queueing Theory and Queueing Networks, 4 <sup>th</sup> ed., McGraw-Hill Education, 2015

Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#		Theory	Practice
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice		
Level 1	Remember Understand	40 %	-	30 %	-	30 %	-	30 %	-	30%	-
Level 2	Apply Analyze	40 %	-	40 %	-	40 %	-	40 %	-	40%	-
Level 3	Evaluate Create	20 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Total	100 %		100 %		100 %		100 %		100 %	

# CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Mr. V. Maheshwaran, CTS, Chennai, maheshwaranv@yahoo.com	1. Dr. K. C. Sivakumar, IIT, Madras, kcckumar@iitm.ac.in	1. Dr. A. Govindarajan, SRMIST
2. Dr. Sricharan Srinivasan, Wipro Technologies, sricharanms@gmail.com	2. Dr. Nanjundan, Bangalore University, nanzundan@gmail.com	2. Dr. V. Srinivasan, SRMIST

Course Code	18MAB204T	Course Name	PROBABILITY AND QUEUEING THEORY	Course Category	B	Basic Sciences	L	T	P	C
							3	1	0	4

Pre-requisite Courses	18MAB102T	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Mathematics	Data Book / Codes/Standards	Nil		

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning			Program Learning Outcomes (PLO)																
CLR-1:	Apply and evaluating probability using random variables	1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15		
CLR-2:	Gain the knowledge and acquire the application of distribution to find the probability using Theoretical distributions	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3		
CLR-3:	To Assess the appropriate model and apply and solving any realistic problem situation to determine the probability				M	H	L	-	-	-	-	-	-	-	M	-	-	H	-	-	-
CLR-4:	To interpret the decision using Markov queueing applications				M	H	-	-	M	M	-	-	-	-	M	L	-	H	-	-	-
CLR-5:	To construct chain of decisions from the past situations using Monroviens				M	H	-	-	-	-	-	-	-	-	M	L	-	H	-	-	-
CLR-6:	Interpret random variables and Queueing theory in engineering problems.				M	H	L	M	-	-	-	-	-	-	M	-	-	H	-	-	-
CLR-6:	Interpret random variables and Queueing theory in engineering problems.				M	H	-	-	-	-	-	-	-	-	M	-	-	H	-	-	-
Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:																				
CLO-1:	Solving problems on Discrete and Continuous Random variables	3	85	80																	
CLO-2:	Identifying Distribution and solving the problems in Discrete and Continuous Distribution	3	85	80																	
CLO-3:	Decision Models using sampling techniques in Large and Small samples	3	85	80																	
CLO-4:	Solving Queueing problems using Kendall's notation	3	85	80																	
CLO-5:	To Evaluate the probability in uncertain situations using Markov chain rule	3	85	80																	
CLO-6:	Solving and analyzing the problems in random variables and Queueing theory.	3	85	80																	

Duration (hour)	12	12	12	12	12
S-1	SLO-1 Probability Basic concepts and Axioms	Discrete Probability distribution	Sampling distribution, Null Hypothesis, Alternate Hypothesis	Introduction to F-test	Markov Process and Introduction of a Markov Chain
	SLO-2 Conditional probability, Multiplication theorem	Introduction to Binomial distribution	One tailed test, two tailed test	Problems on F-test	Past and Future -Step and State
S-2	SLO-1 Discrete and continuous Random variables	MGF, Mean, Variance of Binomial distribution	Level of significance, Critical region	Chi square test -Goodness of fit	One step Transition Probability N step transition Probability
	SLO-2 Probability mass function, cdf	Applications of Binomial distribution	Large samples test	Problems on Chi square test -Goodness of fit	Chapman-kolmogorov theorem definition
S-3	SLO-1 Continuous Random variables	Fit a Binomial distribution.	Student - t test Single Proportion	Problems on Chi-square test Independent-Attributes	Initial Probability distribution problems Using Markov Chain
	SLO-2 pdf and cdf applications	Introduction to Poisson Distribution	Two Sample proportions	Problems on Chi-square test Independent-Attributes with standard distributions	Initial Probability distribution problems Using Markov Chain
S-4	SLO-1 Problem solving using tutorial sheet 1	Problem solving using tutorial sheet 4	Problem solving using tutorial sheet 7	Problem solving using tutorial sheet 10	Problem solving using tutorial sheet 13
	SLO-2				
S-5	SLO-1 Expectation and Variance	MGF, Mean, Variance of Poisson distribution	Large sample test-Single Mean	Introduction to Queueing Theory and Applications. Kendall, notation	Classification of States of a Markov Chain
	SLO-2 Problems on Expectation and Variance	Applications of Poisson Distribution	Difference of Means	Introduction to M/M/1 : infinity/ FIFO	Irreducible, Non irreducible, a period, Persistent, Non null Persistent
S-6	SLO-1 Moment Generating Function	Fit a Poisson Distribution	Problems on difference of Means	Ls, Lq, Ws, Wq	Problems on Classification of a Markov Chain

	SLO-2	Problems on MGF	Introduction , MGF Mean, Variance of Geometric distribution	Applications of Difference of Means	M/M/1 :Infinity /FIFO problems	Problem on Classification of a Markov Chain
S-7	SLO-1	Functions of Random variables	Applications of Geometric Distribution, problems on Memory less property	Introduction to small samples	M/M/1 :Infinity /FIFO problems	Classification of states of a Markov Chain
	SLO-2	Problems on Functions of Random variable	Introduction , MGF, Mean, Variance of Uniform Distribution	Introduction to small Samples	M/M/1 :Infinity /FIFO problems	Stationary and steady state
S-8	SLO-1 SLO-2	Problem solving using tutorial sheet 2	Problem solving using tutorial sheet 5	Problem solving using tutorial sheet 8	Problem solving using tutorial sheet 11	Problem solving using tutorial sheet 14
S-9	SLO-1	Tchebycheffs inequality	Applications of Uniform Distribution problems	Problems on single mean -small samples	Single Server Model with Finite System Capacity, Characteristics of the Model (M/M/1) : (K/FIFO)	Problems on Classification-State-stationary using Markov Chain
	SLO-2	Introduction to theoretical distribution	Introduction , MGF, Mean, Variance of Exponential distribution	Problems on single mean -small samples	Effective arrival rate	Problems on Stationary and steady state
S-10	SLO-1	Formula and application of Tchebycheffs inequality	Applications of Exponential distribution problems	Problems on difference of mean-small samples	Problems on Model (M/M/1) : (K/FIFO)	Problems on Ergodicity using Markov Chain
	SLO-2	Applications of chebychevs inequality	Introduction to Normal distribution	Problems on difference of mean-small samples	Problems on Model (M/M/1) : (K/FIFO)	Problems on Ergodicity using Markov Chain
S-11	SLO-1	Applications of chebychevs inequality using distribution	Applications of Normal distribution problems	Applications of paired - t test	Problems on Model (M/M/1) : (K/FIFO)	Problems on Ergodicity
	SLO-2	Problems practice using chebychevs inequality	Practical applications of Normal distribution	Problems of paired - t test.	Problems on Model (M/M/1) : (K/FIFO)	Problems on Ergodic and Non Ergodic Using Markovchains
S-12	SLO-1	Problem solving using tutorial sheet 3	Problem solving using tutorial sheet 6	Problem solving using tutorial sheet 9	Problem solving using tutorial sheet 12	Problem solving using tutorial sheet 15
	SLO-2	Applications of random variables in engineering	Applications of distribution to find the probability using Theoretical distributions	Applications of solving any realistic problem situation to determine the probability	Applications of Queueing decision models	Applications of constructing chain of decisions from the past situations using Monrovians

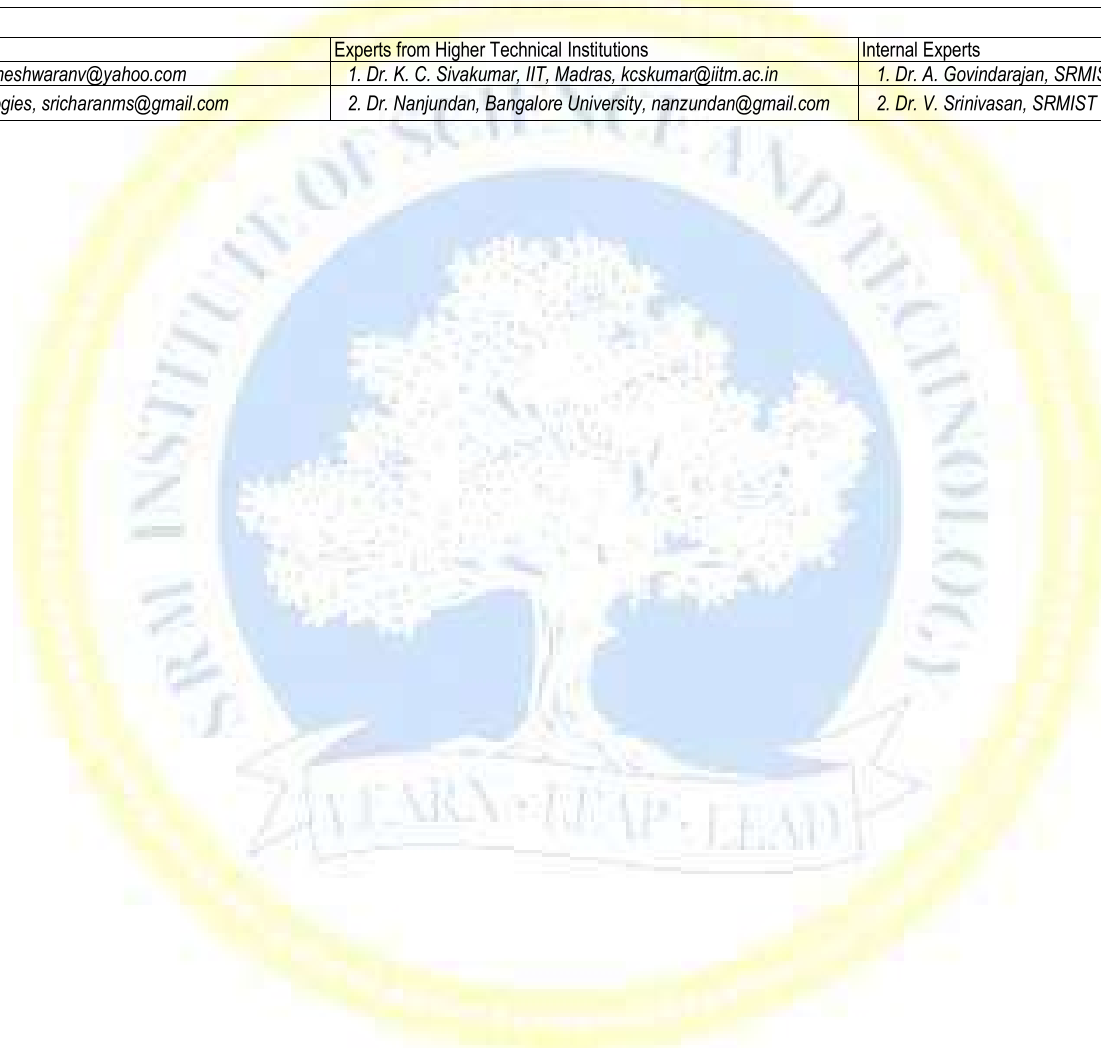
Learning Resources	<ol style="list-style-type: none"> <li>1. Veerarajan T, Probability , Statistics and Random Processes, Tata Mc.Graw Hill, 1st Reprint 2004</li> <li>2. S.C. Gupta, V.K.Kapoor, Fundamentals of Mathematical Statistics, 9<sup>th</sup> ed.,, Sultan Chand &amp; Sons, 1999</li> <li>3. Gross. D and Harri.C.M. Fundamentals of Queueing theory, John Wiley and Sons, 1985</li> </ol>	<ol style="list-style-type: none"> <li>4. Trivedi K S, Probability and Statistics with reliability, Queueing and Computer Science Applications, prentice Hall of India, New Delhi, 1984</li> <li>5. Allen .A.O. , Probability Statistics and Queueing theory, Academic Press</li> </ol>
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Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#		Theory	Practice
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice		
Level 1	Remember Understand	40 %	-	30 %	-	30 %	-	30 %	-	30%	-
Level 2	Apply Analyze	40 %	-	40 %	-	40 %	-	40 %	-	40%	-
Level 3	Evaluate Create	20 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Total	100 %		100 %		100 %		100 %		100 %	



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Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
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# ACADEMIC CURRICULA

**Engineering Science Courses**

**Regulations - 2018**

**SRM INSTITUTE OF SCIENCE AND TECHNOLOGY**

**(Deemed to be University u/s 3 of UGC Act, 1956)**

Kattankulathur, Kancheepuram, Tamil Nadu, India

Course Code	18CHS201J	Course Name	PHYSICAL AND ANALYTICAL CHEMISTRY	Course Category	S	Engineering Sciences			
						L	T	P	C
						3	0	2	4

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Chemical Engineering	Data Book / Codes/Standards	Nil		

Course Learning Rationale (CLR):	The purpose of learning this course is to:			Learning			Program Learning Outcomes (PLO)															
CLR-1 :	Describe the ideal and non-ideal behavior of liquids; learn colligative properties and their applications			1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
CLR-2 :	Elucidate the concepts of chemical equilibrium and the effect of various factors on equilibrium constant			Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3	
CLR-3 :	Illustrate the difference in behavior of different states of matter essential for separation operations																					
CLR-4 :	Elucidate the properties and applications of colloids; Understand the kinetics of photochemical reactions																					
CLR-5 :	Explain the principles of analytical instruments along with their limitations																					
CLR-6 :	Utilize the physical behavior of atoms and molecules at the microscopic scale																					
Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:																					
CLO-1 :	Analyze ideal, non-ideal behavior of fluids; Apply colligative properties to find the molecular weight of unknown compounds			2	80	75	H	H	L	L	-	-	-	-	-	-	-	-	-	H	-	-
CLO-2 :	Describe the significance of Gibbs' free energy and equilibrium constants			2	75	70	H	H	L	L	-	-	-	-	-	-	-	-	-	M	-	-
CLO-3 :	Apply Gibbs' phase rule and draw the phase diagram of one- and three-component systems			2	75	70	H	H	M	L	-	-	-	-	-	-	-	-	-	M	-	-
CLO-4 :	Analyze the distinct properties of colloids and photochemical reactions			2	85	80	H	H	-	L	-	-	-	-	-	-	-	-	-	L	-	-
CLO-5 :	Explain the suitable analytical technique for analyzing various types of compounds			2	80	75	H	-	-	L	L	-	L	-	-	-	-	-	-	L	-	-
CLO-6 :	Apply the concepts of physical chemistry to various processes in chemical engineering			2	75	70	H	H	M	H	H	M	M	-	-	-	-	-	M	H	-	-

Duration (hour)	15		15		15		15		15	
S-1	SLO-1	Introduction to solutions, Raoult's law	Introduction to Chemical equilibria	Introduction to Phase equilibria	Introduction to Colloids	Instrumental Methods of Analysis				
	SLO-2	Vapour pressures of ideal solutions	Gibbs' free energy and Chemical potential	Component, phase and degrees of freedom	General properties of colloids: Tyndall effect and Brownian movement	Accuracy, precision, common errors (system/manual)				
S-2	SLO-1	Vapour pressures of non-ideal solutions	Free energy of a spontaneous reaction	Conditions for equilibrium between phases	Electrical properties of colloids: electrical double layer, Zeta potential	Calibration curves				
	SLO-2	Deviations from ideality of Type I, Type II and Type III solutions	Law of mass action	Derivation of Gibbs' phase rule	Electrokinetic properties of colloids: electrophoresis and electro-osmosis	Classification of instrumental methods - spectroscopy, electrochemical and chromatography				
S-3	SLO-1	Completely miscible binary solutions: Vapor pressure-Composition and Boiling point-Composition curves of Type I solutions	Law of chemical equilibrium	Representation of one component systems using phase diagrams	Gels and emulsions	Electro-magnetic (EM) spectrum, Interaction of EM radiation with matter				
	SLO-2	Vapor pressure-Composition and Boiling point-Composition curves of Type II solutions	Thermodynamic derivation of the law of chemical equilibrium	One component system - water system	Applications of colloids	Generalities of optical methods (light source/ monochromator / sample introduction / detector / signal generator)				
S	SLO-1	Lab 1: Determine critical solution temperature (CST) of phenol-water system	Lab 4: Estimate aspirin drug in tablets using pH meter	Lab 7: Repeat class	Lab 10: Determine the rate constant of acid catalyzed hydrolysis of an ester	Lab 13: Determine fatty acid methyl ester using gas chromatography				
4-5	SLO-2	Vapor pressure-Composition and Boiling point-Composition curves of Type III solutions	Problems on Gibbs' free energy	One component system - CO <sub>2</sub> system	Introduction to Photochemistry	Principle, Instrumentation, Working, Applications, and Limitations of analytical techniques				

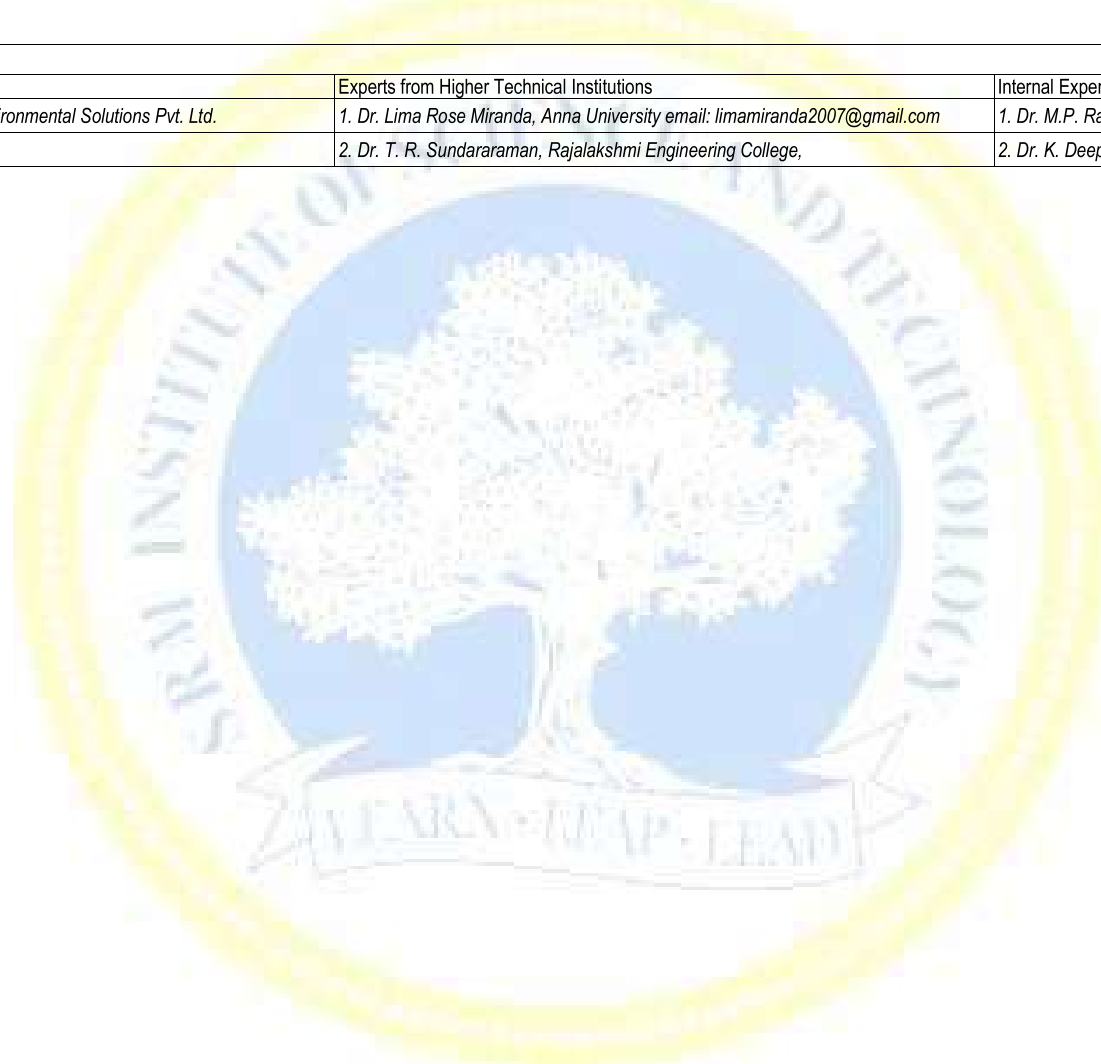
	SLO-2	Fractional distillation of binary liquid systems; The Lever rule	Problems on Gibbs' free energy	One component system - Sulphur system	Laws of photochemistry	UV-Vis spectroscopy
S-7	SLO-1	Distillation of immiscible liquids	Significance of equilibrium constant	Three component systems - Triangular phase diagram	Quantum yield	Infra-red spectroscopy
	SLO-2	Steam distillation	Equilibrium constants: $K_p$ , $K_c$ , and $K_x$	Three component system: acetic acid-chloroform-water system	Photochemical reactions	Atomic absorption spectroscopy
S-8	SLO-1	Partially miscible liquids	Relationship between $K_p$ , $K_c$ , and $K_x$	Three component system: two salts and water system	Photochemical rate law	Chromatographic techniques: General principle
	SLO-2	Critical solution temperature; Phenol-water system	Temperature dependence of Equilibrium constant - Van't Hoff Equation	The Nernst distribution law and distribution co-efficient	Determination of quantum yields	Column chromatography
S-9-10	SLO-1	Lab 2: Determine molecular weight by Rast method	Lab 5: Estimate sulphate by nephelometry	Lab 8: Determine partition co-efficient of benzoic acid between benzene and water	Lab 11: Determine the amount of manganese in the given sample of ore	Lab 14: Repeat class
	SLO-2					
S-11	SLO-1	Solutions of gases in liquids: Factors influencing solubility of a gas, Henry's law	Pressure dependence of equilibrium constants	Conditions for the validity of the distribution law	Problems on Beer Lambert's law	Paper chromatography
	SLO-2	Colligative Properties	Problems on equilibrium constants	Association of the solute in one of the solvents	Problems on quantum yield	Thin layer chromatography
S-12	SLO-1	Relative lowering of vapour pressure, Osmosis and osmotic pressure	Problems on equilibrium constants	Dissociation of the solute in one of the solvents	Kinetics of hydrogen-chlorine reaction: Mechanism	Gas chromatography
	SLO-2	Elevation in boiling point, Depression in freezing point	Le Chatelier's Principle	Applications of Nernst distribution law	Kinetics of hydrogen-chlorine reaction: Derivation	High Performance Liquid Chromatography
S-13	SLO-1	Determination of molecular weight from colligative properties	Effect of change in concentration, temperature, and pressure	Problems on Nernst distribution law	Kinetics of hydrogen-bromine reaction: Mechanism	Open-ended problems on choice and usage of analytical instruments
	SLO-2	Effect of association/dissociation on colligative properties	Le Chatelier's principle and physical equilibria	Problems on Nernst distribution law	Kinetics of hydrogen-bromine reaction: Derivation	Open-ended problems on choice and usage of analytical instruments
S-14-15	SLO-1	Lab 3: Determine strength of the given acid mixture by conductometric titration	Lab 6: Phase diagram of three component system	Lab 9: Estimate amount of iron present in a sample using UV-Vis spectrophotometer	Lab 12: Determine the amount of reducing sugar by DNS method	Lab 15: Practical Model Examination
	SLO-2					

Learning Resources	1. B. R. Puri, L. R. Sharma, Madan S. Pathania, Principles of Physical Chemistry, 47 <sup>th</sup> ed., Vishal Publishing Co., 2015 2. Arun Bahl, B. S. Bahl, G. D. Tuli, Essentials of Physical Chemistry, S. Chand & Company Ltd., 2009.	3. Douglas A. Skoog, F. James Holler, Timothy A. Nieman. Principles of Instrumental Analysis, Thomson Learning Inc., 1998
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Learning Assessment											
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		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice		
Level 1	Remember Understand	20%	20%	15%	15%	15%	15%	15%	15%	15%	15%
Level 2	Apply Analyze	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%
Level 3	Evaluate Create	10%	10%	15%	15%	15%	15%	15%	15%	15%	15%
	Total	100 %		100 %		100 %		100 %		100 %	

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Course Designers			
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts	
1. Mr. A. Subramaniam, PESCO Beam Environmental Solutions Pvt. Ltd.	1. Dr. Lima Rose Miranda, Anna University email: limamiranda2007@gmail.com	1. Dr. M.P. Rajesh, SRMIST	3. Dr. S. Prabhakar, SRMIST
2. Mr. S. T. Kalaimani, CPCL, Chennai	2. Dr. T. R. Sundararaman, Rajalakshmi Engineering College,	2. Dr. K. Deepa, SRMIST	



Course Code	18CHS251T	Course Name	BASIC CHEMICAL ENGINEERING	Course Category	S	Engineering Sciences	L	T	P	C
							3	0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Chemical Engineering	Data Book / Codes/Standards	Nil		

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning			Program Learning Outcomes (PLO)																		
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15				
CLR-1 :	Describe the basic principles of process calculation	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3				
CLR-2 :	Explain the concepts of Stoichiometry equations and material balances.				H	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLR-3 :	Illustrate the basics of Engineering thermodynamics and first law of thermodynamics				H	H	-	-	-	-	-	-	-	-	-	-	-	-	-	H	-	-	-
CLR-4 :	Interpret the Second law of thermodynamics and concept of entropy and its applications in chemical process				H	H	-	-	-	-	-	-	-	-	-	-	-	-	-	H	-	-	-
CLR-5 :	Write the rate equation and reactor design for processes				H	H	-	H	-	-	-	-	-	-	-	-	-	-	-	H	-	-	-
CLR-6 :	Formulate the material and energy balance for processes and carry out thermodynamic and kinetic analysis.				H	H	-	H	-	-	-	-	-	-	-	-	-	-	-	H	M	-	-
CLO-1 :	Do unit conversions and stoichiometric calculations	1	90	85																			
CLO-2 :	Perform material balance for different process	2	80	75																			
CLO-3 :	Calculate the heat and work requirement for processes	2	80	80																			
CLO-4 :	Analyze the feasibility of processes	2	75	70																			
CLO-5 :	Write the basic rate equation and basic design of ideal gas	2	80	75																			
CLO-6 :	Do the material and energy balance and calculate the thermodynamics parameters and kinetic parameters.	2	80	75																			

Duration (hour)	9	9	9	9	9
S-1	SLO-1	Units and dimensions	Fundamentals of stoichiometry	Chemical Engineering Thermodynamics	Ideal Gas Processes
	SLO-2	Unit conversions	limiting reactant, excess reactant, conversion, selectivity, yield	System, surrounding, boundary, Work, Energy, Heat, Internal energy	Equation for process calculations (for an ideal gas in any mechanically reversible closed system processes)
S-2	SLO-1	Problems solving on unit conversions	Problems solving on limiting and excess reactant	Intensive and Extensive properties	Problems solving on ideal gas
	SLO-2	Problems solving on unit conversion	Problems solving on conversion and selectivity	State and path functions	Problems solving on ideal gas
S-3	SLO-1	mole, mole fraction (or percent) and mass fraction (or percent)	Introduction to material balance	First Law of Thermodynamics-Mathematical statement	Statement of Second Law of Thermodynamics
	SLO-2	Problems solving on mole fraction and mass fraction	Steady state and unsteady state material balance	Limitations of First Law of Thermodynamics	Heat engine
S-4	SLO-1	concentrations	material balance - Drying	Reversible process, Equilibrium	Concept of Entropy
	SLO-2	molarity, molality, normality and ppm	Problems solving on drying	Types of Equilibrium	Mathematical statement of entropy
S-5	SLO-1	Density calculation	Problems solving on drying	Energy balance for closed system	Problems solving on entropy
	SLO-2	Problems solving on density calculation	Problems solving on drying with recycle	Energy balance for closed system	Problems solving on

S-6	SLO-1	concentrations	material balance - extraction	Reversible process, Equilibrium	Concept of Entropy	reaction rate-Arrhenius equation
	SLO-2	molarity, molality, normality and ppm	Problems solving on drying with recycle	Types of Equilibrium	Mathematical statement of entropy	Problems – To Calculate Activation Energy
S-7	SLO-1	Problems solving on molarity, molality and normality	Problems solving on extraction	Derivation for constant volume processes	Entropy change of an ideal gas undergoing a mechanical reversible process in a closed system	Reactor design -basics
	SLO-2	Problems solving on molality	Problems solving on extraction	Derivation for constant pressure processes	Entropy change of an ideal gas undergoing a mechanical reversible process in a closed system	Classification of ideal reactors for single reactions
S-8	SLO-1	Problems solving on Normality	material balance - Crystallization	Enthalpy	Problems solving on entropy change of an ideal gas	Ideal Batch reactor
	SLO-2	Problems solving on ppm	Problems solving on crystallization	Heat capacity: Derivation for heat capacity at constant volume and constant pressure processes	Problems solving on entropy change of an ideal gas in a closed system	Design of Ideal Batch Reactor
S-9	SLO-1	predicting P-V-T properties of gases using ideal gas law	Problems solving on crystallization with evaporator	Energy Balance for Steady state flow processes	Problems solving on entropy change of system	Space-Time and Space -velocity
	SLO-2	Problems solving on P-V-T properties of gases	Problems solving on crystallization with recycle stream	Energy Balance for Steady state flow processes	Third Law of Thermodynamics	Steady state mixed flow and plug flow reactor

Learning Resources	1. David M. Himmelblau, <i>Basic Principles and Calculations in Chemical Engineering</i> , 6 <sup>th</sup> ed., Prentice-Hall of India, 1998	3. Smith, J.M., Van Ness, H.C., Abbott, M.M., <i>Introduction to Chemical Engineering Thermodynamics</i> , 6 <sup>th</sup> ed., McGraw Hill International Edition, 2001
	2. Bhatt B.I., Vora S.M., <i>Stoichiometry</i> , 3 <sup>rd</sup> ed., Tata McGraw-Hill Publishing Company, 1996	4. Octave Levenspiel, <i>Chemical Reaction Engineering</i> , 3 <sup>rd</sup> ed., John Wiley & Sons India, 2011

Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#		Theory	Practice
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice		
Level 1	Remember Understand	40 %	-	30 %	-	30 %	-	30 %	-	30%	-
Level 2	Apply Analyze	40 %	-	40 %	-	40 %	-	40 %	-	40%	-
Level 3	Evaluate Create	20 %	-	30 %	-	30 %	-	30 %	-	30%	-
Total		100 %		100 %		100 %		100 %		100 %	

# CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1 Mr. A. Subramaniam, PESCO Beam Environmental Solutions Pvt. Ltd.	1. Dr. Lima Rose Miranda, Anna University email: limamiranda2007@gmail.com	1. Mr. K. Selvam, SRMIST
2. Mr. S. T. Kalaimani, CPCL, Chennai	2. Dr. T. R. Sundararaman, Rajalakshmi Engineering College,	2. Ms. S. Kiruthika, SRMIST

Course Code	18CHS252T	Course Name	CHEMICAL ENGINEERING PRINCIPLES	Course Category	S	Engineering Sciences	L	T	P	C
							3	0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Chemical Engineering	Data Book / Codes/Standards	Nil		

Course Learning Rationale (CLR):		The purpose of learning this course is to:			Learning			Program Learning Outcomes (PLO)															
					1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
					Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3	
CLR-1 :	Describe the various modes of heat transfer and evaluate the rate of steady state heat transfer			2	80	75	H	H	-	-	-	-	-	-	-	-	-	-	-	-	M	M	-
CLR-2 :	Explain and analyze the basic concepts of natural and forced convection as applied to various flows and geometry			2	80	75	H	H	-	-	-	-	-	-	-	-	-	-	-	-	M	M	-
CLR-3 :	Illustrate principles of mass transfer, Diffusion phenomena of mass transfer operations, mass transfer coefficients and calculate mass transfer rates			2	80	70	H	H	-	-	-	-	-	-	-	-	-	-	-	-	M	M	-
CLR-4 :	Elucidate the principles of drying, different types of driers and calculate drying time for different drying periods			2	80	70	H	H	H	-	-	-	-	-	-	-	-	-	-	-	M	M	-
CLR-5 :	Clarify the concept of distillation and various types of distillation and extraction			2	80	75	H	H	-	-	-	-	-	-	-	-	-	-	-	-	M	-	-
CLR-6 :	Introduce the basic principles of heat and mass transfer processes, and its applications			2	80	75	H	H	M	-	-	-	-	-	-	-	-	-	-	-	M	M	-
Course Learning Outcomes (CLO):		At the end of this course, learners will be able to:																					
CLO-1 :	Calculate the rate of heat transfer, and analyze steady state heat conduction.			2	80	75	H	H	-	-	-	-	-	-	-	-	-	-	-	-	M	M	-
CLO-2 :	Apply the basic concepts and calculate the heat transfer coefficient			2	80	75	H	H	-	-	-	-	-	-	-	-	-	-	-	-	M	M	-
CLO-3 :	Use mass transfer principles to solve simple diffusion problems			2	80	70	H	H	-	-	-	-	-	-	-	-	-	-	-	-	M	M	-
CLO-4 :	Calculate drying time for different types of dryer			2	80	70	H	H	H	-	-	-	-	-	-	-	-	-	-	-	M	M	-
CLO-5 :	Differentiate the various types of distillation and the basics of extraction			2	80	75	H	H	-	-	-	-	-	-	-	-	-	-	-	-	M	-	-
CLO-6 :	Explain the basic principles of heat and mass transfer processes, and its applications			2	80	75	H	H	M	-	-	-	-	-	-	-	-	-	-	-	M	M	-

Duration (hour)	9		9		9		9		9	
S-1	SLO-1	Introduction to various modes of heat transfer	Concept of heat transfer by convection. Natural and forced convection	Introduction to Mass Transfer operations	Introduction, Importance of drying in processes	Introduction to Distillation, principle				
	SLO-2	Concept of rate of heat transfer, heat flux.	Newton's law of cooling	Diffusion, Types, Ficks I law of Diffusion.	principles of drying, wet Basis, dry basis	Raoult's law				
S-2	SLO-1	Concept of resistance to heat transfer	Application of dimensional analysis for natural convection	Steady – state molecular diffusion in fluids at rest and in laminar flow: molecular diffusion in gases.	Free moisture, equilibrium moisture, bound and unbound moisture	relative volatility				
	SLO-2	Fourier's law of heat conduction	Significance of dimensionless numbers used in natural convection	Molecular diffusion in gases: steady state diffusion of A through non-diffusing B	Mechanism of drying	Methods of distillation: With reflux and without reflux condition				
S-3	SLO-1	Thermal conductivity	Application of dimensional analysis for forced convection	Problems solving using molecular diffusion	Constant and falling rate period	Types of distillation				
	SLO-2	Steady state heat conduction through a plane wall	Significance of dimensionless numbers used in forced convection	Gas phase equimolar counter diffusion. Diffusion in Multicomponent gas mixtures	Rate of drying curve, critical moisture content	Mechanism of batch distillation				
S-4	SLO-1	Tutorial	Empirical correlations for natural convection	Problems solving using equimolar counter diffusion	Calculation of drying time under constant drying conditions: constant rate period	Rayleigh's equation				
	SLO-2	Steady state heat conduction through a hollow cylinder	Problems solving using empirical correlations	Problems solving on diffusion in multicomponent gas mixtures	Calculation of drying time under constant drying conditions: falling rate period. Total drying time	Mechanism of flash distillation				



S-5	SLO-1	Problems solving on conduction	Problems solving using empirical correlations	Molecular diffusion in liquids: steady state diffusion of A through non-diffusing B	Problems solving using constant rate of drying condition	Operating line equation for flash distillation
	SLO-2	Problems solving on conduction	Empirical correlations for forced convection	Problems solving using molecular diffusion	Problems solving using falling rate of drying condition	Mechanism of steam distillation
S-6	SLO-1	Steady state heat conduction through a composite plane wall	Problems solving using empirical correlations	Problems solving using molecular diffusion	Problems solving using total drying rate of drying condition	Mechanism of vacuum distillation
	SLO-2	Problems solving on composite plane wall	Problems solving using empirical correlations	Liquid phase equimolar counter diffusion	Classification of dryers, solids handling in dryers	Mechanism of extractive distillation
S-7	SLO-1	Problems solving on hollow cylinder	Individual and overall heat transfer coefficient concept	Problems solving on equimolar counter diffusion	equipments for batch and continuous drying processes	Mechanism of azeotropic distillation
	SLO-2	Problems solving on concentric hollow cylinder	Fouling coefficients	Problems solving on equimolar counter diffusion	Working principle of tray drier	Comparison between extractive and azeotropic distillation
S-8	SLO-1	Steady state heat conduction through coaxial cylinders	Problems solving on individual heat transfer coefficient	Effect of temperature and pressure on diffusivity	Working principle of rotary drier	Mechanism of Continuous distillation
	SLO-2	Problems solving on coaxial cylinder	Problems solving on individual heat transfer coefficient	Problems solving on effect of temperature and pressure on diffusion	Working principle of spray drier	General principles of extraction
S-9	SLO-1	Problems solving on coaxial cylinder	Problems solving on overall heat transfer coefficient	Introduction to Mass transfer coefficients	Working principle of fluidized bed drier	Choice of a solvent
	SLO-2	Problems solving on coaxial cylinder	Problems solving on overall heat transfer coefficient	Types of mass transfer coefficients	Concept of freeze drying	Working principle of mixer-settler

Learning Resources	1. Warren L. McCabe, Julian C. Smith, Peter Harriott, Unit Operations of Chemical Engineering, 7 <sup>th</sup> ed., McGraw Hill Education, 2014	3. Binay K Dutta, Heat Transfer: Principles and Applications, PHI Publishers, Delhi, 2010
	2. Christie John Geankoplis, Transport Processes and Separation Process Principles (Includes Unit Operations), 4 <sup>th</sup> ed., Pearson India, 2015	4. Robert E. Treybal, Mass-Transfer Operations, 3 <sup>rd</sup> ed., McGraw Hill Education, 2012
		5. Binay K. Dutta, Principles of Mass transfer and Separation Processes, Prentice- Hall of India, 2007

Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#		Theory	Practice
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice		
Level 1	Remember	40 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Understand										
Level 2	Apply	40 %	-	40 %	-	40 %	-	40 %	-	40%	-
	Analyze										
Level 3	Evaluate	20 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

# CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
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1 Mr. A. Subramaniam, PESCO Beam Environmental Solutions Pvt. Ltd.	1. Dr. Lima Rose Miranda, Anna University email: limamiranda2007@gmail.com	1. Ms. E. Kavitha, SRMIST
2. Mr. S. T. Kalaimani, CPCL, Chennai	2. Dr. T. R. Sundararaman, Rajalakshmi Engineering College,	2. Ms. E. Poonguzhali, SRMIST

Course Code	18CHS204T	Course Name	ENGINEERING THERMODYNAMICS	Course Category	S	Engineering Sciences	L	T	P	C
							3	0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Chemical Engineering	Data Book / Codes/Standards	Nil		

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning			Program Learning Outcomes (PLO)																	
CLR-1 :	Describe the basic concepts and laws of thermodynamics, as applied to various systems and processes	1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15			
CLR-2 :	Illustrate the PVT behavior and various equation of state.	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3			
CLR-3 :	Explain the second law of thermodynamics and the concept of entropy				H	-	L	H	H	H	M	-	-	-	-	H	-	-	H	-	-	-
CLR-4 :	Demonstrate the thermodynamic properties and relations, and thermodynamic diagrams				H	M	M	M	H	H	M	-	H	L	L	L	H	M	M	L	M	
CLR-5 :	Elucidate the applications of thermodynamics concepts.				H	L	L	L	M	H	L	L	L	L	L	L	L	M	M	L	M	
CLR-6 :	Elucidate the concept of Energy balance and its applications				H	L	L	L	L	M	H	L	L	L	L	L	L	M	M	L	M	
Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:				1	90	85	H	L	L	L	L	M	H	L	L	L	M	M	L	M	
CLO-1 :	Comprehend the basic concepts and laws of thermodynamics as applied for different processes.	1	90	85	H	L	L	L	L	M	H	L	L	L	M	M	L	M				
CLO-2 :	Understand the volumetric behavior and calculate the properties using equation of state.	1	90	85	H	L	L	L	L	M	H	L	L	L	M	M	L	M				
CLO-3 :	Comprehend the second law of thermodynamics and the concept of entropy	1	90	85	H	L	L	L	L	M	H	L	L	L	M	M	L	M				
CLO-4 :	Derive the thermodynamic properties and relations and interpret the thermodynamic diagrams	2	90	85	H	L	L	L	L	M	H	L	L	L	M	M	L	M				
CLO-5 :	Apply the thermodynamic principles to various flow processes and refrigeration.	2	90	85	H	L	L	L	L	M	H	L	L	L	M	M	L	M				
CLO-6 :	Apply the conservation of energy in various chemical engineering processes.	2	90	85	H	L	L	L	L	M	H	L	L	L	M	M	L	M				

Duration (hour)	9		9		9		9		9	
S-1	SLO-1	Basic concepts of Engineering Thermodynamics.	PVT behavior of pure substances: PT diagram	Introduction to second law of thermodynamics	Fundamental Property relations for a homogeneous fluid of constant composition in a closed system	Duct flow of compressible fluids.				
	SLO-2	Work, heat and energy. Internal energy	PV diagram	Statements of second law of thermodynamics	Fundamental Property relations for a homogeneous fluid of constant composition in a closed system	Pipe flow				
S-2	SLO-1	Thermodynamic properties and its classification.	Ideal gas, equations for process calculations ( mechanically reversible process in closed system)	Heat Engine, Heat pump	Maxwell's relations and property estimation.	Nozzles				
	SLO-2	Process and its characterization	Isothermal process, isobaric process, isochoric process	Carnot's theorem	Maxwell's relations and property estimation.	Throttling process				
S-3	SLO-1	Equilibrium	Adiabatic process, and polytropic heat capacity	Carnot's cycle	Enthalpy and entropy as functions of T and P	Turbines				
	SLO-2	Reversible process	Problems solving on PVT behavior	Ideal-gas temperature scale	Enthalpy and entropy as functions of T and P	Compression processes: Compressors				
S-4	SLO-1	First law of thermodynamics	Problems solving on PVT behavior	Carnot's equation	Internal energy and entropy as functions of T and V.	Pumps				
	SLO-2	Energy balance for closed systems	Introduction to cubic equations of state:	Concept of entropy	Internal energy and entropy as functions of	Introduction to ejectors				

S-5	SLO-1	Problem solving on closed systems	Vander Waals equation	Entropy changes of an ideal gas in a closed system	T and V. Two-phase systems: temperature dependence of the vapor pressure of liquids	Power cycles
	SLO-2	Problem solving on closed systems	Redlich/Kwong equation	Entropy changes of an ideal gas in a closed system	Two-phase systems: temperature dependence of the vapor pressure of liquids	Rankine cycle.
S-6	SLO-1	Constant volume processes and Constant pressure processes.	Problems solving on equation of state	Problems solving on Carnot's equation	Problems solving on fundamental properties	Otto engine
	SLO-2	Enthalpy, heat capacity	Problems solving on equation of state	Problems solving on entropy	Problems solving on fundamental properties	Diesel engine
S-7	SLO-1	Problems solving on enthalpy	Virial equations of state,	Problems solving on entropy	Thermodynamic diagrams.	Principles of refrigeration
	SLO-2	Problems solving on heat capacity	Application of the virial equations	Mathematical statement of the second law	Joule Thomson expansion	Heat Pump
S-8	SLO-1	Energy balance for steady-state flow processes	Problems solving using Virial equation	Entropy balance for open systems	Joule Thomson expansion - applications.	Carnot refrigerator
	SLO-2	Energy balance for steady-state flow processes	Problems solving using Virial equation	Statement of the third law of thermodynamics.	Liquefaction processes	Vapor-compression cycle
S-9	SLO-1	Problems solving for open system	Theorem of corresponding states, acentric factor	Problems solving using third law of Thermodynamics	Linde liquefaction process	Absorption refrigeration
	SLO-2	Problems solving for open system	Problems solving using acentric factor	Problems solving using third law of Thermodynamics	Claude liquefaction process	Absorption refrigeration

Learning Resources	1. Smith, J.M., Van Ness, H.C., Abbott, M.M., Introduction to Chemical Engineering Thermodynamics, 7 <sup>th</sup> ed., McGraw Hill	2. Rao .Y.V.C. Chemical Engineering Thermodynamics, University Press (I) Ltd., 1997
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Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#		Theory	Practice
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice		
Level 1	Remember Understand	40 %	-	30 %	-	30 %	-	30 %	-	30%	-
Level 2	Apply Analyze	40 %	-	40 %	-	40 %	-	40 %	-	40%	-
Level 3	Evaluate Create	20 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Total	100 %		100 %		100 %		100 %		100 %	

# CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
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2. Mr. S. T. Kalaimani, CPCL, Chennai	2. Dr. T. R. Sundararaman, Rajalakshmi Engineering College,	2. Dr. S. Sam David, SRMIST

Course Code	18CSS201J	Course Name	ANALOG AND DIGITAL ELECTRONICS	Course Category	S	Engineering Sciences	L	T	P	C
							3	0	2	4

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Computer Science and Engineering	Data Book / Codes/Standards	Nil		

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning			Program Learning Outcomes (PLO)																	
CLR-1 :	Identify the applications of analog electronics	1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15			
CLR-2 :	Identify the applications of digital logic families	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3			
CLR-3 :	Design the combinational and sequential logic circuits				H	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLR-4 :	Implement the combinational and sequential logic circuits				H	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLR-5 :	Analyze the design of counters and registers				H	-	H	H	-	-	-	-	-	-	-	-	-	-	H	-	-	-
CLR-6 :	Utilize the concepts in real time scenarios				H	-	H	H	H	H	-	-	-	-	-	-	-	-	-	-	-	-
					2	85	75	-	-	H	H	-	H	-	-	H	-	H	-	-	-	-
Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	3	80	70	-	-	H	H	-	H	-	-	H	-	H	-	-	-	-			
CLO-1 :	Identify the analog and digital components in circuit design	1	80	70																		
CLO-2 :	Analyze the combinational and sequential logic circuits	2	85	75																		
CLO-3 :	Apply gates and flip-flops in circuit design	2	75	70																		
CLO-4 :	Use simulation package and realize	2	85	80																		
CLO-5 :	Apply HDL code and synthesize	2	85	75																		
CLO-6 :	Build the circuits in bread board and demonstrate and FGPA	3	80	70																		

		Introduction to Analog electronics	Logic Families	Combinational Logic Circuits	Sequential Logic circuits	Registers & Counters
Duration (hour)		15	15	15	15	15
S-1	SLO-1	Characteristics of BJT (CB, CE and CC configurations) and DC biasing	Transistor as a Switch	Quine-McCluskey minimization technique	Sequential circuits, Latch and Flip-Flops	Registers and Types of Registers- Serial In - Serial Out, Serial In - Parallel out
	SLO-2	BJT Uses	Characteristics of Digital ICs	Combinational Circuits	RS Flip-Flops,	Parallel In - Serial Out, Parallel In - Parallel Out
S-2	SLO-1	Characteristics and uses of JFET (CS, Common Drain and Common Gate)	DL, RTL	Multiplexer	Gated Flip-Flops	Universal Shift Register
	SLO-2	Differences between BJT and JFET	DTL,TTL	Demultiplexer	Edge-triggered RS FLIP-FLOP	Applications of Shift Registers
S-3	SLO-1	Transistor Amplifier: CE amplifier	ECL	Decoder	Edge-triggered D FLIP-FLOPs	Synchronous Counters
	SLO-2	Transistor Amplifier: CC ,CB amplifier	ILL	Encoder	Edge-triggered T FLIP-FLOPs	Asynchronous Counters
S-4-5	SLO-1	Lab 1: Design and Implement Half and Full Wave Rectifiers using simulation	Lab 4: Design and implement transistor as a switch	Lab 7: Design and implement code converters using logic gates simulation	Lab 10: HDL implementation of Flip-Flop	Lab 13: Implement SISO, SIPO, PISO and PIPO shift registers using Flip- flops
	SLO-2	Power Amplifiers: Different classes of Amplifiers and its operation-Class A	Characteristics and uses of MOSFET (CS, Common drain and Common gate)	Binary adder	Edge-triggered JK FLIPFLOPs	Changing the Counter Modulus
S-6	SLO-1	Class B, AB and C	MOSFET Logic	Binary adder as subtractor	JK Master-slave FLIP-FLOP	Decade Counters
	SLO-2	Operational Amplifiers: Ideal v/s practical Op-amp	PMOS,NMOS	Carry look ahead adder	Analysis of Synchronous Sequential Circuit, State Equation, State table	Presetable counters

	SLO-2	Performance Parameters	CMOS Logic	Decimal adder	State Diagram	Counter Design as a Synthesis problem
S-8	SLO-1	Applications: Peak detector, Comparator, Inverting, Non-Inverting Amplifiers	Propagation delay	Magnitude Comparator	Synthesis of sequential circuit using Flip-Flops	Seven segment Display and A Digital Clock.
	SLO-2	Problem solving session	Problem solving session	Problem solving session	Problem solving session	Problem solving session
S-9-10	SLO-1	Lab 2: Design and implement Schmitt trigger using Op-Amp (simulation)	Lab 5: Design CMOS Inverter, measure propagation delay for rising & falling edge	Lab 8: Design and implement using simulation the combinational circuits	Lab 11: Design and implement using simulation; Synchronous sequential circuits	Lab 14: HDL for Registers and Counters
	SLO-2	Effect of positive and Negative Feedback Amplifiers,	Tristate Logic	Read Only Memory	Asynchronous sequential circuit	D/A Conversion
S-11	SLO-1	Analysis of Practical Feedback Amplifiers	Tristate Logic Applications	Arithmetic Logic Unit	Transition Table	Types of D/A Converters
	SLO-2	Oscillator Operation	FPGA Basics	Programmable Logic Arrays	State table	Problem
S-12	SLO-1	Crystal Oscillator	Introduction to HDL and logic simulation	HDL Gate and Data Flow modeling	Flow table	A/D Conversion
	SLO-2	Overview of UJT, Relaxation Oscillator, 555 Timer	HDL System primitives, user defined primitives, Stimulus to the design	HDL Behavioral modeling	Analysis of asynchronous sequential circuits	Types of A/D conversion
S-13	SLO-1	Problem solving session	Problem solving session	Problem solving session	Problem solving session	Problem solving session
	SLO-2	Lab 3: Design and implement using simulator a rectangular waveform generator (Op-Amp relaxation oscillator)	Lab 6: HDL Program to realize delay and stimulus in simple circuit	Lab 9: HDL program for combinational circuits	Lab 12: HDL program for Sequential circuits	Lab 15: Design and Implement an A/D Converter.

Learning Resources	1. Robert L. Boylestad & Louis Nashelsky, <i>Electronic Devices &amp; Circuit Theory</i> , 11th ed., Pearson, 2013	4. Douglas A, G.K. Kharate, <i>Digital Electronics</i> , Oxford university Press, 2012
	2. Anil K Maini, Varsha Agarwal: <i>Electronic Devices and Circuits</i> , Wiley, 2012	5. M. Morris R. Mano, Michael D. Ciletti, <i>Digital Design: With an Introduction to the Verilog HDL, VHDL, and SystemVerilog</i> , 6th ed., Pearson, 2018
	3. Paul Tuinenga, <i>SPICE: A Guide to Circuit Simulation and Analysis Using PSpice</i> , 3rd ed., Prentice-Hall, 1995,	6. A.P. Malvino, <i>Electronic Principles</i> , 7th Edition, Tata Mcgraw Hill Publications, 2013

Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#		Theory	Practice
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice		
Level 1	Remember	20%	20%	15%	15%	15%	15%	15%	15%	15%	15%
	Understand										
Level 2	Apply	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%
	Analyze										
Level 3	Evaluate	10%	10%	15%	15%	15%	15%	15%	15%	15%	15%
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

# CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Dr. Devi Jayaraman, Virtusa, devij@virtusa.com	1. Dr. J. Dhalia Sweetlin, Anna University, jdsweetlin@mitindia.edu	1. Dr. Annapurani Panaiyappan.K, SRMIST
2. Dr. Viswanadhan, Teken BIM Technologies, viswanathan_alladi@yahoo.com	2. Dr. B. Latha, Sairam Engineering College, hod.cse@sairam.edu.in	2. Dr. D. Anitha, SRMIST
		3. Ms. Kayalvizhi J, SRMIST

Course Code	18CSS202J	Course Name	COMPUTER COMMUNICATIONS	Course Category	S	Engineering Sciences	L	T	P	C
							2	0	2	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Computer Science and Engineering		Data Book / Codes/Standards	Nil	

Course Learning Rationale (CLR):	The purpose of learning this course is to:			Learning			Program Learning Outcomes (PLO)														
CLR-1 :	Understand the basic services and concepts related to Internetwork			1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CLR-2 :	Understand the layered network architecture			Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3
CLR-3 :	Acquire knowledge in IP addressing																				
CLR-4 :	Exploring the services and techniques in physical layer																				
CLR-5 :	Understand the functions of Data Link layer																				
CLR-6 :	Implement and analyze the different Routing Protocols																				
Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:																				
CLO-1 :	Apply the knowledge of communication			3	85	75	H	-	H	-	-	-	-	-	-	-	-	-	M	-	-
CLO-2 :	Identify and design the network topologies			3	75	70	H	H	-	-	-	-	-	-	-	-	-	-	M	-	M
CLO-3 :	Design the network using addressing schemes			1	85	80	H	H	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-4 :	Identify and correct the errors in transmission			1	85	75	H	-	-	H	-	-	-	-	-	-	-	-	-	-	-
CLO-5 :	Identify the guided and unguided transmission media			3	80	70	H	H	H	H	H	-	-	-	-	-	-	-	M	-	M
CLO-6 :	Design and implement the various Routing Protocols																				

Duration (hour)	12		12		12		12		12	
S-1	SLO-1	Evolution of Computer Networks, Network categories	IPv4 Addressing, Address space	Line coding: Unipolar scheme	Framing, Flow Control Mechanisms	Forward Techniques, Forwarding Process				
	SLO-2	Data Transmission Modes, Network topologies	Dotted Decimal Notation, Classful Addressing	Polar schemes, Bipolar schemes	Sender side Stop and Wait Protocol, Receiver side Stop and Wait Protocol	Routing Table				
S-2	SLO-1	Circuit Switching and Packet Switching	Subnet Mask	Amplitude shift keying, Frequency shift keying	Goback N ARQ, Selective Reject ARQ	Intradomain Routing and Interdomain Routing				
	SLO-2	Protocols and standards	Subnetting	Phase shift keying, Pulse code Modulation, Delta Modulation	CRC, Checksum	Static Routing and Dynamic Routing				
S-3-4	SLO-1	Lab 1: IP Addressing	Lab 4: Router Configuration (Creating Passwords, Configuring Interfaces)	Lab 7: RIP v1	Lab 10: EIGRP Authentication and Timers	Lab 13: Examining Network Address Translation (NAT)				
	SLO-2									
S-5	SLO-1	Layers in the OSI model, Functions of Physical layer, data link layer	Special Addresses	Multiplexing: FDM	Types of Errors	Distance Vector Routing, Problem Solving				
	SLO-2	Functions of Network layer, Transport layer	Special Addresses	Multiplexing: FDM	Types of Errors	Link state Routing				
S-6	SLO-1	Functions of Session, Presentation layer and Application layer	Classless Addressing	TDM	Forward Error correction	Problem solving				
	SLO-2	TCP/IP protocol suite, Link layer protocols	Problem Solving	WDM	CSMA, CSMA/CD	Path vector Routing				

S 7-8	SLO-1 SLO-2	Lab 2: Subnetting (VLSM)	Lab 5: Basic Switch Configuration: Vlan	Lab 8: RIP v2	Lab 11: Single-Area OSPF Link Costs and Interface	Lab 14: BGP Configuration
S-9	SLO-1	Network layer protocols	Private Address, NAT, Supernetting	Guided Media: Twisted Pair, Coaxial Cable Fiber optic cable	Hamming Distance	RIP v1,RIP v2
	SLO-2	Transport layer protocols	Hub, Repeaters, Switch	Unguided media: Radio waves	Correction Vs Detection	OSPF
S-10	SLO-1	Serial and Parallel Transmissions	Bridge	Microwaves	HDLC	EIGRP
	SLO-2	Addressing	Structure of Router	Infrared	PPP	BGP
S 11-12	SLO-1 SLO-2	Lab 3: LAN Configuration using straight through and cross over cables	Lab 6: Static and Default Routing	Lab 9: EIGRP Configuration, Bandwidth, and Adjacencies	Lab 12: Multi-Area OSPF with Stub Areas and Authentication	Lab 15: Configuring Static and Default Routes

Learning Resources	1.	Behrouz A. Forouzan, "Data Communications and Networking" 5th ed., 2010	3.	William Stallings, Data and Computer Communications, 9th ed., 2010
	2.	Bhushan Trivedi, "Data Communication and Networks" 2016	4.	Todd Lammle, CCNA Study Guide, 7th ed. 2011

Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember Understand	20%	20%	15%	15%	15%	15%	15%	15%	15%	15%
Level 2	Apply Analyze	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%
Level 3	Evaluate Create	10%	10%	15%	15%	15%	15%	15%	15%	15%	15%
	Total	100 %		100 %		100 %		100 %		100 %	

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Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Dr. Viswanadhan, Teken BIM Technologies, viswanathan_alladi@yahoo.com	1. Dr. J. Dhalia Sweetlin, Anna University, jdsweetlin@mitindia.edu	1. Mrs. T. Manoranjtham, SRMIST
2. Dr. Devi Jayaraman, Virtusa, devij@virtusa.com	2. Dr. B. Latha, Sairam Engineering College, hod.cse@sairam.edu.in	2. Mr. J. Godwin Ponsam, SRMIST Dr. J.S. Femilda Josephin, SRMIST

Course Code	18ECS201T	Course Name	CONTROL SYSTEMS	Course Category	S	Engineering Sciences	L	T	P	C
							3	0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	18ECC104T	Progressive Courses	Nil
Course Offering Department	Electronics and Communication Engineering		Data Book / Codes/Standards	Nil	

Course Learning Rationale (CLR):	The purpose of learning this course is to:
CLR-1 :	Learn about mathematical modeling techniques of mechanical and electrical systems
CLR-2 :	Impart knowledge about the transient and steady state error and analysis
CLR-3 :	Identify and analyze stability of a system in time domain using root locus technique
CLR-4 :	Know about different frequency domain analytical techniques
CLR-5 :	Acquire the knowledge of a controller for specific applications
CLR-6 :	Impart knowledge on controller tuning methods

Learning		
1	2	3
Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)

Program Learning Outcomes (PLO)														
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO-1: Professional Achievement	PSO-2: Project Management Techniques	PSO-3: Analyze & Research

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:
CLO-1 :	Determine Transfer function of a system by mathematical modeling, block diagram reduction and signal flow graphs
CLO-2 :	Identify the standard test inputs, time domain specifications and calculate steady state error
CLO-3 :	Plot a root locus curve and analyze the system stability using Routh array
CLO-4 :	Analyze the frequency domain specifications from bode and polar plots
CLO-5 :	Design a closed loop control system for specific application
CLO-6 :	Identification of controller parameters and tuning

1,2	80	80
1,2	85	80
2,3	90	85
2,3	90	85
1,2,3	80	80
1,2,3	85	85

H	H	-	-	-	-	-	-	-	-	-	-	H	-	-
H	H	-	-	-	-	-	-	-	-	-	-	H	-	-
H	H	-	-	-	-	-	-	-	-	-	-	H	-	-
H	H	-	-	-	-	-	-	-	-	-	-	H	-	-
H	H	-	-	-	-	-	-	-	-	-	-	H	-	-

Duration (hour)	9		9		9		9		9	
S-1	SLO-1	Open and closed loop control system	Standard test signals and their expression	Poles and zeros of a system	Frequency domain analysis	Controllers-Significance and Need				
	SLO-2	Feedback and Feed forward control systems	Type number and order of a system	Pole zero plot and concept of s plane	Frequency domain specifications	Stability of closed loop systems				
S-2	SLO-1	Transfer function of a system and basis of Laplace transforms	Transfer function of First order system for Step and ramp signal	Proper, Strictly Proper and Improper systems	Frequency domain plots, minimum and non minimum phase systems	SISO and MIMO control systems				
	SLO-2	Need for mathematical modeling	Transfer function of First order system Impulse and parabolic signal	Characteristic equation	Correlation between time and frequency domain	Types of controllers-ON-OFF,P,I,D				
S-3	SLO-1	Representation of mechanical translational systems using differential equation and determination of transfer function	General transfer function of second order system	Concept of stability from pole zero location	Bode plot approach and stability analysis	Composite Controller-PI,PD and PID				
	SLO-2		Identification of damping factor and classification based on it	Need for Stability analysis and available techniques	Rules for sketching bode plot	Controller parameters and tuning methods				
S-4	SLO-1	Representation of mechanical rotational systems and determination of transfer function	Step response of critically damped second order system	Necessary and sufficient Condition for stability	Bode plot of typical systems	Design Specification, controller configurations- ON-OFF controller				
	SLO-2		Step response of under damped second order system	Significance of Routh Hurwitz Technique						



S-5	SLO-1	Conversions of Mechanical system to Electrical system	Step response of over damped second order system	Computation of Routh array	Bode plot of typical systems	Design Specification, controller configurations-PID controller
	SLO-2	f-V and f-I electrical analogies	Step response of undamped second order system	Routh array of stable systems		
S-6	SLO-1	Block diagram reduction rules and methodology	Time domain specifications and their significance	Routh array of Unstable systems	Polar plot and significance	Design of speed control system for DC motor
	SLO-2		Numerical solution	Routh array of Unstable systems	Nyquist stability criterion	
S-7	SLO-1	Evaluation of transfer function using block diagram reduction	Transient and steady state error analysis	Root locus technique	Sketching of polar plot on polar graphs	Design of control system for Twin Rotor Multi input Multi output System(TRMS) with one degree of freedom
	SLO-2		Static and dynamic Error coefficients	Rules for sketching root locus		
S-8	SLO-1	Signal flow graphs and evaluation of transfer function	Static error constants and evaluation of steady state error	Root locus plot of typical systems	Polar plot of typical systems	Case study 1
	SLO-2					
S-9	SLO-1	Block diagram to signal flow conversion	Dynamic error constants and evaluation of steady state error	Root locus plot of typical systems	Polar plot of typical systems	Case study 2
	SLO-2					

Learning Resources	<ol style="list-style-type: none"> <li>Nagrath.J and Gopal.M., "Control System Engineering", 5<sup>th</sup> Edition, New Age, 2007</li> <li>Benjamin C Kuo, "Automatic Control System", 9<sup>th</sup> edition, John Wiley &amp; Sons, 2010</li> <li>Gopal.M, "Control System Principles and Design", 2<sup>nd</sup> Edition, TMH, 2002</li> <li>Sivanandam and Deepa, "Control system Engineering using MATLAB", 2<sup>nd</sup> edition, Vikas publishers, 2007</li> </ol>
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Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#		Theory	Practice
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice		
Level 1	Remember Understand	40 %	-	30 %	-	30 %	-	30 %	-	30%	-
Level 2	Apply Analyze	40 %	-	40 %	-	40 %	-	40 %	-	40%	-
Level 3	Evaluate Create	20 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Total	100 %		100 %		100 %		100 %		100 %	

# CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Mr. Anuj Kumar, Bombardier Transportation, Ahmedabad, kumaranuj.ani@gmail.com	1. Dr. Meenakshi, Professor of ECE, CEG, Anna University, meena68@annauniv.edu	Dr. T. Deepa, SRMIST
2. Mr. Hariharasudhan - Johnson Controls, Pune, hariharasudhan.v@jci.com	2. Dr. Venkatesan, Sr. Scientist, NIOT, Chennai, venkat@niot.res.in	Mrs. R. Bakhya Lakshmi, SRMIST

Course Code	18MES201T	Course Name	ENGINEERING MECHANICS			Course Category	S	Engineering Sciences							L	T	P	C						
													3	1	0	4								
Pre-requisite Courses	Nil		Co-requisite Courses	Nil		Progressive Courses	Nil																	
Course Offering Department	Mechanical Engineering			Data Book / Codes/Standards			Nil																	
Course Learning Rationale (CLR):	The purpose of learning this course is to:					Learning			Program Learning Outcomes (PLO)															
CLR-1 :	Construct mathematical models, formulate and solve static equilibrium problems in engineering and its applications					1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
CLR-2 :	Utilize theory of dry friction in Mechanical Engineering applications					Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3	
CLR-3 :	Utilize the concept of centroid and moment of inertia in engineering problems and its applications																							
CLR-4 :	Solve problems on kinematics and kinetics of particles																							
CLR-5 :	Solve problems on kinematics and kinetics of rigid bodies																							
CLR-6 :	Apply static and dynamic equilibrium of particles and rigid bodies																							
Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:																							
CLO-1 :	Solve statically determinate equilibrium problems in the field of Engineering					2	80	75	H	H	M	M	M	L	L	L	L	L	L	L	L	L	L	
CLO-2 :	Solve problems related to dry friction and analyze machines that are functioning based on the theory of friction					2	85	75	H	H	M	M	M	L	L	L	L	L	L	L	L	L	L	
CLO-3 :	Determine centroid and moment of inertia for composite objects					2	85	75	H	H	M	M	M	L	L	L	L	L	L	L	L	L	L	
CLO-4 :	Analyze kinematics of particles with rectilinear, curvilinear motions, solve dynamic equilibrium problems in particles					2	80	75	H	H	M	M	M	L	L	L	L	L	L	L	L	L	L	
CLO-5 :	Analyze kinematics of rigid bodies with translation, rotation, general plane motion, solve dynamic equilibrium in rigid bodies					2	80	75	H	H	M	M	M	L	L	L	L	L	L	L	L	L	L	
CLO-6 :	Solve static and dynamic equilibrium of particle and rigid body problems					2	75	70	H	H	M	M	M	L	L	L	L	L	L	L	L	L	L	
Duration (hour)	12		12		12		12		12		12		12											
S-1	SLO-1	Introduction to Mechanics, classification of mechanics	Friction and its types, Laws of Friction, coefficient of friction	Centre of Gravity and Centroids of lines, areas	Rectilinear motion, with non-uniform velocity and acceleration motion	Kinematics of rigid bodies: Translation and rotation of rigid bodies,																		
	SLO-2	Fundamental concepts and principles of engineering mechanics	Angle of Friction, Angle of repose, limiting friction	Centre of Gravity and Centroids of volumes	Uniform velocity and uniform acceleration motion	Fixed axis rotation - determination of angular displacement, velocity and acceleration																		
S-2	SLO-1	Concurrent forces in a plane, Coplanar forces	Equilibrium of a block resting on a rough inclined plane	Determination of centroid of line by integration	Curvilinear motion, Normal, tangential, radial	General plane motion																		
	SLO-2	Vector approach on addition, subtraction of forces	Range of force required to maintain equilibrium of block on rough inclined plane	Determination of area by integration	transverse components of acceleration	Relative motion method																		
S-3	SLO-1	Resolution of forces	Example problems on dry friction	Centroid of composite lines	Projectile motion, terminology	Velocity analysis of rigid bodies using relative velocity method																		
	SLO-2	Resultant of several concurrent forces in plane (vector approach)	Applications of friction in wedges	Centroid of composite areas	Derivation of equation of trajectory of a projectile	Velocity analysis of rigid bodies using relative velocity method																		
S-4	SLO-1	Tutorial on resultant of several concurrent forces	Tutorial on dry and wedge friction	Tutorial on centroid of composite line and area	Tutorial on Projectile motion	Tutorials on velocity analysis of general plane motion using relative velocity method																		
	SLO-2	Equilibrium of Particle, Free body diagram, Forces in planes, Lami's theorem	Application of friction in Ladder	Determination of centroid of volume by integration	Relative motion	Acceleration analysis of rigid bodies using relative acceleration method																		
S-5	SLO-1	Problems on equilibrium of particle in planes	Example problems	Determination of centroid of volume by integration	constrained motion	Acceleration analysis of rigid bodies using relative acceleration method																		
	SLO-2	Forces in space: resultant of concurrent	Application of friction in flat and V-belts,	Determination of centroid of composite	Newton's second law of motion,	Instantaneous center of rotation in plane																		

		forces in space	Ratio of belt tensions	volume	D'Alembert's principle	motion
	SLO-2	Problems on equilibrium of particle in space	Application of friction in V-belts, Ratio of belt tensions	Theorems of Pappus & Guldinus	Problems using Newton's second law	examples
S-7	SLO-1	Statics of rigid body, Principle of transmissibility	Application of friction in screw jack	Determination of moment of inertia of area by integration	Principle of work and energy	Velocity analysis of rigid bodies using Instantaneous center method
	SLO-2	Moment of a force, Varignon's Theorem and its applications	Terminology in screws, self-locking of screw jack	Determination of moment of inertia of area by integration	conservative forces, law of conservation of energy	Velocity analysis of rigid bodies using Instantaneous center method
S-8	SLO-1	Tutorials on Moment of force and couple system	Tutorial on Screw and belt friction	Tutorial on area moment of Inertia of composite section	Tutorial on principle of work energy	Tutorial on Velocity analysis of rigid bodies using Instantaneous center of rotation
	SLO-2					
S-9	SLO-1	Reduction of system of forces into single force and couple system	Effort, Mechanical advantage of a screw jack	Radius of gyration	Principle of impulse and momentum	kinetics of rigid bodies, Angular momentum
	SLO-2	Reduction of system of forces into single force and couple system	efficiency of a screw jack	Parallel and perpendicular axis theorems	problems on Impulsive motion	Newton's second law
S-10	SLO-1	Resultant of non-concurrent forces in plane	Problems on simple screw jack	Derivation of Mass moment of inertia of plate, prism	Problems on impulse	Problems using Newton's second law
	SLO-2	Types of supports and reactions	Problems on simple screw jack	Derivation of Mass moment of inertia of cylinder	Problems on momentum principle	Problems using Newton's second law
S-11	SLO-1	Equilibrium of rigid bodies in two dimensions	Problems on differential screw jack	Derivation of Mass moment of inertia of cone	Impact of elastic bodies, direct central	Kinetics of rigid bodies using work energy principle
	SLO-2	Equilibrium of rigid bodies in two dimensions	Problems on differential screw jack	Derivation of Mass moment of inertia of sphere	oblique central impact of elastic bodies	Kinetics of rigid bodies using work energy principle
S-12	SLO-1	Tutorial on Equilibrium of a two-force body	Tutorial on simple and differential screw jack	Tutorial on determination of mass moment of inertia of composite bodies	Tutorial on oblique central impact of elastic bodies	Tutorial on rigid bodies using work- energy principle
	SLO-2					

Learning Resources	1. Ferdinand.P. Beer. E, Russell Johnston Jr., David Mazurek, Philip J Cornwell, Vector Mechanics for Engineers: Statics and Dynamics, McGraw - Hill, 10 <sup>th</sup> ed., 2013	3. Russel C Hibler, Engineering Mechanics: Statics, Dynamics, Pearson, 14 <sup>th</sup> ed., 2015
	2. Meriam J.L and Kraige L.G., Engineering Mechanics, Volume I - statics, Volume II - dynamics, John Wiley & Sons, 7 <sup>th</sup> ed., 2012	4. Shames.I.H, Krishna MohanaRao.G, Engineering Mechanics (Statics and Dynamics), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education), 2006
		5. Timoshenko, Young, Engineering Mechanics, Tata Mc-Graw Hill, 5 <sup>th</sup> ed., 2013

Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#		Theory	Practice
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice		
Level 1	Remember	40 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Understand										
Level 2	Apply	40 %	-	40 %	-	40 %	-	40 %	-	40%	-
	Analyze										
Level 3	Evaluate	20 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

# CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Dr. R. Kalimuthu, ISRO, Mahendragiri, r_kalimuthu@vssc.gov.in, rkpearls@yahoo.com	1.Dr. Shankar Krishnapillai, IIT Madras, skris@iitm.ac.in	1. Dr P. Nandakumar, SRMIST
2. Dr. A. Velayutham, DRDO, Avadi, velayudham.a@cvrde.drdo.in	2.Dr. K. Jayabal, IIITDM, Kancheepuram, jayabal@iiitdm.ac.in	2. Dr. S. H. Venkatasubramanian, SRMIST

Course Code	18MHS201T	Course Name	THERMODYNAMICS AND HEAT TRANSFER	Course Category	S	Engineering Sciences			
						L	T	P	C
						3	0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Mechatronics Engineering			Data Book / Codes/Standards	Nil

Course Learning Rationale (CLR):	The purpose of learning this course is to:			Learning			Program Learning Outcomes (PLO)																																
CLR-1 :	Utilize the thermodynamic processes with the help of P-V and T-S diagram			1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15																		
CLR-2 :	Utilize second law of thermodynamics and the performance of Heat pump, engine and refrigeration system			Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3																		
CLR-3 :	Utilize the properties of air and the working principle of different air conditioning and refrigeration system																					H	H	M	M	L	L	L	L	L	L	L	L	L	L	H	M	M	M
CLR-4 :	Solve the basic calculations involving conduction and convection in Mechatronics system																					H	H	M	M	L	L	L	L	L	L	L	L	L	L	H	M	M	M
CLR-5 :	Identify applications of heat transfer in mechatronics systems, study heat requirements of gas turbines and IC engines.																					H	H	M	M	L	L	L	L	L	L	L	L	L	L	H	M	M	M
CLR-6 :	Utilize fundamentals of thermodynamics and its application in Mechatronics system																					H	H	M	M	L	L	L	L	L	L	L	L	L	L	H	M	M	M
Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:																					2	75	70	H	H	M	M	L	L	L	L	L	L	L	H	M	M	M
CLO-1 :	Identify and describe the energy exchange processes in engineering systems.			2	75	70	H	H	M	M	L	L	L	L	L	L	L	H	M	M	M																		
CLO-2 :	Understand the second law of thermodynamics and its application to a wide range of systems			2	75	70	H	H	M	M	L	L	L	L	L	L	L	H	M	M	M																		
CLO-3 :	Extrapolate the psychrometric properties and performance of refrigeration and air conditioning systems			2	75	70	H	H	M	M	L	L	L	L	L	L	L	H	M	M	M																		
CLO-4 :	Extrapolate the different modes of heat transfer like conduction, convection and radiation.			2	75	70	H	H	M	M	L	L	L	L	L	L	L	H	M	M	M																		
CLO-5 :	Analyze the heat transfer in refrigeration and air-conditioning systems, internal combustion engine and heat exchangers.			3	75	70	H	H	M	M	L	L	L	L	L	L	L	H	M	M	M																		
CLO-6 :	Understand the basic laws of thermodynamics and its applications in different engineering systems			3	75	70	H	H	M	M	L	L	L	L	L	L	L	H	M	M	M																		

Duration (hour)	12		12		12		12		12	
S-1	SLO-1	Introduction to thermodynamics	Second law of thermodynamics	Introduction to psychrometric properties	Introduction to heat transfer	Introduction to IC engine and engine components				
	SLO-2	Statistical and classical approach.	Kelvin Planck statement, Clausius statement	Dry air, moist air, dry bulb temperature.	Modes of heat transfer: Conduction, convection and radiation	Working principle of two and four stroke of SI and CI engine				
S-2	SLO-1	Thermodynamic system, properties, processes and cycles.	Reversible and irreversible processes	Wet bulb temperature, dew point temperature, specific humidity	Fourier law of conduction	Modes of Heat transfer in IC engine				
	SLO-2	Thermodynamic equilibrium: Mechanical, chemical and thermal equilibrium.	Second law aspects of heat engine	Calculations of vapor mixtures	General heat conduction equation in Cartesian co-ordinates.	Heat transfer and Engine energy balance				
S-3	SLO-1	Quasi-static process, Work and heat transfer	Performance of heat engine	Introduction to Psychrometric chart	Heat stored in the element, heat Conduction with internal heat generation	Problems on heat transfer in IC engine				
	SLO-2	Problems on Work and heat transfer	Second law aspects of refrigerator	Psychrometric processes.	Plane wall and cylinder with uniform heat generation	Principle of Heat flux measurement in IC engine				
S-4	SLO-1	zeroth law of thermodynamics	CoP of refrigerator	Sensible heating process	Heat Conduction through plane wall	Introduction to turbine, Classifications of turbines				
	SLO-2	First law of thermodynamics.	Second law aspects of heat pump	Sensible cooling process	Heat Conduction through composite wall	Merits, demerits and its applications of gas turbine				

S-5	SLO-1	First law of thermodynamics applied to closed systems	CoP of heat pump	Humidification and dehumidification	Heat Conduction through hollow Cylinder	Evaluation of Thermodynamics model in pneumatic cylinder
	SLO-2	Isoobaric process	Problems on combination of heat engine, heat pump and refrigerator	Cooling and dehumidification	Heat Conduction through composite cylinder	Analysis of heat transfer between the air and the cylinder wall
S-6	SLO-1	Isochoric process	Clausius inequality	Adiabatic mixing	Heat Conduction through hollow Sphere	Conduction heat transfer in Electronics equipment heat sink
	SLO-2	Isothermal process	concept of entropy	Solving problems by using psychrometric chart	Heat Conduction through composite Sphere	Convection heat transfer in electronics equipment heat sink
S-7	SLO-1	Isetropic process	Entropy changes in different thermodynamics processes	Solving problems on sensible heating process	Introduction about convection	Introduction to heat exchanger and its types
	SLO-2	Polytropic process	Entropy changes in isobaric process	Solving problems on sensible cooling process	Characteristics parameters in free convection	Heat transfer analysis in heat exchangers
S-8	SLO-1	First law of thermodynamics applied to open systems	Entropy changes in Isochoric process	Solving problems on adiabatic mixing Elements of refrigeration systems.	Empirical correlations for free convection with horizontal plate	Analysis of heat transfer in refrigeration
	SLO-2	Steady flow energy equation for boiler, turbine and heat exchanger	Entropy changes in Isothermal process	Coefficient of performance	Empirical correlations for free convection with horizontal Cylinder	Analysis of heat transfer in Air conditioning system
S-9	SLO-1	Steady flow energy equation for turbine.	Problems on Entropy changes in different thermodynamics processes	Air-conditioning systems	Forced convection with laminar flow over a flat plate	Heat transfer problems on refrigeration system
	SLO-2	Limitations of first law of thermodynamics	Problems on Entropy changes in combined processes	Open and closed system.	Forced convection with Turbulent flow over a flat plate	Heat transfer problems on Air conditioning system
S-10	SLO-1	Introduction to thermodynamics	Second law of thermodynamics	Introduction to psychrometric properties	Introduction to heat transfer	Introduction to IC engine and engine components.
	SLO-2	Statistical and classical approach.	Kelvin Planck statement, Clausius statement	Dry air, moist air, dry bulb temperature.	Modes of heat transfer: Conduction, convection and radiation.	Working principle of two and four stroke of SI and CI engine
S-11	SLO-1	Thermodynamic system, properties, processes and cycles.	Reversible and irreversible processes	Wet bulb temperature, dew point temperature, specific humidity.	Fourier law of conduction	Modes of Heat transfer in IC engine
	SLO-2	Thermodynamic equilibrium: Mechanical, chemical and thermal equilibrium.	Second law aspects of heat engine	Calculations of vapor mixtures	General heat conduction equation in Cartesian co-ordinates.	Heat transfer and Engine energy balance
S-12	SLO-1	Quasi-static process, Work and heat transfer	Performance of heat engine	Introduction to Psychrometric chart	Heat stored in the element, heat Conduction with internal heat generation	Problems on heat transfer in IC engine
	SLO-2	Problems on Work and heat transfer	Second law aspects of refrigerator	Psychrometric processes	Plane wall and cylinder with uniform heat generation	Principle of Heat flux measurement in IC engine

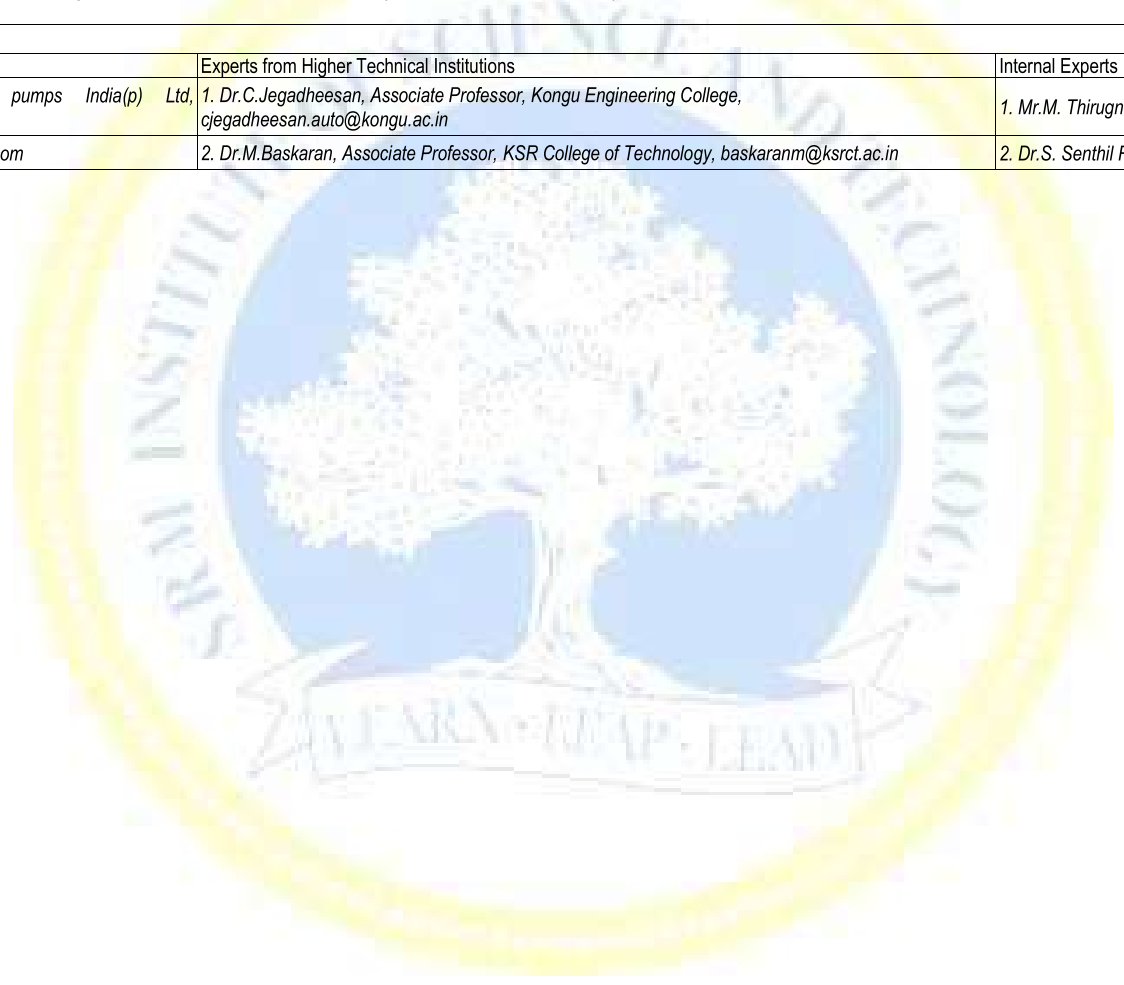
Learning Resources	1. Rajput. R. K. Engineering Thermodynamics, 4 <sup>th</sup> ed., Laxmi Publications (P) Ltd., 2015	4. Yunus a Cengel Michael a Boles, Thermodynamics, 7 <sup>th</sup> ed., Tata McGraw-Hill, 20115
	2. Kumar. D. S, Engineering Thermodynamics, 2 <sup>nd</sup> ed., S.K. Kataria and Sons, 2013	5. Nag.P.K., Engineering Thermodynamics, 5 <sup>th</sup> ed., Tata McGraw-Hill, 2013
	3. Holman.J.P, Heat Transfer (In SI Units), 10 <sup>th</sup> edition, McGraw Hill Education, 2016	6. Mechanics Laboratory Manual.

Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#		Theory	Practice
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice		
Level 1	Remember	40 %	-	30 %	-	30 %	-	30 %	-	30%	-
Level 2	Understand	40 %	-	40 %	-	40 %	-	40 %	-	40%	-
	Apply										

	Analyze										
Level 3	Evaluate	20 %	-	30 %	-	30 %	-	30 %	-	30 %	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

# CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Mr. S. Senthil Kumar, Grundfos pumps India(p) Ltd, senthel.s@gmail.com	1. Dr.C.Jegadheesan, Associate Professor, Kongu Engineering College, cjegadheesan.auto@kongu.ac.in	1. Mr.M. Thirugnanam, SRMIST
2. Mr.G.Vijayaram, TAFE, vijayaram@tafe.com	2. Dr.M.Baskaran, Associate Professor, KSR College of Technology, baskaranm@ksrct.ac.in	2. Dr.S. Senthil Raja, SRMIST



Course Code	18PYS201T	Course Name	MATERIALS SCIENCE	Course Category	S	Engineering Sciences	L	T	P	C
							3	0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Physics		Data Book / Codes/Standards	Nil	

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning			Program Learning Outcomes (PLO)																		
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15				
CLR-1 :	Understand the structure of crystalline materials.	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3				
CLR-2 :	Gain knowledge on the basics of material structures, properties and strength of materials				H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLR-3 :	Gain knowledge on ceramics, polymers, copolymers and non-crystalline materials				H	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLR-4 :	Acquire knowledge on polymer nanocomposites, biomaterials, catalytic materials and corrosion and degradation of materials				H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLR-5 :	Introduce the working principle of various characterization techniques				H	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLR-6 :	Understand the structure of crystalline materials				H	-	-	-	-	H	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-1 :	Acquire the knowledge on structure of crystalline materials	2	80	85	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			
CLO-2 :	Acquire the ability to identify engineering problems using plastic deformation, fatigue, fracture and creep of materials	2	75	80	H	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-			
CLO-3 :	Understand the basic ideas about ceramics, polymers and non-crystalline solids	2	85	80	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			
CLO-4 :	Appreciate the concepts of reinforced matrix interface, corrosion parameters and uses of various nanocomposites.	2	80	75	H	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-			
CLO-5 :	Apply the knowledge for structural and spectroscopic characterization of materials	2	75	85	H	-	-	H	-	-	-	-	-	-	-	-	-	-	-	-			
CLO-6 :	Acquire the knowledge on structure of crystalline materials	2	80	85	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			

Duration (hour)	9	9	9	9	9	
S-1	SLO-1	Introduction to materials-crystalline and amorphous	Imperfections in solids: point defects	Semi-crystalline materials: introduction and classification	Introduction to composites	Introduction to experimental techniques
	SLO-2	Single crystalline and polycrystalline materials	Equilibrium concentration of vacancies	Structure and configuration of ceramics	Classification of composites	X-Ray Diffraction (Single Crystal method)
S-2	SLO-1	Concept of basis and lattice	Interstitial impurities in solids	Advanced ceramics-functional properties	Polymer nanocomposites materials	Scanning Ion Conductance Microscopy-principle
	SLO-2	Lattice translational vectors	Substitutional impurities in solids	Mechanical behavior of ceramics-flexural strength	Polymer-matrix composites	Scanning Ion Conductance Microscopy-construction and working
S-3	SLO-1	Primitive cell and Bravais lattice	Line defects: edge dislocations	Fabrication and processing of advanced ceramics	Fiber-reinforced composites	Molecular and spectroscopic analysis-introduction
	SLO-2	Seven types of Bravais lattices	Screw dislocations	Applications of advanced ceramic materials	Metal-matrix composites	FTIR spectroscopy
S-4	SLO-1	Symmetry operations in crystals	Surface and volume imperfections	Glass ceramics-introduction	Ceramic-matrix composites	Concept of Raman spectroscopy
	SLO-2	Rotational and translational symmetry	Interfacial defects, stacking faults	Glass forming and glass tempering	Carbon-carbon composites	Raman spectroscopy- instrumentation
S-5	SLO-1	Indexing of crystal planes	Elastic properties-Hooke's law	Polymers-classification	Degradation of polymers	XPS spectroscopy-concept
	SLO-2	Miller indices -directions and planes	Yield strength	Thermoplastic and thermosetting polymers	Recycling of polymers	XPS spectroscopy- instrumentation

S-6	SLO-1	Various planes in cubic structure	Tensile strength	Mechanical behavior of polymers-macroscopic deformation	Corrosion of metals, forms of corrosion	Introduction to Nuclear Magnetic Resonance (NMR)
	SLO-2	Directions in cubic structure	Ductile and brittle materials	Polymer synthesis-addition and condensation polymerization	Corrosion prevention	Nuclear Magnetic Resonance (NMR)-instrumentation
S-7	SLO-1	Packing of atoms inside solids- packing fraction calculation	Stress strain behavior of metals	Concept of copolymers	Biomaterials-introduction	Introduction to Thermal analysis
	SLO-2	Ionic solids-NaCl crystal structure	Stress strain behavior of ceramics and polymers	Applications of polymers	Classification of biomaterials	Thermo Gravimetric Analyzer-instrumentation
S-8	SLO-1	Hexagonal close packed (HCP) structure	Tensile test, plastic deformation	Types of liquid crystals	Surface properties of biomaterials	Differential Thermal Analyses (DTA)
	SLO-2	Estimation of packing fraction in HCP	Concept of necking	Construction and working of LCD	Mechanical properties of biomaterials	Differential Scanning Calorimetry (DSC)
S-9	SLO-1	Diamond structure-APF	Fatigue	Non-crystalline materials-metallic glass	Catalytic biomaterials –silica, enzymatic hydrogels	Dynamic light scattering
	SLO-2	Cubic Zinc-Sulfide structure	Creep behavior	Glass transition-melting and glass transition temperature	Applications of biomaterials	Particle Size Analysis

Learning Resources	<ol style="list-style-type: none"> <li>V. Raghavan, <i>Materials Science and Engineering: A First Course</i>, 5<sup>th</sup> ed., Prentice Hall India, 2004.</li> <li>William D. Callister, <i>Materials Science and Engineering, An Introduction</i>, John Wiley &amp; Sons, 2007</li> </ol>	<ol style="list-style-type: none"> <li>Kingery, W. D., Bowen H. K., Uhlmann, D. R., <i>Introduction to Ceramics</i>, 2<sup>nd</sup> ed., John Wiley &amp; Sons, 1976.</li> <li>Upadhyaya and A. Upadhyaya, <i>Material Science and Engineering</i>, Anshan Publications, 2007</li> </ol>
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Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#		Theory	Practice
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice		
Level 1	Remember Understand	40 %	-	30 %	-	30 %	-	30 %	-	30%	-
Level 2	Apply Analyze	40 %	-	40 %	-	40 %	-	40 %	-	40%	-
Level 3	Evaluate Create	20 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Total	100 %		100 %		100 %		100 %		100 %	

# CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Dr. Narayanasvamy Vijayan, National Physical Laboratory, <a href="mailto:nvijayan@nplindia.org">nvijayan@nplindia.org</a>	1. Prof. V. Subramaniam, IITM Chennai, <a href="mailto:manianvs@iitm.ac.in">manianvs@iitm.ac.in</a>	1. Dr. C. Preferencial Kala, SRMIST
2. Dr. M. Krishna Surendra, Saint-Gobain Research, <a href="mailto:Krishna.muvvala@saintgobain.com">Krishna.muvvala@saintgobain.com</a>	2. Prof. D. Arivuoli, Anna University, <a href="mailto:arivuoli@annauniv.edu">arivuoli@annauniv.edu</a>	2. Sandeep Kumar Lakhera, SRMIST



Course Code	18NTS101T	Course Name	NANOSCIENCE AND NANOTECHNOLOGY	Course Category	S	Engineering Sciences	L	T	P	C
							3	0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Nanotechnology		Data Book / Codes/Standards	Nil	

Course Learning Rationale (CLR):	The purpose of learning this course is to:			Learning			Program Learning Outcomes (PLO)																	
CLR-1 :	Acquire knowledge on basics of nanoscience, classes of nanomaterials and their size and dimensionality dependence			1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15			
CLR-2 :	Obtain knowledge on physical properties of nanostructured materials and their size and dimensionality dependence			Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3			
CLR-3 :	Understand the physics and chemistry-based experimental approaches to synthesize various types of nanomaterials						H	M	H	H	M	H	H	H	H	H	M	H	M	H	H	H	H	H
CLR-4 :	Gain knowledge on the basic principles of characterization techniques at nanoscale						H	H	H	M	M	H	H	H	H	M	H	H	M	H	H	H	H	H
CLR-5 :	Appreciate the potential applications of the nanotechnology						H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	M	H
CLR-6 :	Know the safety and technological issues associated with nanoscience and nanotechnology						H	M	H	H	H	M	H	H	M	H	H	H	M	H	H	H	H	H
Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:						2	80	75	H	M	H	H	M	H	H	H	M	H	M	H	H	H	H
CLO-1 :	Analyze fundamentals of nanotechnology, different classes of nanomaterials and their sizes and dimensions			2	80	70	H	H	H	M	M	H	H	M	H	H	M	H	H	H	H			
CLO-2 :	Describe various physical properties of nanomaterials			2	75	70	H	H	H	H	H	H	H	H	H	H	H	H	H	M	H			
CLO-3 :	Apply chemical and physical methods to synthesize and fabricate nanomaterials			2	80	75	H	M	H	H	M	H	H	H	H	H	H	H	M	H	H			
CLO-4 :	Distinguish various characterization techniques involved in nanotechnology			2	80	70	M	M	M	H	M	H	H	H	M	H	M	H	H	H	H			
CLO-5 :	Identify the potentialities of nanotechnology			2	80	75	H	M	H	H	M	H	H	H	H	M	H	H	H	H	H			
CLO-6 :	Perform preliminary level research in nanoscience/nanotechnology			2	80	75	H	M	H	H	M	H	H	H	H	M	H	H	H	H	H			

Duration (hour)	9		9		9		9		9	
S-1	SLO-1	Matter at different scales, Moore's Law	Mechanical properties of nanomaterials	Chemical methods: Metal nanocrystals by reduction	Introduction to electron microscopy	Role of nanotechnology in solar energy conversion				
	SLO-2	Nanosystems – classification based on time and length scale	Size dependence of material properties	Synthesis of metal nanoparticles by chemical reduction methods and properties	SEM operating principles	Catalytic application of nanoparticles				
S-2	SLO-1	Size dependent phenomena: Quantum dots, wells and wires	Nanodispersions, nanocrystalline solids	Hydrothermal and solvothermal synthesis	Field emission scanning electron microscope (FESEM)	Nanotechnology in molecular electronics and nanoelectronics				
	SLO-2	Principle behind emission of different colors from different size quantum dots	Amorphous materials: Nanocrystalline materials embedded in amorphous matrix	Photochemical synthesis	Environmental scanning electron microscope (E- SEM)	Printed electronics				
S-3	SLO-1	Surface to volume ratio	Thermal properties of nanomaterials	Sonochemical routes	High resolution -transmission electron microscope (HRTEM)	Polymers with a special nano-architecture				
	SLO-2	Fraction of surface atoms and surface energy	Violation of second law of thermodynamics for small systems and short timescale	Ball milling, Grinding	Scanning Tunneling Microscopy (STM)	Applications of nanomaterials based liquid crystalline systems				
S-4	SLO-1	Surface stress and surface defects	Thermal transport-size dependence	Electrodeposition techniques	SPM image processing and image analysis	Nanotechnology in food storage				
	SLO-2	Quantum confinement – exciton confinement in quantum dots	Melting point- size dependence	Fabrication of nanotubes, nanowires and nanorods	Dynamic AFM imaging of biological samples	Nanotechnology in improving environment				
S-5	SLO-1	Carbon-based nano materials	Electronic properties of nanomaterials	Spray Pyrolysis	Nanomechanical characterization	Concept of data storage				

	SLO-2	Fullerenes and buckyballs	Electronic States: Dependence of size and dimensionality	Flame pyrolysis	Nanoindentation	Nanomaterials for data storage
S-6	SLO-1	Carbon nanotubes	The electron density of states D(E)	Physical Vapor Deposition: Thermal evaporation	Raman scattering	Chemical sensors
	SLO-2	Graphene	Luttinger liquid behavior of electrons in 1D metals	DC/RF magnetron sputtering	Surface enhanced -Raman scattering	Biosensors
S-7	SLO-1	Metal based nano materials	Magnetic properties of nanomaterials: Particle size and magnetic behavior	Molecular beam epitaxy (MBE)	UV-Vis - absorption spectra of nanoparticles of different sizes	Nanomedicine
	SLO-2	Nanogold and nanosilver	Superparamagnetism: Langevin function, surface effects, magnetoresistance	Chemical vapor deposition(CVD)	Semiconductor nanoparticles	Nanobiotechnology
S-8	SLO-1	Metal-oxide based nano materials	Optical properties: instances of light absorption in nanomaterials	Metal organic chemical vapor deposition (MOCVD)	Metal nanoparticle: Surface plasmons	Nanotoxicology
	SLO-2	Nanocomposites and nanopolymers	Red- and blue shift	Layer-by-layer growth of highly controlled high-quality ultrathin films deposition	Surface plasmon resonance	Challenges in nanotoxicology
S-9	SLO-1	Nanoglasses and nanoceramics	Phenomenon of light absorption, light emission- quantum yield	Nanofabrication: Concept of lithography	Magnetic measurements	Nanotechnology in cosmetics
	SLO-2	Biological nanomaterials	Photoluminescence and electroluminescence of nanomaterials	Photo and electron beam lithography techniques	Vibrating sample magnetometer (VSM)	Nanotechnology in aviation industry

Learning Resources	1. T. Pradeep, A Textbook of Nanoscience and Nanotechnology, Tata McGraw Hill Education Pvt. Ltd., 2012	5. M. F. Ashby, P.J. Ferreira, D. L. Schodek, Nanomaterials, Nanotechnologies and Design: An Introduction for Engineers and Architects, BH Publishers of Elsevier, 2009
	2. Hari Singh Nalwa, Nanostructured Materials and Nanotechnology, Academic Press, 2008	
	3. Edward L. Wolf, Nanophysics and Nanotechnology: An Introduction to Modern Concepts in Nanoscience. 2nd ed., Wiley-VCH, 2004	7. B. Zhang, Physical Fundamentals of Nanomaterials, Elsevier, 1st Edition, 2018.
	4. Hans-Eckhardt Schaefer, Nanoscience: The Science of the Small in Physics, Engineering, Chemistry, Biology, and Medicine, Springer-Verlag Berlin Heidelberg, 1st Edition, 2010.	

Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#		Theory	Practice
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice		
Level 1	Remember Understand	40 %	-	30 %	-	30 %	-	30 %	-	30%	-
Level 2	Apply Analyze	40 %	-	40 %	-	40 %	-	40 %	-	40%	-
Level 3	Evaluate Create	20 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Total	100 %		100 %		100 %		100 %		100 %	

# CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Dr. Sunil Varughese, CSIR-NIIST, s.varughese@niist.res.in	1. Prof. M. Ghanashyam Krishna, HCU Hyderabad, mgksp@uohyd.ernet.in	1. Dr. Kiran Mangalmpalli, SRMIST
2. Dr. M. Krishna Surendra, Saint-Gobain Research, Chennai, krishna.muvala@saint-gobain.com	2. Prof. S. Balakumar, University of Madras, balakumar@unom.ac.in	2. Dr. Debabrata Sarkar, SRMIST

# ACADEMIC CURRICULA

## Professional Core Courses

COMPUTER SCIENCE AND ENGINEERING

Regulations - 2018

**SRM INSTITUTE OF SCIENCE AND TECHNOLOGY**

**(Deemed to be University u/s 3 of UGC Act, 1956)**

Kattankulathur, Kancheepuram, Tamil Nadu, India

Course Code	18CSC201J	Course Name	DATA STRUCTURES AND ALGORITHMS	Course Category	C	Professional Core			
						L	T	P	C
						3	0	2	4

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	18CSC204J
Course Offering Department	Computer Science and Engineering		Data Book / Codes/Standards	Nil	

Course Learning Rationale (CLR):	The purpose of learning this course is to:			Learning			Program Learning Outcomes (PLO)																																			
CLR-1 :	Utilize the different data types; Utilize searching and sorting algorithms for data search			1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15																					
CLR-2 :	Utilize linked list in developing applications			Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3																					
CLR-3 :	Utilize stack and queues in processing data for real-time applications																					L	H	-	L	L	-	H	-	-	L	L	-	H	-	-	-	-				
CLR-4 :	Utilize tree data storage structure for real-time applications																					M	H	L	M	L	-	-	-	-	-	M	L	-	H	-	-	-	-			
CLR-5 :	Utilize algorithms to find shortest data search in graphs for real-time application development																					M	H	M	H	L	-	-	-	-	-	M	L	-	H	-	-	-	-			
CLR-6 :	Utilize the different types of data structures and its operations for real-time programming applications																					M	H	M	H	L	-	-	-	-	-	M	L	-	H	-	-	-	-			
CLR-6 :	Utilize the different types of data structures and its operations for real-time programming applications																					H	H	M	H	L	-	-	-	-	-	M	L	-	H	-	-	-	-			

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:			3	80	70	L	H	-	H	L	-	-	-	L	L	-	H	-	-	-			
CLO-1 :	Identify linear and non-linear data structures. Create algorithms for searching and sorting			3	85	75	M	H	L	M	L	-	-	-	M	L	-	H	-	-	-			
CLO-2 :	Create the different types of linked lists and evaluate its operations			3	75	70	M	H	M	H	L	-	-	-	M	L	-	H	-	-	-			
CLO-3 :	Construct stack and queue data structures and evaluate its operations			3	85	80	M	H	M	H	L	-	-	-	M	L	-	H	-	-	-			
CLO-4 :	Create tree data structures and evaluate its types and operations			3	85	80	M	H	M	H	L	-	-	-	M	L	-	H	-	-	-			
CLO-5 :	Create graph data structure, evaluate its operations, implement algorithms to identify shortest path			3	85	75	H	H	M	H	L	-	-	-	M	L	-	H	-	-	-			
CLO-6 :	Construct the different data structures and evaluate their types and operations			3	80	70	L	H	-	H	L	-	-	-	L	L	-	H	-	-	-			

Duration (hour)	15		15		15		15		15	
S-1	SLO-1	Introduction-Basic Terminology	Array	Stack ADT	General Trees	Graph Terminology				
	SLO-2	Data Structures	Operations on Arrays – Insertion and Deletion	Stack Array Implementation	Tree Terminologies	Graph Traversal				
S-2	SLO-1	Data Structure Operations	Applications on Arrays	Stack Linked List Implementation	Tree Representation	Topological sorting				
	SLO-2	ADT	Multidimensional Arrays- Sparse Matrix	Applications of Stack- Infix to Postfix Conversion	Tree Traversal	Minimum spanning tree – Prims Algorithm				
S-3	SLO-1	Algorithms – Searching techniques	Linked List Implementation - Insertion	Applications of Stack- Postfix Evaluation	Binary Tree Representation	Minimum Spanning Tree - Kruskal's Algorithm				
	SLO-2	Complexity – Time , Space Trade off	Linked List- Deletion and Search	Applications of Stack- Balancing symbols	Expression Trees	Network flow problem				
S 4-5	SLO-1	Lab 1: Implementation of Searching - Linear and Binary Search Techniques	Lab 4: Implementation of Array – Insertion, Deletion.	Lab 7 :Implementation of stack using array and Linked List	Lab 10: Implementation of Tree using array	Lab 13: Implementation of Graph using Array				
	SLO-2									
S-6	SLO-1	Algorithms - Sorting	Applications of Linked List	Applications of Stack- Nested Function Calls	Binary Tree Traversal	Shortest Path Algorithm- Introduction				
	SLO-2	Complexity – Time , Space Trade off	Polynomial Arithmetic	Recursion concept using stack	Threaded Binary Tree	Shortest Path Algorithm: Dijkstra's Algorithm				
S-7	SLO-1	Mathematical notations	Cursor Based Implementation – Methodology	Applications of Recursion: Tower of Hanoi	Binary Search Tree :Construction, Searching	Hashing: Hash functions - Introduction				

	SLO-2	Asymptotic notations-Big O, Omega	Cursor Based Implementation	Queue ADT	Binary Search Tree : Insertion and Deletion	Hashing: Hash functions
S-8	SLO-1	Asymptotic notations - Theta	Circular Linked List	Queue Implementation using array	AVL Trees: Rotations	Hashing : Collision avoidance
	SLO-2	Mathematical functions	Circular Linked List - Implementation	Queue Implementation using Linked List	AVL Tree: Insertions	Hashing : Separate chaining
S 9-10	SLO-1	Lab 2: Implementation of sorting Techniques – Insertion sort and Bubble Sort Techniques	Lab 5: Implementation of Linked List - Cursor Based Implementation	Lab 8: Implementation of Queue using Array and linked list	Lab 11: Implementation of BST using linked list\	Lab 14 :Implementation of Shortest path Algorithm
	SLO-2					
S-11	SLO-1	Data Structures and its Types	Applications of Circular List -Joseph Problem	Circular Queue	B-Trees Constructions	Open Addressing
	SLO-2	Linear and Non-Linear Data Structures	Doubly Linked List	Implementation of Circular Queue	B-Trees Search	Linear Probing
S-12	SLO-1	1D, 2D Array Initialization using Pointers	Doubly Linked List Insertion	Applications of Queue	B-Trees Deletions	Quadratic probing
	SLO-2	1D, 2D Array Accessing using Pointers	Doubly Linked List Insertion variations	Double ended queue	Splay Trees	Double Hashing
S-13	SLO-1	Declaring Structure and accessing	Doubly Linked List Deletion	Priority Queue	Red Black Trees	Rehashing
	SLO-2	Declaring Arrays of Structures and accessing	Doubly Linked List Search	Priority Queue - Applications	Red Black Trees Insertion	Extensible Hashing
S 14-15	SLO-1	Lab 3: Implement Structures using Pointers	Lab 6: Implementation of Doubly linked List	Lab 9: Applications of Stack, Queue	Lab 12:Implementation of B-Trees	Lab 15 :Implementation of Minimal Spanning Tree
	SLO-2					

Learning Resources	<ol style="list-style-type: none"> <li>1. Seymour Lipschutz, Data Structures with C, McGraw Hill, 2014</li> <li>2. R.F.Gilberg, B.A.Forouzan, Data Structures, 2<sup>nd</sup> ed., Thomson India, 2005</li> <li>3. A.V.Aho, J.E Hopcroft , J.D.Ullman, Data structures and Algorithms, Pearson Education, 2003</li> <li>4. Mark Allen Weiss, Data Structures and Algorithm Analysis in C, 2<sup>nd</sup> ed., Pearson Education, 2015</li> </ol>	<ol style="list-style-type: none"> <li>5. Reema Thareja, Data Structures Using C, 1<sup>st</sup> ed., Oxford Higher Education, 2011</li> <li>6. Thomas H Cormen, Charles E Leiserson, Ronald L Revest, Clifford Stein, Introduction to Algorithms 3<sup>rd</sup> ed., The MIT Press Cambridge, 2014</li> </ol>
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#### Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember Understand	20%	20%	15%	15%	15%	15%	15%	15%	15%	15%
Level 2	Apply Analyze	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%
Level 3	Evaluate Create	10%	10%	15%	15%	15%	15%	15%	15%	15%	15%
	Total	100 %		100 %		100 %		100 %		100 %	

# CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

#### Course Designers

Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Dr. Nagaveer, CEO, Campus Corporate Connect, nagaveer@campuscorporateconnect.com	1. Dr. Srinivasa Rao Bakshi, IITM, Chennai, sbakshi@iitm.ac.in	1. Mr. K. Venkatesh, SRMIST
2. Dr. Sricharan Srinivasan, Wipro Technologies, sricharanms@gmail.com	2. Dr. Ramesh Babu, N , nrbabu@iitm.ac.in	2. Dr.Subalalitha C.N, SRMIST
	3. Dr.Noor Mahammad, IIITDM, Kancheepuram, noor@iiitdm.ac.in	3. Ms. Ferni Ukrit, SRMIST

Course Code	18CSC202J	Course Name	OBJECT ORIENTED DESIGN AND PROGRAMMING	Course Category	C	Professional Core			
						L	T	P	C
						3	0	2	4

Pre-requisite Courses	18CSS101J	Co-requisite Courses	Nil	Progressive Courses	18CSC207J
Course Offering Department	Computer Science and Engineering		Data Book / Codes/Standards	Nil	

Course Learning Rationale (CLR):		The purpose of learning this course is to:			Learning			Program Learning Outcomes (PLO)																	
					1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15			
CLR-1 :	Utilize class and build domain model for real-time programs			Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge																		
CLR-2 :	Utilize method overloading and operator overloading for real-time application development programs						Problem Analysis																		
CLR-3 :	Utilize inline, friend and virtual functions and create application development programs						Design & Development																		
CLR-4 :	Utilize exceptional handling and collections for real-time object oriented programming applications						Analysis, Design, Research																		
CLR-5 :	Construct UML component diagram and deployment diagram for design of applications						Modern Tool Usage																		
CLR-6 :	Create programs using object oriented approach and design methodologies for real-time application development						Society & Culture																		
				Environment & Sustainability																					
				Ethics																					
				Individual & Team Work																					
				Communication																					
				Project Mgt. & Finance																					
				Life Long Learning																					
				PSO - 1																					
				PSO - 2																					
				PSO - 3																					

Course Learning Outcomes (CLO):		At the end of this course, learners will be able to:			3	80	70
CLO-1 :	Identify the class and build domain model						
CLO-2 :	Construct programs using method overloading and operator overloading						
CLO-3 :	Create programs using inline, friend and virtual functions, construct programs using standard templates						
CLO-4 :	Construct programs using exceptional handling and collections						
CLO-5 :	Create UML component diagram and deployment diagram						
CLO-6 :	Create programs using object oriented approach and design methodologies						

Duration (hour)	15	15	15	15	15
S-1	SLO-1	Comparison of Procedural and Object Oriented Programming	Types of constructor (Default, Parameter)	Feature Inheritance: Single and Multiple	Generic - Templates : Introduction
	SLO-2	OOPS and its features	Static constructor and copy constructor	Inheritance: Multilevel	Function templates
S-2	SLO-1	I/O Operations, Data Types, Variables, static	Feature Polymorphism: Constructor overloading	Inheritance: Hierarchical	Example programs Function templates
	SLO-2	Constants, Pointers, Type Conversions	Method Overloading	Inheritance: Hybrid	Class Templates
S-3	SLO-1	Features: Class and Objects	Example for method overloading	Inheritance: Example Programs	Class Templates
	SLO-2	UML Diagrams Introduction	Method Overloading: Different parameter with different return values		Example programs for Class and Function templates
S-4	SLO-1	Lab 1: I/O operations	Lab 4: Constructor and Method overloading	Lab 7: Inheritance and its types	Lab 10: Templates
	SLO-2	Lab 1: I/O operations			
S-6	SLO-1	Feature :Class and Objects	Operator Overloading and types	Advanced Functions: Inline, Friend	Exceptional Handling: try and catch
	SLO-2	Examples of Class and Objects	Overloading Assignment Operator	Advanced Functions: Virtual, Overriding	Exceptional Handling: Multilevel exceptional
S-7	SLO-1	UML Class Diagram and its components	Overloading Unary Operators	Advanced Function: Pure Virtual function	Exceptional Handling: throw and throws
	SLO-2	Class Diagram relations and Multiplicity	Example for Unary Operator overloading	Example for Virtual and pure virtual function	Exceptional Handling: finally

S-8	SLO-1	Feature Abstraction and Encapsulation	Overloading Binary Operators	Abstract class and Interface	Exceptional Handling: User defined exceptional	Algorithms: find(), count(), sort()
	SLO-2	Application of Abstraction and Encapsulation	Example for Binary Operator overloading	Example Program	Example Programs using C++	Algorithms: search(), merge()
S 9-10	SLO-1	Lab 2: Classes and Objects, Class Diagram	Lab 5: Polymorphism : Operators Overloading	Lab 8: Virtual Function and Abstract class	Lab 11: Exceptional Handling	Lab 15: STL Associative containers and algorithms
	SLO-2					
S-11	SLO-1	Access specifiers – public, private	UML Interaction Diagrams	UML State Chart Diagram	Dynamic Modeling: Package Diagram	Function Object : for_each(), transform()
	SLO-2	Access specifiers - protected, friend, inline	Sequence Diagram	UML State Chart Diagram	UML Component Diagram	Example for Algorithms
S-12	SLO-1	UML use case Diagram, use case, Scenario	Collaboration Diagram	Example State Chart Diagram	UML Component Diagram	Streams and Files: Introduction
	SLO-2	Use case Diagram objects and relations	Example Diagram	UML Activity Diagram	UML Deployment Diagram	Classes and Errors
S-13	SLO-1	Method, Constructor and Destructor	Feature: Inheritance	UML Activity Diagram	UML Deployment Diagram	Disk File Handling Reading Data and Writing Data
	SLO-2	Example program for constructor	Inheritance and its types	Example Activity Diagram	Example Package, Deployment, Package	
S 14-15	SLO-1	Lab 3: Methods and Constructor, Usecase	Lab 6: UML Interaction Diagram	Lab 9: State Chart and Activity Diagram	Lab12 : UML Component, Deployment, Package diagram	Lab15: Streams and File Handling
	SLO-2					

Learning Resources	<ol style="list-style-type: none"> <li>Grady Booch, Robert A. Maksimchuk, Michael W. Engle, <i>Object-Oriented Analysis and Design with Applications</i>, 3<sup>rd</sup> ed., Addison-Wesley, May 2007</li> <li>Reema Thareja, <i>Object Oriented Programming with C++</i>, 1<sup>st</sup> ed., Oxford University Press, 2015</li> <li>Sourav Sahay, <i>Object Oriented Programming with C++</i>, 2<sup>nd</sup> ed., Oxford University Press, 2017</li> </ol>	<ol style="list-style-type: none"> <li>Robert Lafore, <i>Object-Oriented Programming in C++</i>, 4<sup>th</sup> ed., SAMS Publishing, 2008</li> <li>Ali Bahrami, <i>Object Oriented Systems Development</i>, McGraw Hill, 2004</li> <li>Craig Larmen, <i>Applying UML and Patterns</i>, 3<sup>rd</sup> ed., Prentice Hall, 2004</li> </ol>
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Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember Understand	20%	20%	15%	15%	15%	15%	15%	15%	15%	15%
Level 2	Apply Analyze	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%
Level 3	Evaluate Create	10%	10%	15%	15%	15%	15%	15%	15%	15%	15%
	Total	100 %		100 %		100 %		100 %		100 %	

# CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc

# For the laboratory component the students are advised to take an application and apply the concepts

Course Designers	Experts from Higher Technical Institutions	Internal Experts
Experts from Industry		
Mr. Girish Raghavan, Senior DMTS Member, Wipro Ltd.	1. Dr. Srinivasa Rao Bakshi, IITM Chennai, sbakshi@iitm.ac.in	1. Ms. C.G.Anupama, SRMIST
Ms. Tamilchelvi, Solutions Architect, Wipro Ltd	2. Dr. Ramesh Babu, N, IITM Chennai, nrbabu@iitm.ac.in	2. Mr. C.Arun, SRMIST
		3. Mr. Geogen George, SRMIST
		4. Mr. Muthukumar, SRMIST

Course Code	18CSC203J	Course Name	COMPUTER ORGANIZATION AND ARCHITECTURE	Course Category	C	Professional Core				L	T	P	C
										3	0	2	4

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	18CSC207J							
Course Offering Department	Computer Science and Engineering			Data Book / Codes/Standards	Nil							

Course Learning Rationale (CLR):	The purpose of learning this course is to:			Learning			Program Learning Outcomes (PLO)																	
CLR-1 :	Utilize the functional units of a computer			1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15			
CLR-2 :	Analyze the functions of arithmetic Units like adders, multipliers etc.			Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3			
CLR-3 :	Understand the concepts of Pipelining and basic processing units						H	H	-	-	-	-	-	-	-	-	M	L	-	M	-	-	-	-
CLR-4 :	Study about parallel processing and performance considerations.						H	H	H	-	H	-	-	-	-	-	M	L	-	M	-	-	-	-
CLR-5 :	Have a detailed study on Input-Output organization and Memory Systems.						H	-	-	H	-	-	-	-	-	-	M	L	-	M	-	-	-	-
CLR-6 :	Simulate simple fundamental units like half adder, full adder etc						H	H	H	H	H	-	-	-	-	-	M	L	-	M	-	-	-	-

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:			2	80	70	H	H	-	-	-	-	-	-	M	L	-	M	-	-	-
CLO-1 :	Identify the computer hardware and how software interacts with computer hardware			3	85	75	H	H	H	-	H	-	-	-	M	L	-	M	-	-	-
CLO-2 :	Apply Boolean algebra as related to designing computer logic, through simple combinational and sequential logic circuits			2	75	70	H	H	H	H	-	-	-	-	M	L	-	M	-	-	-
CLO-3 :	Analyze the detailed operation of Basic Processing units and the performance of Pipelining			3	85	80	H	-	-	H	-	-	-	-	M	L	-	M	-	-	-
CLO-4 :	Analyze concepts of parallelism and multi-core processors.			3	85	75	H	-	H	H	-	-	-	-	M	L	-	M	-	-	-
CLO-5 :	Identify the memory technologies, input-output systems and evaluate the performance of memory system			3	85	75	H	H	H	H	H	-	-	-	M	L	-	M	-	-	-
CLO-6 :	Identify the computer hardware, software and its interactions			3	85	75	H	H	H	H	H	-	-	-	M	L	-	M	-	-	-

Duration (hour)	15		15		15		15		15	
S-1	SLO-1	Functional Units of a computer	Addition and subtraction of Signed numbers	Fundamental concepts of basic processing unit	Parallelism	Memory systems -Basic Concepts				
	SLO-2	Operational concepts	Problem solving	Performing ALU operation	Need, types of Parallelism	Memory hierarchy				
S-2	SLO-1	Bus structures	Design of fast adders	Execution of complete instruction, Branch instruction	applications of Parallelism	Memory technologies				
	SLO-2	Memory locations and addresses	Ripple carry adder and Carry look ahead adder	Multiple bus organization	Parallelism in Software	RAM, Semiconductor RAM				
S-3	SLO-1	Memory operations	Multiplication of positive numbers	Hardwired control	Instruction level parallelism	ROM, Types				
	SLO-2	Memory operations	Problem Solving	Generation of control signals	Data level parallelism	Speed, size cost				
S 4-5	SLO-1	Lab 1: To recognize various components of PC- Input Output systems Processing and Memory units	Lab4:Study of TASM Addition and Subtraction of 8-bit number	Lab-7: Design of Half Adder Design of Full Adder	Lab-10: Study of Array Multiplier Design of Array Multiplier	Lab-13: Study of Carry Save Multiplication Program to carry out Carry Save Multiplication				
	SLO-2	Instructions, Instruction sequencing	Signed operand multiplication	Micro-programmed control-	Challenges in parallel processing	Cache memory				
S-6	SLO-1	Addressing modes	Problem solving	Microinstruction	Architectures of Parallel Systems - Flynn's classification	Mapping Functions				
S-7	SLO-1	Problem solving	Fast multiplication- Bit pair recoding of Multipliers	Micro-program Sequencing	SISD, SIMD	Replacement Algorithms				



S-8	SLO-2	Introduction to Microprocessor	Problem Solving	Micro instruction with Next address field	MIMD, MISD	Problem Solving
	SLO-1	Introduction to Assembly language	Carry Save Addition of summands	Basic concepts of pipelining	Hardware multithreading	Virtual Memory
	SLO-2	Writing of assembly language programming	Problem Solving	Pipeline Performance	Coarse Grain parallelism, Fine Grain parallelism	Performance considerations of various memories
S-9-10	SLO-1	Lab-2: To understand how different components of PC are connected to work properly Assembling of System Components	Lab 5: Addition of 16-bit number Subtraction of 16-bit number	Lab-8: Study of Ripple Carry Adder Design of Ripple Carry Adder	Lab-11: Study of Booth Algorithm	Lab-14: Understanding Processing unit Design of primitive processing unit
	SLO-2					
S-11	SLO-1	ARM Processor: The thumb instruction set	Integer division – Restoring Division	Pipeline Hazards-Data hazards	Uni-processor and Multiprocessors	Input Output Organization
	SLO-2	Processor and CPU cores	Solving Problems	Methods to overcome Data hazards	Multi-core processors	Need for Input output devices
S-12	SLO-1	Instruction Encoding format	Non Restoring Division	Instruction Hazards	Multi-core processors	Memory mapped IO
	SLO-2	Memory load and Store instruction in ARM	Solving Problems	Hazards on conditional and Unconditional Branching	Memory in Multiprocessor Systems	Program controlled IO
S-13	SLO-1	Basics of IO operations.	Floating point numbers and operations	Control hazards	Cache Coherency in Multiprocessor Systems	Interrupts-Hardware, Enabling and Disabling Interrupts
	SLO-2	Basics of IO operations.	Solving Problems	Influence of hazards on instruction sets	MESI protocol for Multiprocessor Systems	Handling multiple Devices
S-14-15	SLO-1	Lab -3 To understand how different components of PC are connected to work properly Disassembling of System Components	Lab-6: Multiplication of 8-bit number Factorial of a given number	Lab-9: Study of Carry Look-ahead Adder Design of Carry Look-ahead Adder	Lab-12: Program to carry out Booth Algorithm	Lab-15: Understanding Pipeline concepts Design of basic pipeline.
	SLO-2					

Learning Resources	<ol style="list-style-type: none"> <li>1. Carl Hamacher, Zvonko Vranesic, Safwat Zaky, Computer Organization, 5<sup>th</sup> ed., McGraw-Hill, 2015</li> <li>2. Kai Hwang, Faye A. Briggs, Computer Architecture and Parallel Processing, 3<sup>rd</sup> ed., McGraw Hill, 2016</li> <li>3. Ghosh T. K., Computer Organization and Architecture, 3<sup>rd</sup> ed., Tata McGraw-Hill, 2011</li> <li>4. P. Hayes, Computer Architecture and Organization, 3<sup>rd</sup> ed., McGraw Hill, 2015.</li> </ol>	<ol style="list-style-type: none"> <li>5. William Stallings, Computer Organization and Architecture – Designing for Performance, 10<sup>th</sup> ed., Pearson Education, 2015</li> <li>6. David A. Patterson and John L. Hennessy Computer Organization and Design - A Hardware software interface, 5<sup>th</sup> ed., Morgan Kaufmann, 2014</li> </ol>
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Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#		Theory	Practice
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice		
Level 1	Remember Understand	20%	20%	15%	15%	15%	15%	15%	15%	15%	15%
Level 2	Apply Analyze	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%
Level 3	Evaluate Create	10%	10%	15%	15%	15%	15%	15%	15%	15%	15%
	Total	100 %		100 %		100 %		100 %		100 %	

# CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. T. V. Sankar, HCL Technologies Ltd, Chennai, sankar_t@hcl.com	1. Prof. A.P. Shanthi, ANNA University Chennai, a.p.shanthi@cs.annauniv.edu	1. Dr. V. Ganapathy, SRMIST
		2. Dr. C. Malathy, SRMIST
		3. Mrs M.S. Abirami, SRMIST

Course Code	18CSC204J	Course Name	DESIGN AND ANALYSIS OF ALGORITHMS	Course Category	C	Professional Core			
						L	T	P	C
						3	0	2	4

Pre-requisite Courses	18CSC201J, 18CSC202J	Co-requisite Courses	18CSC207J	Progressive Courses	Nil
Course Offering Department	Computer Science and Engineering		Data Book / Codes/Standards	Nil	

Course Learning Rationale (CLR):	The purpose of learning this course is to:			Learning			Program Learning Outcomes (PLO)																	
CLR-1 :	Design efficient algorithms in solving complex real time problems			1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15			
CLR-2 :	Analyze various algorithm design techniques to solve real time problems in polynomial time			Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3			
CLR-3 :	Utilize various approaches to solve greedy and dynamic algorithms						L	H	-	H	L	-	-	-	-	L	L	-	H	-	-	-	-	-
CLR-4 :	Utilize back tracking and branch and bound paradigms to solve exponential time problems						M	H	L	M	L	-	-	-	-	M	L	-	H	-	-	-	-	-
CLR-5 :	Analyze the need of approximation and randomization algorithms, utilize the importance Non polynomial algorithms						M	H	M	H	L	-	-	-	-	M	L	-	H	-	-	-	-	-
CLR-6 :	Construct algorithms that are efficient in space and time complexities						H	H	M	H	L	-	-	-	-	M	L	-	H	-	-	-	-	-
							L	H	M	H	L	-	-	-	-	L	L	-	H	-	-	-	-	-

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:			3	80	70	L	H	-	H	L	-	-	-	L	L	-	H	-	-	-
CLO-1 :	Apply efficient algorithms to reduce space and time complexity of both recurrent and non-recurrent relations			3	85	75	M	H	L	M	L	-	-	-	M	L	-	H	-	-	-
CLO-2 :	Solve problems using divide and conquer approaches			3	75	70	M	H	M	H	L	-	-	-	M	L	-	H	-	-	-
CLO-3 :	Apply greedy and dynamic programming types techniques to solve polynomial time problems.			3	85	80	M	H	M	H	L	-	-	-	M	L	-	H	-	-	-
CLO-4 :	Create exponential problems using backtracking and branch and bound approaches.			3	85	75	H	H	M	H	L	-	-	-	M	L	-	H	-	-	-
CLO-5 :	Interpret various approximation algorithms and interpret solutions to evaluate P type, NP Type, NPC, NP Hard problems			3	80	70	L	H	M	H	L	-	-	-	L	L	-	H	-	-	-
CLO-6 :	Create algorithms that are efficient in space and time complexities by using divide conquer, greedy, backtracking technique																				

Duration (hour)	15		15		15		15		15	
S-1	SLO-1	Introduction-Algorithm Design	Introduction-Divide and Conquer	Introduction-Greedy and Dynamic Programming	Introduction to backtracking - branch and bound	Introduction to randomization and approximation algorithm				
	SLO-2	Fundamentals of Algorithms	Maximum Subarray Problem	Examples of problems that can be solved by using greedy and dynamic approach	N queen's problem - backtracking	Randomized hiring problem				
S-2	SLO-1	Correctness of algorithm	Binary Search	Huffman coding using greedy approach	Sum of subsets using backtracking	Randomized quick sort				
	SLO-2	Time complexity analysis	Complexity of binary search	Comparison of brute force and Huffman method of encoding	Complexity calculation of sum of subsets	Complexity analysis				
S-3	SLO-1	Insertion sort-Line count, Operation count	Merge sort	Knapsack problem using greedy approach	Graph introduction	String matching algorithm				
	SLO-2	Algorithm Design paradigms	Time complexity analysis	Complexity derivation of knapsack using greedy	Hamiltonian circuit - backtracking	Examples				
S 4-5	SLO-1	Lab 1: Simple Algorithm-Insertion sort	Lab 4: Quicksort, Binary search	Lab 7: Huffman coding, knapsack and using greedy	Lab 10: N queen's problem	Lab 13: Randomized quick sort				
	SLO-2									
S-6	SLO-1	Designing an algorithm	Quick sort and its Time complexity analysis	Tree traversals	Branch and bound - Knapsack problem	Rabin Karp algorithm for string matching				
	SLO-2	And its analysis-Best, Worst and Average case	Best case, Worst case, Average case analysis	Minimum spanning tree – greedy Kruskal's algorithm - greedy	Example and complexity calculation. Differentiate with dynamic and greedy	Example discussion				
S-7	SLO-1	Asymptotic notations Based on growth functions.	Strassen's Matrix multiplication and its recurrence relation	Minimum spanning tree - Prims algorithm	Travelling salesman problem using branch and bound	Approximation algorithm				

	SLO-2	O,O,Θ, ω, Ω	Time complexity analysis of Merge sort	Introduction to dynamic programming	Travelling salesman problem using branch and bound example	Vertex covering
S-8	SLO-1	Mathematical analysis	Largest sub-array sum	0/1 knapsack problem	Travelling salesman problem using branch and bound example	Introduction Complexity classes
	SLO-2	Induction, Recurrence relations	Time complexity analysis of Largest sub-array sum	Complexity calculation of knapsack problem	Time complexity calculation with an example	P type problems
S-9-10	SLO-1	Lab 2: Bubble Sort	Lab 5: Strassen Matrix multiplication	Lab 8: Various tree traversals, Krukshall's MST	Lab 11: Travelling salesman problem	Lab 14: String matching algorithms
	SLO-2					
S-11	SLO-1	Solution of recurrence relations	Master Theorem Proof	Matrix chain multiplication using dynamic programming	Graph algorithms	Introduction to NP type problems
	SLO-2	Substitution method	Master theorem examples	Complexity of matrix chain multiplication	Depth first search and Breadth first search	Hamiltonian cycle problem
S-12	SLO-1	Solution of recurrence relations	Finding Maximum and Minimum in an array	Longest common subsequence using dynamic programming	Shortest path introduction	NP complete problem introduction
	SLO-2	Recursion tree	Time complexity analysis-Examples	Explanation of LCS with an example	Floyd-Warshall Introduction	Satisfiability problem
S-13	SLO-1	Solution of recurrence relations	Algorithm for finding closest pair problem	Optimal binary search tree (OBST) using dynamic programming	Floyd-Warshall with sample graph	NP hard problems
	SLO-2	Examples	Convex Hull problem	Explanation of OBST with an example.	Floyd-Warshall complexity	Examples
S-14-15	SLO-1	Lab 3: Recurrence Type-Merge sort, Linear search	Lab 6: Finding Maximum and Minimum in an array, Convex Hull problem	Lab 9: Longest common subsequence	Lab 12: BFS and DFS implementation with array	Lab 15: Discussion over analyzing a real time problem
	SLO-2					

Learning Resources	<ol style="list-style-type: none"> <li>1. Thomas H Cormen, Charles E Leiserson, Ronald L Revest, Clifford Stein, Introduction to Algorithms, 3<sup>rd</sup> ed., The MIT Press Cambridge, 2014</li> <li>2. Mark Allen Weiss, Data Structures and Algorithm Analysis in C, 2<sup>nd</sup> ed., Pearson Education, 2006</li> </ol>	<ol style="list-style-type: none"> <li>3. Ellis Horowitz, Sartaj Sahni, Sanguthevar, Rajesekaran, Fundamentals of Computer Algorithms, Galgotia Publication, 2010</li> <li>4. S. Sridhar, Design and Analysis of Algorithms, Oxford University Press, 2015</li> </ol>
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Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#		Theory	Practice
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice		
Level 1	Remember Understand	20%	20%	15%	15%	15%	15%	15%	15%	15%	15%
Level 2	Apply Analyze	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%
Level 3	Evaluate Create	10%	10%	15%	15%	15%	15%	15%	15%	15%	15%
	Total	100 %		100 %		100 %		100 %		100 %	

# CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. G. Venkateswaran, Wipro Technologies, gvenki@pilani.bits-pilani.ac.in	1. Mitesh Khapra, IITM Chennai, miteshk@cse.iitm.ac.in	1. Mr.K.Senthil Kumar, SRMIST
2. Dr.Sainarayanan Gopalakrishnan, HCL Technologies, sai.jgk@gmail.com	2. V. Masilamani. IIITDM, masila@iiitdm.ac.in	2. Dr.A.Razia Sulthana, SRMIST
		3. Mr. V. Sivakumar, SRMIST
		4. Ms. R. Vidhya, SRMIST

Course Code	18CSC205J	Course Name	OPERATING SYSTEMS	Course Category	C	Professional Core	L	T	P	C
							3	0	2	4

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Computer Science and Engineering		Data Book / Codes/Standards	Nil	

Course Learning Rationale (CLR):	The purpose of learning this course is to:			Learning			Program Learning Outcomes (PLO)																	
CLR-1 :	Introduce the key role of an Operating system			1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15			
CLR-2 :	Insist the Process Management functions of an Operating system			Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3			
CLR-3 :	Emphasize the importance of Memory Management concepts of an Operating system						H	H	H	H	H	H	M	L	M	M	H	M	M	M	H	H	H	M
CLR-4 :	Realize the significance of Device Management part of an Operating system						H	H	H	H	H	H	M	L	M	M	H	M	M	M	H	H	H	M
CLR-5 :	Comprehend the need of File Management functions of an Operating system						H	H	H	H	H	H	M	L	M	M	H	M	M	M	H	H	H	M
CLR-6 :	Explore the services offered by the Operating system practically						H	H	H	H	H	H	M	L	M	M	H	M	M	M	H	H	H	M

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:			1	80	70	H	H	H	H	H	M	L	M	M	M	M	H	H	H	M
CLO-1 :	Identify the need of an Operating system			1	85	75	H	H	H	H	M	L	M	M	M	M	M	H	H	H	M
CLO-2 :	Know the Process management functions of an Operating system			1	75	70	H	H	H	H	M	L	M	M	M	M	M	H	H	H	M
CLO-3 :	Understand the need of Memory Management functions of an Operating system			2	85	80	H	H	H	H	M	L	M	M	M	M	M	H	H	H	M
CLO-4 :	Find the significance of Device management role of an Operating system			2	85	75	H	H	H	H	M	L	M	M	M	M	M	H	H	H	M
CLO-5 :	Recognize the essentials of File Management part of an Operating system			3	80	70	H	H	H	H	M	L	M	M	M	M	M	H	H	H	M
CLO-6 :	Gain an insight of Importance of an Operating system through practical						H	H	H	H	M	L	M	M	M	M	M	H	H	H	M

Duration (hour)	15		15		15		15		15	
S-1	SLO-1	Operating System Objectives and functions	PROCESS SYNCHRONIZATION : Peterson's solution, Synchronization Hardware	MEMORY MANAGEMENT: Memory Management: Logical Vs Physical address space, Swapping	VIRTUAL MEMORY- Background		STORAGE MANAGEMENT : Mass storage structure – Overview of Mass storage structure – Magnetic Disks			
	SLO-2	Gaining the role of Operating systems	Understanding the two-process solution and the benefits of the synchronization hardware	Understanding the basics of Memory management	Understanding the need of demand paging		Understanding the Basics in storage management			
S-2	SLO-1	The evolution of operating system, Major achievements	Process synchronization: Semaphores, usage, implementation	Contiguous Memory allocation – Fixed and Dynamic partition	VIRTUAL MEMORY – Basic concepts – page fault handling		Disk Scheduling			
	SLO-2	Understanding the evolution of Operating systems from early batch processing systems to modern complex systems	Gaining the knowledge of the usage of the semaphores for the Mutual exclusion mechanisms	Getting to know about Partition memory management and issues: Internal fragmentation and external fragmentation problems	Understanding , how an OS handles the page faults		Understanding the various scheduling with respect to the disk			
S-3	SLO-1	OS Design considerations for Multiprocessor and Multicore	Classical Problems of synchronization – Readers writers problem, Bounded Buffer problem	Strategies for selecting free holes in Dynamic partition	Performance of Demand paging		FILE SYSTEM INTERFACE: File concept, File access methods			
	SLO-2	Understanding the key design issues of Multiprocessor Operating systems and	Good understanding of synchronization mechanisms	Understanding the allocation strategies with examples	Understanding the relationship of effective access time and the page fault rate		Understanding the file basics			

		<i>Multicore Operating systems</i>				
S 4-5	SLO-1	LAB 1 : Understanding the booting process of Linux	LAB4 : System admin commands – Basics	LAB7: Shell Programs – Basic level	LAB10 : Overlay concept	LAB13:Process synchronization
	SLO-2					
S-6	SLO-1	PROCESS CONCEPT– Processes, PCB	Classical Problems of synchronization – Dining Philosophers problem (Monitor)	Paged memory management	Copy-on write	File sharing and Protection
	SLO-2	Understanding the Process concept and Maintenance of PCB by OS	Understanding synchronization of limited resources among multiple processes	Understanding the Paging technique.PMT hardware mechanism	Understanding the need for Copy-on write	Emphasis the need for the file sharing and its protection
S-7	SLO-1	Threads – Overview and its Benefits	CPU SCHEDULING : FCFS,SJF,Priority	Structure of Page Map Table	Page replacement Mechanisms: FIFO, Optimal, LRU and LRU approximation Techniques	FILE SYSTEM IMPLEMENTATION : File system structure
	SLO-2	Understanding the importance of threads	Understanding the scheduling techniques	Understanding the components of PMT	Understanding the Pros and cons of the page replacement techniques	To get the basic file system structure
S-8	SLO-1	Process Scheduling : Scheduling Queues, Schedulers, Context switch	CPU Scheduling: Round robin, Multilevel queue Scheduling, Multilevel feedback Scheduling	Example : Intel 32 bit and 64 –bit Architectures	Counting based page replacement and Page Buffering Algorithms	Directory Implementation
	SLO-2	Understanding basics of Process scheduling	Understanding the scheduling techniques	Understanding the Paging in the Intel architectures	To know on additional Techniques available for page replacement strategies	Understanding the various levels of directory structure
S 9-10	SLO-1	LAB2 : Understanding the Linux file system	LAB5: System admin commands – Simple task automations	LAB 8: Process Creation	LAB11: IPC using Pipes	LAB14 : Study of OS161
	SLO-2					
S-11	SLO-1	Operations on Process – Process creation, Process termination	Real Time scheduling: Rate Monotonic Scheduling and Deadline Scheduling	Example : ARM Architectures	Allocation of Frames - Global Vs Local Allocation	FILE SYSTEM IMPLEMENTATION :Allocation methods
	SLO-2	Understanding the system calls – fork(),wait(),exit()	Understanding the real time scheduling	Understanding the Paging with respect to ARM	Understanding the root cause of the Thrashing	Understanding the pros and Cons of various disk allocation methods
S-12	SLO-1	Inter Process communication : Shared Memory, Message Passing ,Pipe()	DEADLOCKS: Necessary conditions, Resource allocation graph, Deadlock prevention methods	Segmented memory management	Thrashing, Causes of Thrashing	FILE SYSTEM IMPLEMENTATION :Free space Management
	SLO-2	Understanding the need for IPC	Understanding the deadlock scenario	Understanding the users view of memory with respect to the primary memory	Understanding the Thrashing	Understanding the methods available for maintaining the free spaces in the disk
S-13	SLO-1	PROCESS SYNCHRONIZATION: Background, Critical section Problem	Deadlocks :Deadlock Avoidance, Detection and Recovery	Paged segmentation Technique	Working set Model	Swap space Management
	SLO-2	Understanding the race conditions and the need for the Process synchronization	Understanding the deadlock avoidance, detection and recovery mechanisms	Understanding the combined scheme for efficient management	Understanding the working set model for controlling the Working set Model	Understanding the Low-level task of the OS
S 14-15	SLO-1	LAB3: Understanding the various Phases of Compilation of a 'C' Program	LAB6 : Linux commands	LAB9: Overlay concept	LAB12: IPC using shared memory and Message queues	LAB15 : Understanding the OS161 filesystem and working with test programs
	SLO-2					

Learning Resources	<ol style="list-style-type: none"> <li>1. Abraham Silberschatz, Peter Baer Galvin, Greg Gagne, Operating systems, 9<sup>th</sup> ed., John Wiley &amp; Sons, 2013</li> <li>2. William Stallings, Operating Systems-Internals and Design Principles, 7<sup>th</sup> ed., Prentice Hall, 2012</li> </ol>	<ol style="list-style-type: none"> <li>3. Andrew S. Tanenbaum, Herbert Bos, Modern Operating systems, 4<sup>th</sup> ed., Pearson, 2015</li> <li>4. Bryant O'Hallaxn, Computer systems- A Programmer's Perspective, Pearson, 2015</li> </ol>
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Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember Understand	20%	20%	15%	15%	15%	15%	15%	15%	15%	15%
Level 2	Apply Analyze	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%
Level 3	Evaluate Create	10%	10%	15%	15%	15%	15%	15%	15%	15%	15%
	Total	100 %		100 %		100 %		100 %		100 %	

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Mr. Balamurugan, Infosys, balams@gmail.com	1. Dr. Latha Parthiban, Pondicherry University, lathaparthiban@yahoo.com	1. Dr.G.Maragatham, SRMIST 2. Mr. Eliazer M, SRMIST
		3. Ms. Aruna S, SRMIST

Course Code	18CSC206J	Course Name	SOFTWARE ENGINEERING AND PROJECT MANAGEMENT	Course Category	C	Professional Core	L	T	P	C
							3	0	2	4

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Computer Science and Engineering		Data Book / Codes/Standards	Nil	

Course Learning Rationale (CLR):	The purpose of learning this course is to:			Learning			Program Learning Outcomes (PLO)														
CLR-1 :	Familiarize the software life cycle models and software development process			1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CLR-2 :	Understand the various techniques for requirements, planning and managing a technology project			Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3
CLR-3 :	Examine basic methodologies for software design, development, testing, closure and implementation.																				
CLR-4 :	Understand manage users expectations and the software development team																				
CLR-5 :	Acquire the latest industry knowledge, tools and comply to the latest global standards for project management																				
Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:																				
CLO-1 :	Identify the process of project life cycle model and process			1	85	80	H	H	L	-	-	-	L	-	H	H	M	M	-	-	-
CLO-2 :	Analyze and specify software requirements through a productive working Relationship with project stakeholders			2	80	75	H	H	H	H	H	-	M	-	H	H	H	M	-	-	-
CLO-3 :	Design the system based on Functional Oriented and Object Oriented Approach for Software Design.			3	85	85	H	H	M	H	H	M	M	L	H	H	M	-	-	-	-
CLO-4 :	Develop the correct and robust code for the software products			3	85	85	H	H	H	-	H	-	-	M	H	M	H	-	-	-	-
CLO-5 :	Perform by applying the test plan and various testing techniques			2	85	75	H	M	M	M	M	M	M	-	H	H	-	M	-	-	-

Duration (hour)	15		15		15		15		15	
S-1	SLO-1	Introduction to Software Engineering	Software Design - Software Design Fundamentals	Software Construction	Introduction to testing	Product Release				
	SLO-2	Software Project Management - life cycle activities	Design Standards - Design Type	Coding Standards	Verification	Product Release				
S-2	SLO-1	Traditional – Waterfall, V Model	Design model – Architectural design, Software architecture	Coding Framework	Validation	Product Release Management				
	SLO-2	Prototype, Spiral, RAD	Software Design Methods	Reviews - Desk checks (Peer Reviews)	Test Strategy	Product Release Management				
S-3	SLO-1	Conventional – Agile,	Top Down , Bottom Up	Walkthroughs	Planning	Implementation				
	SLO-2	XP, Scrum	Module Division (Refactoring)	Code Reviews, Inspections	Example: Test Strategy and Planning	Implementation				
S 4-5	SLO-1	Lab1:Identify the Software Project, Create Business Case, Arrive at a Problem Statement	Lab 4:Prepare Project Plan based on scope, Find Job roles and responsibilities, Calculate Project effort based on resources	Lab 7:State and Sequence Diagram, Deployment Diagram, Sample Frontend Design (UI/UX)	Lab 10: Module Implementation (Phase 2), Scrum Master to Induce New Issues in Agile Development	Lab 13:Manual Testing				
	SLO-2									
S-6	SLO-1	Introduction to Requirement Engineering	Module Coupling	Coding Methods	Test Project Monitoring and Control	User Training				
	SLO-2	Requirements Elicitation	Component level design	Structured Programming	Test Project Monitoring and Control	Maintenance Introduction				
S-7	SLO-1	Software Project Effort and cost estimation	User Interface Design	Object-Oriented Programming	Test Project Monitoring and Control	Maintenance Types - Corrective				
	SLO-2	Cost estimation	Pattern oriented design	Automatic Code Generation	Test Project Monitoring and Control	Adaptive				
S-8	SLO-1	Cococo 1 and 2	Web application design	Automatic Code Generation	Test Project Monitoring and Control	Perfective				
	SLO-2	Cococo 1 and 2	Web application design	Automatic Code Generation	Test Project Monitoring and Control	Preventive				

S 9-10	SLO-1	Lab 2:Stakeholder and User Description, Identify the appropriate Process Model, Comparative study with Agile Model	Lab 5:Prepare the Work, Breakdown Structure based on timelines, Risk Identification and Plan	Lab 8:Module Description, Module Implementation (phase 1) Using Agile	Lab 11:Module Implementation (Phase 3) Scrum Master to Induce New requirements in Agile Development, Scrum Master to Induce New Issues in Agile Development, Code Documentation	Lab 14:User Manual, Analysis of Costing, Effort and Resources
	SLO-2					
S-11	SLO-1	Risk Management	Design Reuse	Software Code Reuse	Design –Master test plan, types	Maintenance Cost
	SLO-2	Risk Management	Design Reuse	Software Code Reuse	Design –Master test plan, types	Maintenance Process
S-12	SLO-1	Configuration management	Concurrent Engineering in Software Design	Pair Programming	Test Case Management	life cycle
	SLO-2	Configuration management	Concurrent Engineering in Software Design	Test-Driven Development	Test Case Management	Software Release
S-13	SLO-1	Project Planning – WBC, planning, scope, risk	Design Life-Cycle Management	Configuration Management	Test Case Reporting	Software Maintenance
	SLO-2		Design Life-Cycle Management	Software Construction Artifacts	Test Case Reporting	Software Release, Software Maintenance
S 14-15	SLO-1	Lab 3:Identify the Requirements, System Requirements, Functional Requirements, Non-Functional Requirements	Lab 6:Design a System Architecture, Use Case Diagram, ER Diagram (Database), DFD Diagram (process) (Upto Level 1), Class Diagram (Applied For OOPS based Project), Collaboration Diagram (Applied For OOPS based Project) (Software – Rational Rose)	Lab 9:Module Implementation, Scrum Master to Induce New requirements in Agile Development	Lab 12:Master Test Plan, Test Case Design (Phase 1)	Lab 15: Project Demo and Report Submission with the team
	SLO-2					

Learning Resources	<ol style="list-style-type: none"> <li>1. Roger S. Pressman, <i>Software Engineering – A Practitioner Approach</i>, 6<sup>th</sup> ed., McGraw Hill, 2005</li> <li>2. Ian Sommerville, <i>Software Engineering</i>, 8<sup>th</sup> ed., Pearson Education, 2010</li> <li>3. Rajib Mall, <i>Fundamentals of Software Engineering</i>, 4<sup>th</sup> ed., PHI Learning Private Limited, 2014</li> <li>4. Ramesh, Gopaldaswamy, <i>Managing Global Projects</i>, Tata McGraw Hill, 2005</li> </ol>	<ol style="list-style-type: none"> <li>5. Ashfaque Ahmed, <i>Software Project Management: a process-driven approach</i>, Boca Raton, Fla: CRC Press, 2012</li> <li>6. Walker Royce, <i>Software Project Management</i>, Pearson Education, 1999</li> <li>7. Jim Smith <i>Agile Project Management: Creating Innovative Products</i>, Pearson 2008</li> </ol>
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#### Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#		Theory	Practice
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice		
Level 1	Remember Understand	20%	20%	15%	15%	15%	15%	15%	15%	15%	15%
Level 2	Apply Analyze	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%
Level 3	Evaluate Create	10%	10%	15%	15%	15%	15%	15%	15%	15%	15%
	Total	100 %		100 %		100 %		100 %		100 %	

# CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

#### Course Designers

Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Mr. Girish Raghavan, Wipro Technologies	1. Dr. Latha Parthiban, Pondicherry University, lathaparthiban@yahoo.com	1. Mrs. Sasi Rekha Sankar, SRMIST
2. Dr.Mariappan Vaithilingam, Amazon, Bangalore	2. V. Masilamani. IIITDM, masila@iiitdm.ac.in	2. Dr. T.S.Shiny Angel, SRMIST
		3. Mr.N.Arivazhagan, SRMIST
		4. Mrs K.R.Jansi, SRMIST



Course Code	18CSC207J	Course Name	ADVANCED PROGRAMMING PRACTICE	Course Category	C	Professional Core	L	T	P	C
							3	0	2	4

Pre-requisite Courses	18CSC202J	Co-requisite Courses	18CSC204J	Progressive Courses	Nil
Course Offering Department	Computer Science and Engineering		Data Book / Codes/Standards	Nil	

Course Learning Rationale (CLR):	The purpose of learning this course is to:			Learning			Program Learning Outcomes (PLO)														
CLR-1 :	Create Real-time Application Programs using structured, procedural and object oriented programming paradigms			1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CLR-2 :	Create Real-time Application Programs using event driven, declarative and imperative programming paradigms			Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3
CLR-3 :	Create Real-time Application Programs using parallel, concurrent and functional programming paradigms																				
CLR-4 :	Create Real-time Application Programs using logic, dependent type and network programming paradigms																				
CLR-5 :	Create Real-time Application Programs using symbolic, automata based and graphical user interface program paradigm																				
CLR-6 :	Create Real-time Application Programs using different programming paradigms using python language																				

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:			3	85	80	H	H	H	H	H	-	-	L	M	M	L	M	-	-	-
CLO-1 :	Create Programs using structured, procedural and object oriented programming paradigms			3	85	80	H	H	H	H	H	-	-	L	M	M	L	M	-	-	-
CLO-2 :	Create Programs using event driven, declarative and imperative programming paradigms			3	85	80	H	H	H	H	H	-	-	L	M	M	L	M	-	-	-
CLO-3 :	Create Programs using parallel, concurrent and functional programming paradigms			3	85	80	H	H	H	H	H	-	-	L	M	M	L	M	-	-	-
CLO-4 :	Create Programs using logic, dependent type and network programming paradigms			3	85	80	H	H	H	H	H	-	-	L	M	M	L	M	-	-	-
CLO-5 :	Create Programs using symbolic, automata based and graphical user interface programming paradigms			3	85	80	H	H	H	H	H	-	-	L	M	M	L	M	-	-	-
CLO-6 :	Create Programs using different programming paradigms using python language			3	85	80	H	H	H	H	H	-	-	L	M	M	L	M	-	-	-

Duration (hour)	15		15		15		15		15	
S-1	SLO-1	Structured Programming Paradigm	Event Driven Programming Paradigm	Parallel Programming Paradigm	Logic Programming Paradigm	Symbolic Programming Paradigm				
	SLO-2	Programming Language Theory	Event Object, handler, bind	Multi-threading, Multi-Processing	First-class function, Higher-order function, Pure functions, Recursion	Symbolic Maths, algebraic manipulations, limits, differentiation, integration, series				
S-2	SLO-1	Bohm-Jacopini structured program theorem	Keypress events, Mouse events	Serial Processing, Parallel Processing	Packages: Kanren, SymPy	SymPy usage for symbolic maths				
	SLO-2	Sequence, selection, decision, iteration, recursion	Automatic events from a timer	Multiprocessing module in Python	PySWIP, PyDatalog	Equation Solving, Matrices				
S-3	SLO-1	Other languages: C, C++, Java, C#, Ruby	Other languages: Algol, Javascript, Elm	Process class, Pool class	Other languages: Prolog, ROOP, Janus	Other languages: Aurora, LISP, Wolfram				
	SLO-2	Demo: Structured Programming in Python	Demo: Event Driven Programming in Python	Demo: Parallel Programming in Python	Demo: Logic Programming in Python	Demo: Symbolic Programming in Python				
S 4-5	SLO-1	Lab 1: Structured Programming	Lab 4: Event Driven Programming	Lab 7: Parallel Programming	Lab 10: Logic Programming	Lab 13: Symbolic Programming				
	SLO-2	Lab 2: Structured Programming	Lab 5: Event Driven Programming	Lab 8: Parallel Programming	Lab 11: Logic Programming	Lab 14: Symbolic Programming				
S-6	SLO-1	Procedural Programming Paradigm	Declarative Programming Paradigm	Concurrent Programming Paradigm	Dependent Type Programming Paradigm	Automata Based Programming Paradigm				
	SLO-2	Routines, Subroutines, functions	Sets of declarative statements	Parallel Vs Concurrent Programming	Logic Quantifier: for all, there exists	Finite State Machine, deterministic finite automaton (dfa), nfa				
S-7	SLO-1	Using Functions in Python	Object attribute, Binding behavior	threading, multiprocessing	Dependent functions, dependent pairs	State transitions using python-automaton				
	SLO-2	logical view, control flow of procedural	Creating Events without describing flow	concurrent.futures, gevent, greenlets,	Relation between data and its computation	Initial state, destination state, event				

		<i>programming in various aspects</i>		<i>celery</i>		<i>(transition)</i>
S-8	SLO-1	Other languages: Bliss, ChucK, Matlab	Other languages: Prolog, Z3, LINQ, SQL	Other languages: ANI, Plaid	Other Languages: Idris, Agda, Coq	Other languages: Forth, Ragel, SCXML
	SLO-2	Demo: creating routines and subroutines using functions in Python	Demo: Declarative Programming in Python	Demo: Concurrent Programming in Python	Demo: Dependent Type Programming in Python	Demo: Automata Based Programming in Python
S 9-10	SLO-1	Lab 2: Procedural Programming	Lab 5: Declarative Programming	Lab 8: Concurrent Programming	Lab 11: Dependent Type Programming	Lab 14: Automata Programming
	SLO-2					
S-11	SLO-1	Object Oriented Programming Paradigm	Imperative Programming Paradigm	Functional Programming Paradigm	Network Programming Paradigm	GUI Programming Paradigm
	SLO-2	Class, Objects, Instances, Methods	Program State, Instructions to change the program state	Sequence of Commands	Socket Programming: TCP & UDP Connection oriented, connectionless	Graphical User Interface (GUI)
S-12	SLO-1	Encapsulation, Data Abstraction	Combining Algorithms and Data Structures	map(), reduce(), filter(), lambda	Sock_Stream, Sock_Dgram, socket(), bind(), recvfrom(), sendto(), listen()	Tkinter, WxPython, JPython
	SLO-2	Polymorphism, Inheritance	Imperative Vs Declarative Programming	partial, functools	Server-Client; send(), recv(), connect(), accept(), read(), write(), close()	WxWidgets, PyQt5
S-13	SLO-1	Constructor, Destructor	Other languages: PHP, Ruby, Perl, Swift	Other languages: F#, Clojure, Haskell	Other languages: PowerShell, Bash, TCL	Other languages: GTK, java-gnome
	SLO-2	Example Languages: BETA, Cecil, Lava Demo: OOP in Python	Demo: Imperative Programming in Python	Demo: Functional Programming in Python	Demo: Socket Programming in Python	Demo: GUI Programming in Python
S 14-15	SLO-1	Lab 3: Object Oriented Programming	Lab 6: Imperative Programming	Lab 9: Functional Programming	Lab 12: Network Programming	Lab 15: GUI Programming
	SLO-2					

Learning Resources	<ol style="list-style-type: none"> <li>1. Elad Shalom, <i>A Review of Programming Paradigms throughout the History: With a suggestion Toward a Future Approach</i>, Kindle Edition, 2018</li> <li>2. John Goerzen, Brandon Rhodes, <i>Foundations of Python Network Programming: The comprehensive guide to building network applications with Python</i>, 2<sup>nd</sup> ed., Kindle Edition, 2010</li> <li>3. Elliot Forbes, <i>Learning Concurrency in Python: Build highly efficient, robust and concurrent applications</i>, Kindle Edition, 2017</li> </ol>	<ol style="list-style-type: none"> <li>4. Amit Saha, <i>Doing Math with Python: Use Programming to Explore Algebra, Statistics, Calculus and More</i>, Kindle Edition, 2015</li> <li>5. Alan D Moore, <i>Python GUI Programming with Tkinter: Develop responsive and powerful GUI applications with Tkinter</i>, Kindle Edition, 2018</li> <li>6. <a href="https://www.scipy-lectures.org/">https://www.scipy-lectures.org/</a></li> </ol>
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Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#		Theory	Practice
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice		
Level 1	Remember Understand	20%	20%	15%	15%	15%	15%	15%	15%	15%	15%
Level 2	Apply Analyze	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%
Level 3	Evaluate Create	10%	10%	15%	15%	15%	15%	15%	15%	15%	15%
	Total	100 %		100 %		100 %		100 %		100 %	

# CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Mr. Sagar Sahani, Amadeus Software Labs, Bangalore, <a href="mailto:hello.sagarsahni@gmail.com">hello.sagarsahni@gmail.com</a>	1. Dr. Rajeev Sukumaran, IIT Madras, <a href="mailto:rajeev@wmail.iitm.ac.in">rajeev@wmail.iitm.ac.in</a>	1. Dr. R. Annie Uthra, SRMIST
2. Mr. Janmajay Singh, Fuji Xerox R&D, Japan, <a href="mailto:janmajaysingh14@gmail.com">janmajaysingh14@gmail.com</a>	2. Prof. R. Golda Brunet, GCE, <a href="mailto:goldabrunet@gcessalem.edu.in">goldabrunet@gcessalem.edu.in</a>	2. Dr. Christhu Raj M R, SRMIST
		3. Ms. K. Somalakshmi, SRMIST
		4. Mr. C. Arun, SRMIST

# ACADEMIC CURRICULA

## Professional Core Courses

### COMPUTER SCIENCE AND ENGINEERING

Regulations - 2018



**SRM**

INSTITUTE OF SCIENCE & TECHNOLOGY  
*(Deemed to be University u/s 3 of UGC Act, 1956)*

**SRM INSTITUTE OF SCIENCE AND TECHNOLOGY**

**(Deemed to be University u/s 3 of UGC Act, 1956)**

**Kattankulathur, Kancheepuram, Tamil Nadu, India**

Course Code	18CSC301T	Course Name	FORMAL LANGUAGE AND AUTOMATA	Course Category	C	Professional Core	L	T	P	C
							3	0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Computer Science and Engineering		Data Book / Codes/Standards	Nil	

Course Learning Rationale (CLR):	The purpose of learning this course is to:			Learning			Program Learning Outcomes (PLO)																	
CLR-1:	Utilize the mathematics and engineering principles for the basics of Formal Language			1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15			
CLR-2:	Acquire knowledge of Automata and minimize with Regular language's			Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3			
CLR-3:	Acquire knowledge of Context free Grammar and simplify using normal forms						M	H	-	H	L	-	-	-	L	L	-	H	-	-	-	-	-	-
CLR-4:	Gain knowledge to push down automata and apply it with CFL						M	H	L	M	L	-	-	-	M	L	-	H	-	-	-	-	-	-
CLR-5:	Analyze the methods of turning machine						M	H	M	H	L	-	-	-	M	L	-	H	-	-	-	-	-	-
CLR-6:	Analyze and Design the methods of computational complexity						H	H	M	H	L	-	-	-	M	L	-	H	-	-	-	-	-	-
Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:						3	80	70	L	H	-	H	L	-	-	-	L	L	-	H	-	-	-
CLO-1:	Acquire the knowledge of mathematics and engineering principles for the basics of Formal Language			3	80	70	M	H	L	M	L	-	-	-	M	L	-	H	-	-	-			
CLO-2:	Acquire the ability to identify specification of a Regular language's with Automata			3	85	75	M	H	M	H	L	-	-	-	M	L	-	H	-	-	-			
CLO-3:	Acquire knowledge of Context free Grammar and simplify using normal forms			3	75	70	M	H	M	H	L	-	-	-	M	L	-	H	-	-	-			
CLO-4:	Understand the concepts of push down automata and CFL.			3	85	80	M	H	M	H	L	-	-	-	M	L	-	H	-	-	-			
CLO-5:	Apply the knowledge to turning machine and its methods			3	85	75	H	H	M	H	L	-	-	-	M	L	-	H	-	-	-			
CLO-6:	Design the computational and acceptor machines using FA, PDA and Turing machines			3	80	70	L	H	-	H	L	-	-	-	L	L	-	H	-	-	-			

Duration (hour)	11		9		9		9		7		
S-1	SLO-1	Introduction to Automaton	Grammars: Introduction: Types of Grammar	Pushdown Automata: Definitions Moves	Turing Machines: Introduction	Undecidability :Basic definitions					
	SLO-2	Mathematical concepts	Context Free Grammars and Languages	Instantaneous descriptions	Formal definition of Turing machines, Instantaneous descriptions	Decidable problems,					
S-2	SLO-1	Formal Languages: Strings, Languages, Properties	Derivations	Deterministic pushdown automata	Turing Machine as Acceptors	Examples of undecidable problems and Problems					
	SLO-2	Finite Representation : Regular Expressions	Ambiguity	Problems related to DPDA	Problems related to turning machine as Acceptors	Rice's Theorem					
S-3	SLO-1	Problems related to regular expressions	Relationship between derivation and derivation trees	Non - Deterministic pushdown automata	Problems related to turning machine as Acceptors	Undecidable problems about Turing Machine- Post's Correspondence Problem					
	SLO-2	Finite Automata :Deterministic Finite Automata	Problems related to Context free Grammar	Problems related to NDPDA		Problems related to Post's Correspondence Problem					
S-4	SLO-1	Nondeterministic Finite Automata	Simplification of CFG :	Problems related to DPDA and NDPDA	Turing Machine as a Computing Device	Properties of Recursive and Recursively enumerable languages					
	SLO-2	Finite Automaton with $\epsilon$ - moves	Elimination of Useless Symbols		Problems related to turning Turing Machine as a Computing Device						
S-5	SLO-1	Problems related to Deterministic and Nondeterministic Finite Automata	Simplification of CFG : Unit productions	Pushdown automata to CFL Equivalence	Problems related to turning Turing Machine as a Computing Device	Introduction to Computational Complexity: Definitions					
	SLO-2	Problems related to Finite Automaton with $\epsilon$ - moves	Simplification of CFG : Null productions	Problems related to Equivalence of PDA to CFG		Time and Space complexity of TMs					

Duration (hour)	11		9	9	9	7
S-6	SLO-1	Equivalence of NFA and DFA	Problems related to Simplification of CFG	Problems related to Equivalence of PDA to CFG	Techniques for Turing Machine Construction	Complexity classes: Class P, Class NP
	SLO-2	Heuristics to Convert NFA to DFA	Chomsky normal form	CFL to Pushdown automata Equivalence	Considering the state as a tuple	Complexity classes: Introduction to NP-Hardness
S-7	SLO-1	Equivalence of NDFA's with and without $\epsilon$ -moves	Problems related to CNF	Problems related to Equivalence of CFG to PDA	Considering the tape symbol as a tuple	NP Completeness
	SLO-2	Problems related Equivalence of NDFA's with and without $\epsilon$ -moves	Greiback Normal form	Pumping lemma for CFL	Checking off symbols	
S-8	SLO-1	Minimization of DFA	Problems related to GNF	Problems based on pumping Lemma	Modifications of Turing Machine	
	SLO-2	Problems related to Minimization of DFA			Multi-tape Turing Machine	
S-9	SLO-1	Regular Languages : Equivalence of Finite Automata and Regular Languages			Non-Deterministic Turing Machine	
	SLO-2	Equivalence of Finite Automata and Regular Grammars			Semi-Infinite Tape Turing Machine	
S-10	SLO-1	Problems related to Equivalence of Finite Automata and Regular Languages and Regular Grammars				
	SLO-2	Variants of Finite Automata :Two-way Finite Automaton Mealy Machines				
S-11	SLO-1	Properties of Regular Languages: Closure Properties				
	SLO-2	Set Theoretic Properties & Other Properties				
	SLO-3	Pumping Lemma				

Learning Resources	1. Hopcroft J.E., Motwani R. and Ullman J.D, "Introduction to Automata Theory, Languages and Computations", Second Edition, Pearson Education, 2008.	3. .John.C.Martin, "Introduction to Languages and the Theory of Computation" McGraw-Hill Education, 01- May-2010.
	2. Michael Sipser, "Introduction to the Theory of Computation" Cengage Learning, 2012.	4. Kamala Krithivasan, Rama.R, " Introduction to Formal Languages, Automata Theory and Computation", Pearson Education India, 01-Sep-2009. 5. Peter Linz , "An introduction to formal languages and automata", Jones & Bartlett Learning, 2001.

Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#		Theory	Practice
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice		
Level 1	Remember	40 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Understand										
Level 2	Apply	40 %	-	40 %	-	40 %	-	40 %	-	40%	-
	Analyze										
Level 3	Evaluate	20 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

# CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
		1. Dr.R.AnnieUthra
		2. Dr.Jeyasudha

Course Code	18CSC302J	Course Name	COMPUTER NETWORKS	Course Category	C	Professional Core	L	T	P	C
							3	0	2	4

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	CSE	Data Book / Codes/Standards			

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning			Program Learning Outcomes (PLO)														
CLR-1:	Describe the importance of various Internet protocols like ARP, RARP, ICMP, Multicasting and multi routing, SCTP	1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CLR-2:	Understand the transport layer protocols, application layer protocol and its characteristics	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3
CLR-3:	Learn and Understand IPV6 technologies																		
CLR-4:	Work with client server sockets and develop related applications to communicate with each other.																		
CLR-5:	Understand the wide area network protocols																		
CLR-6:	Learn the basics of DSL, ATM, HDLC, MPLS																		

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Learning			Program Learning Outcomes (PLO)														
CLO-1:	Identify the basics of different types of network and transport layer protocols	3	80	70	L	H	-	H	L	-	-	-	L	L	-	H	-	-	-
CLO-2:	Design and implement the socket programming	3	85	75	M	H	-	M	L	-	-	-	M	L	-	H	-	-	-
CLO-3:	Enumerate the types of application layer protocols	3	75	70	M	H	-	H	L	-	-	-	M	L	-	H	-	-	-
CLO-4:	Analyze and compare the IPv4 and IPv6 protocols	3	85	80	M	H	-	H	L	-	-	-	M	L	-	H	-	-	-
CLO-5:	Familiarize with wide area technologies	3	85	75	H	H	-	H	L	-	-	-	M	L	-	H	-	-	-
CLO-6:	Describe the working of DSL, ATM, PPP,	3	80	70	L	H	-	H	L	-	-	-	L	L	-	H	-	-	-

Duration (hour)	15		15		15		15		15	
S-1	SLO-1	IP header	Byte ordering	DNS	IPV6 Overview	DSL				
	SLO-2	IP fragmentation	Byte ordering conversion functions	DNS in the Internet,	IPV6 Features	Other DSL Technology				
S-2	SLO-1	ARP	System calls	DNS Resolution	IPV6 Addressing Modes	DSL Benefits				
	SLO-2	RARP	Sockets	DNS Messages	IPV6 Address Types	Cable Technology				
S-3	SLO-1	ICMP –introduction	System calls used with Sockets	TELNET	Introduction	Compare DSL Vs Cable				
	SLO-2	ICMP-Messages	Iterative and concurrent server	SSH	Address Space Allocation	Frame Relay, VPN				
S 4-5	SLO-1	Study of necessary header files with respect to socket programming.	UDP Echo Client Server Communication	Full Duplex Chat Using TCP/IP	ARP implementation Using UDP	Implementation of VPN				
	SLO-2									
S-6	SLO-1	Debugging tools	Socket Interface	FTP	Global Unicast Addresses	ATM Introduction				
	SLO-2	ICMP package	Structure and Functions of Socket	TFTP	Auto configuration	ATM Cell Format				
S-7	SLO-1	UDP Datagram	Remote Procedure Call	WWW Architecture	Renumbering	ATM Layer				
	SLO-2	UDP characteristics	RPC Model, Features	WWW Documents	IPV6 Routing Protocols	AAL Layer				
S-8	SLO-1	TCP Header	TCP Client Server Program	HTTP	Introduction	ATM Application				
	SLO-2	TCP connection establishment process	Input, Output Processing Module	HTTP Request and Reply	IPV6 Packet Format	PPP				
S 9-10	SLO-1	Study of Basic Functions of Socket Programming	Concurrent TCP/IP Day-Time Server	Implementation of File Transfer Protocol	Study of IPV6 Addressing & Subnetting	Communication Using HDLC				
	SLO-2									
S-11	SLO-1	TCP Error Control	UDP Client Server Program	DHCP Operation	Comparison between IPV4 and IPV6 Header	PPP Services, Components				

Duration (hour)	15	15	15	15	15	
S-12	SLO-2	TCP Congestion Control	UDP Control block table & Module	DHCP Configuration	IPV4 to IPV6 Tunneling	PPP frame and byte stuffing
	SLO-1	TCP Flow Control	UDP Input & Output Module	SMTP	IPV4 to IPV6 Translation Techniques	HDLC
	SLO-2	Multicasting	SCTP Sockets	POP3	NAT Protocol Translation	HDLC Transfer Modes, Frame
S-13	SLO-1	Multicasting and Multicast Routing Protocol	SCTP Services and Features, Packet Format	IMAP	IPV6 Mobility	Types of HDLC Frame
	SLO-2	Stream Control Transmission Protocol	SCTP Client/Server	MIME	Protocols Changed to Support IPV6	MPLS
S 14-15	SLO-1	Simple TCP/IP Client Server Communication	Half Duplex Chat Using TCP/IP	Remote Command Execution Using UDP	Implementation of NAT	Communication Using PPP
	SLO-2					

Learning Resources	<ol style="list-style-type: none"> <li>Behrouz A. Forouzan, "TCP IP Protocol Suite " 4th edition, 2010, McGraw-Hill ISBN: 0073376043</li> <li>Douglas E. Comer, Internetworking with TCP/IP, Principles, protocols, and architecture, Vol 1 5th Edition, 2006 ISBN: 0131876716, ISBN: 978-0131876712</li> </ol>	<ol style="list-style-type: none"> <li>Richard Stevens, Unix Network Programming, vol.1, 3rd edition, 2003, McGraw-Hill ISBN 0-07-246060-1</li> </ol>
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Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#		Theory	Practice
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice		
Level 1	Remember	20 %	20%	15 %	15%	15 %	15%	15 %	15%	15 %	15%
Level 2	Understand										
	Apply	20 %	20 %	20 %	20%	20 %	20%	20 %	20%	20 %	20%
Level 3	Analyze										
	Evaluate	10 %	10%	15 %	15%	15 %	15%	15 %	15%	15 %	15%
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

# CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Thamaraiselvam.S, Zoho Corporation. thamaraiselvams@gmail.com	1. Dr.Uma, Anna University ,umaramesh@auist.net	1. Dr.K.Venkatesh, SRMIST, 2. Dr.G.Usha, SRMIST
2. Mithun, Cognizant, Mithun.SS@cognizant.com	2. Dr.KunvarSingh, NIT Trichy, kunwar@nitt.edu	2. Dr.J.Kalaivani, SRMIST, 4. Mr.GodwinPon, SRMIST

Course Code	18CSC303J	Course Name	DATABASE MANAGEMENT SYSTEMS	Course Category	C	Professional Core	L	T	P	C
							3	0	2	4

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Computer Science and Engineering	Data Book / Codes/Standards			Nil

Course Learning Rationale (CLR):	<i>The purpose of learning this course is to:</i>	Learning			Program Learning Outcomes (PLO)														
CLR-1:	<i>Understand the fundamentals of Database Management Systems, Architecture and Languages</i>	1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CLR-2:	<i>Conceive the database design process through ER Model and Relational Model</i>	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3
CLR-3:	<i>Design Logical Database Schema and mapping it to implementation level schema through Database Language Features</i>				H	M	L	L	-	-	-	-	L	L	L	H	-	-	-
CLR-4:	<i>Familiarize queries using Structure Query Language (SQL) and PL/SQL</i>				H	H	H	H	H	-	-	-	H	H	H	H	-	-	-
CLR-5:	<i>Familiarize the Improvement of the database design using normalization criteria and optimize queries</i>				H	H	H	H	H	-	-	-	H	H	H	H	-	-	-
CLR-6:	<i>Understand the practical problems of concurrency control and gain knowledge about failures and recovery</i>				H	H	L	M	L	-	-	-	M	M	M	L	-	-	-
					H	L	L	L	L	-	-	-	H	L	L	L			

Course Learning Outcomes (CLO):	<i>At the end of this course, learners will be able to:</i>																			
CLO-1:	<i>Acquire the knowledge on DBMS Architecture and Languages</i>	3	80	70	H	M	L	L	-	-	-	-	L	L	L	H	-	-	-	
CLO-2:	<i>Apply the fundamentals of data models to model an application's data requirements using conceptual modeling tools like ER diagrams</i>	3	85	75	H	H	H	H	H	-	-	-	H	H	H	H	-	-	-	
CLO-3:	<i>Apply the method to convert the ER model to a database schemas based on the conceptual relational model</i>	3	75	70	H	H	H	H	H	-	-	-	H	H	H	H	-	-	-	
CLO-4:	<i>Apply the knowledge to create, store and retrieve data using Structure Query Language (SQL) and PL/SQL</i>	3	85	80	H	H	H	H	H	-	-	-	H	H	H	H	-	-	-	
CLO-5:	<i>Apply the knowledge to improve database design using various normalization criteria and optimize queries</i>	3	85	75	H	H	L	M	L	-	-	-	M	M	M	L	-	-	-	
CLO-6:	<i>Appreciate the fundamental concepts of transaction processing- concurrency control techniques and recovery procedures.</i>	3	85	75	H	L	L	L	L	-	-	-	H	L	L	L				

Duration (hour)	15	15	15	15	15
S-1	SLO-1 What is Database Management System	Database Design	Basics of SQL-DDL,DML,DCL,TCL	Relational Algebra – Fundamental Operators and syntax, relational algebra queries, Tuple relational calculus	Transaction concepts, properties of transactions,
	SLO-2 Advantage of DBMS over File Processing System	Design process	Structure Creation, alteration		
S-2	SLO-1 Introduction and applications of DBMS	Entity Relation Model	Defining Constraints-Primary Key, Foreign Key, Unique, not null, check, IN operator		Serial izability of transactions, testing for serial inability, System recovery,
	SLO-2 Purpose of database system				
S-3	SLO-1 Views of data	ER diagram	Functions-aggregation functions Built-in Functions-numeric, date, string functions, string functions, Set operations,	Pitfalls in Relational database, Decomposing bad schema Functional Dependency – definition, trivial and non-trivial FD	Concurrency Control
	SLO-2				
S 4-5	SLO-1 Lab 1: SQL Data Definition Language Commands on sample exercise * The abstract of the project to construct database must be framed	Lab4 Inbuilt functions in SQL on sample Exercise.	Lab 7 : Join Queries on sample exercise. * Frame and execute the appropriate DDL,DML,DCL,TCL for the project	Lab10: PL/SQL Procedures on sample exercise. * Frame and execute the appropriate Join Queries for the project	Lab 13: PL/SQL Exception Handling * Frame and execute the appropriate PL/SQL Procedures and Functions for the project
	SLO-2				
S-6	SLO-1 Database system Architecture	Keys , Attributes and Constraints	Sub Queries, correlated sub queries	closure of FD set , closure of attributes irreducible set of FD	Two- Phase Commit protocol, Recovery and Atomicity
	SLO-2				
S-7	SLO-1 Data Independence	Mapping Cardinality	Nested Queries, Views and its Types	Normalization – 1Nf, 2NF, 3NF,	Log-based recovery
	SLO-2				



Duration (hour)		15	15	15	15	15
S-8	SLO-1 SLO-2	The evolution of Data Models	Extended ER - Generalization, Specialization and Aggregation	Transaction Control Commands Commit, Rollback, Save point	Decomposition using FD- dependency preservation,	concurrent executions of transactions and related problems
S 9-10	SLO-1 SLO-2	Lab 2: SQL Data Manipulation Language Commands * Identification of project Modules and functionality	Lab 5: Construct a ER Model for the application to be constructed to a Database	Lab 8: Set Operators & Views. * Frame and execute the appropriate In- Built functions for the project	Lab 11: PL/SQL Functions * Frame and execute the appropriate Set Operators & Views for the project	Lab 14: PL/SQL Trigger * Frame and execute the appropriate PL/SQL Cursors and Exceptional Handling for the project
S-11	SLO-1 SLO-2	Degrees of Data Abstraction	ER Diagram Issues Weak Entity	PL/SQL Concepts- Cursors	BCNF	Locking mechanism, solution to concurrency related problems
S-12	SLO-1 SLO-2	Database Users and DBA	Relational Model	Stored Procedure, Functions Triggers and Exceptional Handling	Multi- valued dependency, 4NF	Deadlock
S-13	SLO-1 SLO-2	Database Languages	Conversion of ER to Relational Table	Query Processing	Join dependency and 5NF	two-phase locking protocol, Isolation, Intent locking
S 14-15	SLO-1 SLO-2	Lab 3: SQL Data Control Language Commands and Transaction control commands to the sample exercises * Identify the issues that can arise in a business perspective for the application	Lab 6: Nested Queries on sample exercise * Construction of Relational Table from the ER Diagram	Lab9: PL/SQL Conditional and Iterative Statements * Frame and execute the appropriate Nested Queries for the project	Lab 12: PL/SQL Cursors * Frame and execute the appropriate PL/SQL Conditional and Iterative Statements for the project	Lab 15 : * Frame and execute the appropriate PL/SQL Cursors and Exceptional Handling for the project * Demo of the project

Learning Resources	<ol style="list-style-type: none"> <li>1. Abraham Silberschatz, Henry F. Korth, S. Sudharshan, Database System ConceptsII, Sixth Edition, Tata McGraw Hill, 2011.</li> <li>2. Ramez Elmasri, Shamkant B. Navathe, Fundamentals of Database SystemsII, Sixth Edition, Pearson Education, 2011.</li> <li>3. C.J Date, A Kannan, S Swamynathan, An Introduction to Database Systems, Eight Edition, Pearson Education, 2006.</li> <li>4. Rajesh Narang, Database Management Systems, 2<sup>nd</sup> ed., PHI Learning Private Limited, 2011.</li> </ol>	<ol style="list-style-type: none"> <li>4. Martin Gruber, Understanding SQL, Sybex, 1990</li> <li>5. Sharad Maheshwari, Introduction to SQL and PL/SQL, 2<sup>nd</sup> ed., Laxmi Publications, 2016.</li> <li>6. Raghurama Krishnan, Johannes Gehrke, Database Management Systems, 3<sup>rd</sup> Edition, McGraw Hill Education, 2003.</li> </ol>
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Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#		Theory	Practice
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice		
Level 1	Remember Understand	20%	20%	15%	15%	15%	15%	15%	15%	15%	15%
Level 2	Apply Analyze	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%
Level 3	Evaluate Create	10%	10%	15%	15%	15%	15%	15%	15%	15%	15%
	Total	100 %		100 %		100 %		100 %		-	

# CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Dr. Mariappan Vaithilingam, Engineering Leader Amazon, dr.v.m@ieee.org		1. Ms. Sasi Rekha Sankar SRMIST
2. Mr. Badinath, SDET, Amzon, sbadhrinath@gmail.com		2. Mr. Elizer, SRMIST
		3. Mrs. Hemavathy, SRMIST

Course Code	18CSC304J	Course Name	COMPILER DESIGN	Course Category	C	Professional Core	L	T	P	C
							3	0	2	4

Pre-requisite Courses	18CSC301T	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Computer Science and Engineering		Data Book / Codes/Standards	Nil	

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning			Program Learning Outcomes (PLO)														
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CLR-1 :	Utilize the mathematics and engineering principles for the Design of Compilers				Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3
CLR-2 :	Acquire knowledge of Lexical Analyzer from a specification of a language's lexical rules				H	H	H	H	M	L	L	L	M	M	L	H	H	H	H
CLR-3 :	Acquire knowledge of Syntax Analyzer for parsing the sentences in a compiler grammar				H	H	H	H	M	L	L	L	M	M	L	H	H	H	H
CLR-4 :	Gain knowledge to translate a system into various intermediate codes				H	H	H	H	M	L	L	L	M	M	L	H	H	H	H
CLR-5 :	Analyze the methods of implementing a Code Generator for compilers				H	H	H	H	M	L	L	L	M	M	L	H	H	H	H
CLR-6 :	Analyze and Design the methods of developing a Code Optimizer				H	H	H	H	M	L	L	L	M	M	L	H	H	H	H

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-1 :	Utilize the mathematics and engineering principles for the Design of Compilers	3	80	70
CLR-2 :	Acquire knowledge of Lexical Analyzer from a specification of a language's lexical rules	3	85	75
CLR-3 :	Acquire knowledge of Syntax Analyzer for parsing the sentences in a compiler grammar	3	75	70
CLR-4 :	Gain knowledge to translate a system into various intermediate codes	3	85	80
CLR-5 :	Analyze the methods of implementing a Code Generator for compilers	3	85	75
CLR-6 :	Analyze and Design the methods of developing a Code Optimizer	3	80	70

Duration (hour)	15	15	15	15	15	
S-1	SLO-1	Compilers – Analysis of the source program	Syntax Analysis Definition - Role of parser	Bottom Up Parsing	Intermediate Code Generation	Code optimization
	SLO-2	Phases of a compiler – Cousins of the Compiler	Lexical versus Syntactic Analysis	Reductions	Intermediate Languages - prefix - postfix	Introduction– Principal Sources of Optimization
S-2	SLO-1	Grouping of Phases – Compiler construction tools	Representative Grammars	Handle Pruning	Quadruple - triple - indirect triples Representation	Function Preserving Transformation
	SLO-2	Lexical Analysis – Role of Lexical Analyzer	Syntax Error Handling	Shift Reduce Parsing	Syntax tree- Evaluation of expression - three-address code	Loop Optimization
S-3	SLO-1	Input Buffering	Elimination of Ambiguity, Left Recursion	Problems related to Shift Reduce Parsing	Synthesized attributes – Inherited attributes	Optimization of basic Blocks
	SLO-2	Specification of Tokens	Left Factoring	Conflicts During Shift Reduce Parsing	Intermediate languages – Declarations	Building Expression of DAG
S 4-5	SLO-1	Lab 1 - Implementation of Lexical Analyzer	Lab 4 Elimination of Ambiguity, Left Recursion and Left Factoring	Lab 7 - Shift Reduce Parsing	Lab 10-Intermediate code generation – Postfix, Prefix	Lab 13 Implementation of DAG
	SLO-2	Finite automation - deterministic	Top down parsing	LR Parsers- Why LR Parsers	Assignment Statements	Peephole Optimization
S-6	SLO-2	Finite automation - non deterministic	Recursive Descent Parsing, back tracking	Items and LR(0) Automaton, Closure of Item Sets,	Boolean Expressions, Case Statements	Basic Blocks, Flow Graphs
S-7	SLO-1	Transition Tables	Computation of FIRST	LR Parsing Algorithm	Back patching – Procedure calls	Next -Use Information
	SLO-2	Acceptance of Input Strings by Automata	Problems related to FIRST	Operator Precedence Parser Computation of LEADING	Code Generation	Introduction to Global Data Flow Analysis

Duration (hour)	15	15	15	15	15	
S-8	SLO-1	State Diagrams and Regular Expressions	Computation of FOLLOW	Computation of TRAILING	Issues in the design of code generator	Computation of gen and kill
	SLO-2	Conversion of regular expression to NFA – Thompson's	Problems related to FOLLOW	Problems related to LEADING AND TRAILING	The target machine – Runtime Storage management	Computation of in and out
S 9-10	SLO-1	Lab 2 conversion from Regular Expression to NFA	Lab 5 -FIRST AND FOLLOW computation	Lab 8- Computation of LEADING AND TRAILING	Lab 11 Intermediate code generation – Quadruple, Triple, Indirect triple	Lab 14 : Implementation of Global Data Flow Analysis
	SLO-2	Conversion of NFA to DFA	Construction of a predictive parsing table	SLR Grammars	A simple Code generator	Parameter Passing.
S-11	SLO-1	Simulation of an NFA	Predictive Parsers LL(1) Grammars	SLR Parsing Tables	Code Generation Algorithm	Runtime Environments
	SLO-2	Converting Regular expression directly to DFA	Transition Diagrams for Predictive Parsers	Problems related to SLR	Register and Address Descriptors	Source Language issues
S-12	SLO-1	Minimization of DFA	Error Recovery in Predictive Parsing	Construction of Canonical LR(1) and LALR	Generating Code of Assignment Statements	Storage Organization
	SLO-2	Minimization of NFA	Predictive Parsing Algorithm	Construction of LALR	Cross Compiler – T diagrams	Activation Records
S-13	SLO-1	Design of lexical analysis (LEX)	Non Recursive Predictive Parser	Problems related to Canonical LR(1) and LALR Parsing Table	Issues in Cross compilers	Storage Allocation strategies
	SLO-2	Lab 3 Conversion from NFA to DFA	Lab 6 Predictive Parsing Table	Lab9 Computation of LR(0) items	Lab 12 : A simple code Generator	Lab 15: Implement any one storage allocation strategies(heap, stack, static)

Learning Resources	1. AlfredVAho,JefferyDULLman,RaviSethi,"Compilers,Principlestechniquesandtools",Pearson Education2011	4. K.Muneeswaran,,"CompilerDesign",OxfordHigherEducation,Fourthedition2015
	2. S.GodfreyWinster,S.ArunaDevi,R.Sujatha,"CompilerDesign",YesdeePublishingPvt.Ltd,2016	5. DavidGalles,"ModernCompilerDesign",PearsonEducation,Reprint2012.
	3. WilliamM.WaiteandGerhardGoos.CompilerConstruction.Springer-Verlag,New York,2013.	6. RaghavanV.,,"PrinciplesofCompilerDesign",TataMcGrawHillEducationPvt.Ltd.,2010

Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50%weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#		Theory	Practice
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice		
Level 1	Remember	20%	20%	15%	15%	15%	15%	15%	15%	15%	15%
	Understand										
Level 2	Apply	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%
	Analyze										
Level 3	Evaluate	10%	10%	15%	15%	15%	15%	15%	15%	15%	15%
	Create										
	Total	100 %		100 %		100 %		100 %		-	

# CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
		1. Ms.R.Jeya
		2. Mrs.J. Jeyasudha

Course Code	18CSC305J	Course Name	ARTIFICIAL INTELLIGENCE	Course Category	C	Professional Core			
						L	T	P	C
						3	0	2	4

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Computer Science and Engineering		Data Book / Codes/Standards	Nil	

Course Learning Rationale (CLR):		The purpose of learning this course is to:			Learning			Program Learning Outcomes (PLO)														
					1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
					Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3
CLR-1:	Provide a broad understanding of the basic techniques for building intelligent computer systems and an understanding of how AI is applied to problems.							M	M	M	M	H	-	-	-	M	L	-	H	L	L	L
CLR-2:	Gain knowledge in problem formulation and building intelligent agents							M	H	H	H	H	-	-	-	M	L	-	H	M	L	M
CLR-3:	Understand the search technique procedures applied to real world problems							M	H	H	M	H	-	-	-	M	L	-	H	M	L	M
CLR-4:	Understand the types of logic and knowledge representation schemes							M	H	M	H	H	-	-	-	M	L	-	H	M	M	M
CLR-5:	Acquire knowledge in planning and learning algorithms							M	H	H	H	H	-	-	-	M	L	-	H	H	M	H
CLR-6:	Gain knowledge in AI Applications and advances in Artificial Intelligence							L	H	M	M	H	-	-	-	H	L	-	H	H	M	H
Course Learning Outcomes (CLO):		At the end of this course, learners will be able to:																				
CLO-1:	Formulate a problem and build intelligent agents				1	80	70	M	M	M	M	H	-	-	-	M	L	-	H	L	L	L
CLO-2:	Apply appropriate searching techniques to solve a real world problem				2	85	75	M	H	H	H	H	-	-	-	M	L	-	H	M	L	M
CLO-3:	Analyze the problem and infer new knowledge using suitable knowledge representation schemes				2	75	70	M	H	H	M	H	-	-	-	M	L	-	H	M	L	M
CLO-4:	Develop planning and apply learning algorithms on real world problems				2	85	80	M	H	M	H	H	-	-	-	M	L	-	H	M	M	M
CLO-5:	Design an expert system and implement natural language processing techniques				3	85	75	M	H	H	H	H	-	-	-	M	L	-	H	H	M	H
CLO-6:	Implement advance techniques in Artificial Intelligence				3	80	70	L	H	M	M	H	-	-	-	H	L	-	H	H	M	H

Duration (hour)	15	15	15	15	15	
S-1	SLO-1	Introduction to AI-AI techniques	Searching techniques- Uniformed search- General search Algorithm	Knowledge and reasoning-Approaches and issues of knowledge reasoning	Planning- Planning problems, Simple planning agent	Expert system-Architecture
	SLO-2	Problem solving with AI	Uniformed search Methods-Breadth first search	Knowledge base agents-Logic Basics	Planning languages	Pros and Cons of expert system
S-2	SLO-1	AI Models, Data acquisition and learning aspects in AI	Uniformed search Methods-Depth first search	Logic-Propositional logic-syntax ,semantics and inferences	Blocks world ,Goal stack planning	Rule based systems
	SLO-2	Problem solving- Problem solving process, Formulating problems	Uniformed search Methods-Depth limited search	Propositional logic- Reasoning patterns	Mean Ends Analysis	Frame based expert system
S-3	SLO-1	Problem types and characteristics	Uniformed search Methods- Iterative Deepening search	Predicate logic – Syntax and semantics, instance and is relationship	Non-linear Planning	Case study
	SLO-2	Problem space and search	Bi-directional search	Unification and Resolution	Conditional planning, Reactive planning	Case study
S-4-5	SLO-1	Lab 1: Implementation of toy problems	Lab4: Implementation and Analysis of DFS and BFS for an application	Lab 7: Implementation of unification and resolution for real world problems.	Lab 10 :Implementation of block world problem	Natural language processing-Levels of NLP
	SLO-2	Intelligent agent	Informed search- Generate and test, Best First search	Knowledge representation using rules	Learning- Machine learning	Syntactic and Semantic Analysis
S-6	SLO-1	Rationality and Rational agent with performance measures	Informed search-A* Algorithm	Knowledge representation using semantic nets	Goals and Challenges of machine learning	Information retrieval
	SLO-2	Flexibility and Intelligent agents	AO* research	Knowledge representation using frames	Learning concepts, models	Information Extraction

Duration (hour)	15	15	15	15	15
	SLO-2 Task environment and its properties	Local search Algorithms-Hill Climbing, Simulated Annealing	Inferences	Artificial neural network based learning- Back propagation	Machine translation
S-8	SLO-1 Types of agents	Local Beam Search	Uncertain Knowledge and reasoning- Methods	Support vector machines	NLP Applications
	SLO-2 Other aspects of agents	Genetic Algorithms	Bayesian probability and belief network	Reinforcement learning	NLP Applications
S 9-10	SLO-1 Lab 2: Developing agent programs for real world problems	Lab 5: Developing Best first search and A* Algorithm for real world problems	Lab 8: Implementation of knowledge representation schemes - use cases	Lab 11: Implementation of learning algorithms for an application	Lab 14: Implementation of NLP programs
S-11	SLO-1 Constraint satisfaction problems(CSP)	Adversarial search Methods-Game playing-Important concepts	Probabilistic reasoning	Adaptive learning	Advance topics in Artificial Intelligence- Cloud Computing and intelligent agent
	SLO-2 Crypto arithmetic puzzles	Game playing and knowledge structure	Probabilistic reasoning over time	Multi agent based learning	Business intelligence and analytics
S-12	SLO-1 CSP as a search problem-constraints and representation	Game as a search problem-Mini max approach	Forward and backward reasoning	Ensemble learning	Sentiment Analysis
	SLO-2 CSP-Backtracking, Role of heuristic	Mini max Algorithm	Other uncertain techniques-Data mining	Learning for decision making	Deep learning Algorithms
S-13	SLO-1 CSP-Forward checking and constraint propagation	Alpha beta pruning	Fuzzy logic	Distributed learning	Deep learning Algorithms
	SLO-2 CSP-Intelligent backtracking	Game theory problems	Dempster -shafer theory	Speedup learning	Planning and logic in intelligent agents
S 14-15	SLO-1 Lab 3: Implementation of constraint satisfaction problems	Lab 6: Implementation of mini max algorithm for an application	Lab 9: Implementation of uncertain methods for an application	Lab12: Development of ensemble model for an application	Lab 15: Applying deep learning methods to solve an application.

Learning Resources	<ol style="list-style-type: none"> <li>1. Parag Kulkarni, Prachi Joshi, Artificial Intelligence –Building Intelligent Systems, 1<sup>st</sup> ed., PHI learning, 2015</li> <li>2. DeepakKemhani, FirstcourseinArtificialIntelligence, McGrawHillPvtLtd, 2013</li> <li>3. Stuart J. Russell, Peter Norwig , Artificial Intelligence –A Modern approach, 3<sup>rd</sup> Pearson Education, 2016</li> </ol>	<ol style="list-style-type: none"> <li>4. PrateekJoshi, ArtificialIntelligencewithPython, 1<sup>st</sup>ed., PacktPublishing, 2017</li> <li>5. DenisRothman, ArtificialIntelligencebyExample, Packt, 2018</li> </ol>
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Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#		Theory	Practice
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice		
Level 1	Remember	20%	20%	10%	10%	15%	15%	15%	15%	15%	15%
	Understand										
Level 2	Apply	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%
	Analyze										
Level 3	Evaluate	10%	10%	20%	20%	15%	15%	15%	15%	15%	15%
	Create										
	Total	100 %		100 %		100 %		100 %		-	

# CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers	Experts from Higher Technical Institutions	Internal Experts
Experts from Industry	1. Dr. Chitrakala, Anna University, au.chitras@gmail.com	1. Dr.M.Pushpalatha, SRMIST
1. Mr.Jagatheeswaran, Lead, Auxo labs jagatheeswarans.iot@auxolabs.in		2. Dr.G.Vadivu, SRMIST
		3. Dr.C.Lakshmi, SRMIST

Course Code	18CSC350T	Course Name	COMPREHENSION	Course Category	C	Professional Core	L	T	P	C
							0	1	0	1

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Computer Science and Engineering	Data Book / Codes/Standards			

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning	Program Learning Outcomes (PLO)																			
CLR-1:	Acquire skills to solve real world problems in Data Structures and Analysis and Design of Algorithms	1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15			
CLR-2:	Acquire skills to solve real world problems in Object Oriented Design and Programming and advanced programming concepts	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design,	Modern Tool Usage	Society & Culture	Environment &	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3			
CLR-3:	Acquire skills to solve real world problems in Operating systems , Computer networking and Formal Language and Automata				H	H	H	M	M	L	L	M	M	L	H	M	L	H	M	L	H	
CLR-4:	Acquire skills to solve real world problems in Compiler Design, Database Management systems and Software Engineering				H	H	M	H	H	M	L	L	H	H	M	H	M	H	H	M	M	H
CLR-5:	Acquire skills to solve real world problems for competitive examinations in Mechanical Engineering				H	H	M	H	H	H	L	L	H	H	H	H	M	M	H	M	M	H
CLR-6:	Acquire skills to solve real world problems in the broad domain of Mechanical Engineering				H	H	H	L	L	L	L	L	L	L	L	L	L	M	L	M	M	M
CLR-6:	Acquire skills to solve real world problems in the broad domain of Mechanical Engineering				H	H	M	L	L	L	L	L	L	L	L	L	L	L	M	M	M	M

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design,	Modern Tool Usage	Society & Culture	Environment &	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3
CLO-1:	Practice and gain confidence, competence to solve problems in Data Structures and Analysis and Design of Algorithms	3	85	80	H	H	H	H	M	M	L	L	M	M	L	H	M	L	H
CLO-2:	Practice and gain confidence, competence to solve problems in Object Oriented Design, Programming and advanced programming concepts	3	85	80	H	H	M	H	H	M	L	L	H	H	M	H	H	H	H
CLO-3:	Practice and gain confidence, competence to solve problems in Operating systems , Computer networking, Formal Language and Automata	3	85	80	H	H	M	M	M	M	L	L	M	H	L	M	M	H	M
CLO-4:	Practice and gain confidence, competence to solve problems in Compiler Design, Database Management systems and Software Engineering	3	85	80	H	H	M	H	H	H	L	L	H	H	H	H	M	H	H
CLO-5:	Practice and gain confidence and competence to solve problems for competitive examinations in Computer Science and Engineering	3	85	80	H	H	H	L	L	L	L	L	L	L	L	L	M	L	M
CLO-6:	Practice and gain confidence and competence to solve problems in the broad domain of Computer Science and Engineering	3	85	80	H	H	M	L	L	L	L	L	L	L	L	L	M	M	M

Duration (hour)	3		3		3		3		3	
S-1	SLO-1	Tutorial on Linear Data Structures	Tutorial on Object Oriented Design	Tutorial on Operating Systems	Tutorial on Compiler Design	Problem Solving				
	SLO-2	Problem Solving	Problem Solving	Problem Solving	Problem Solving	Problem Solving				
S-2	SLO-1	Tutorial on Non Linear Data Structures	Tutorial on Object Oriented Programming	Tutorial on Computer networking	Tutorial on Database Management systems	Problem Solving				
	SLO-2	Problem Solving	Problem Solving	Problem Solving	Problem Solving	Problem Solving				
S-3	SLO-1	Tutorial on Analysis and Design of Algorithms	Tutorial on Advanced Programming concepts	Tutorial on Formal Language and Automata	Tutorial on Software Engineering	Problem Solving				
	SLO-2	Problem Solving	Problem Solving	Problem Solving	Problem Solving	Problem Solving				

Learning Resources	1. Jushta Jaiswal, Objective "Computer Science & Information Technology", Source books, , 2015 2. G.K.Mithal, "Objective Computer Science and Information Technology", G.K.Publishing, 10th edition, 2016	3. R.Agor, "Computer Science Conventional & Objective type solved questions", Birla Publishing, 2004 4. Timothy Williams, "MCQs in Computer Science", McGraw Hill, 5th edition, 2017 5. Surbhi Mitra, "Computer Science and IT", Arihant Handbook series, 2013
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Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (100% weightage)								Final Examination	
		CLA – 1 (20%)		CLA – 2 (30%)		CLA – 3 (30%)		CLA – 4 (20%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	40%	-	30%	-	30%	-	30%	-	-	-
	Understand										
Level 2	Apply	40%	-	40%	-	40%	-	40%	-	-	-
	Analyze										
Level 3	Evaluate	20%	-	30%	-	30%	-	30%	-	-	-
	Create										
Total		100 %		100 %		100 %		100 %		-	

# CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Dr. Anbu Rathinavel , Chief Design Officer, Design Intellect	1. Dr. Viraj Kumar, Professor, CSE, PES University	1. Dr. B.Amutha, Professor & Head, CSE, SRMIST
		2. Dr.S.S.Sridhar, Professor,CSE, SRMIST

# ACADEMIC CURRICULA

**Professional Elective Courses**

**COMPUTER SCIENCE AND ENGINEERING**

**Regulations - 2018**

**SRM INSTITUTE OF SCIENCE AND TECHNOLOGY**

**(Deemed to be University u/s 3 of UGC Act, 1956)**

**Kattankulathur, Kancheepuram, Tamil Nadu, India**



Course Code	18CSE351T	Course Name	COMPUTATIONAL LOGIC	Course Category	E	Professional Elective	L	T	P	C
							3	0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Computer Science and Engineering		Data Book / Codes/Standards	Nil	

Course Learning Rationale (CLR):		Learning			Program Learning Outcomes (PLO)															
CLR-1 :		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
The purpose of learning this course is to:																				
CLR-1 :	Understand the basics of Propositional logic				Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3	
CLR-2 :	Acquire skills on rules to handle Propositional logic				H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLR-3 :	Understand the First order Logic and Meta theorems				H	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLR-4 :	Learn the art of application of AI Concepts.				H	M	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLR-5 :	Master various theorems on Logic				H	H	H	-	-	-	-	-	-	-	-	-	-	-	-	-
Course Learning Outcomes (CLO):		At the end of this course, learners will be able to:																		
CLO-1 :	Apply the skills acquired on propositional logic to solve examples at hand	2	80	85																
CLO-2 :	Apply the rules learnt towards problem solving	2	75	80																
CLO-3 :	Acquire mastery over FOL and Meta theorems and apply the same with confidence	2	85	80																
CLO-4 :	Apply the acquired knowledge on AI under appropriate problem solving contexts	2	80	75																
CLO-5 :	Attempt to apply the acquired knowledge on logics under appropriate problem solving contexts	2	75	85																

Duration (hour)	9	9	9	9	9	
S-1	SLO-1	Propositional Logic-Introduction	Natural Deduction of Propositional Logic: Rules of Conjunction, Disjunction	First Order Logic-Introduction	Axiomatic System FC: Introduction	Modal Logic K-Introduction
	SLO-2	Syntax of PL	Natural Deduction of Propositional Logic: Implication, Negation	First Order Logic-Illustration	Axiomatic System FC: Example applications, Illustrations	Modal Logic K-Illustration
S-2	SLO-1	Is It a Proposition?	Natural Deduction of Propositional Logic: Proofs	Syntax of FL	Monotonicity Theorem-Detail	Syntax and Semantics of K
	SLO-2	Unique Parsing, PropDet	Natural Deduction of Propositional Logic: Examples	Scope and Binding	Deduction Theorem- Detail	Syntax and Semantics of K: Illustration
S-3	SLO-1	Sub Propositions, Precedence rules	Natural Deduction of Propositional Logic: Problems	Scope and Binding-Illustration	Theorem-RA, Fitness- Detail	Validity and Consequence in K
	SLO-2	Proposition: Theorems and Examples	Natural Deduction of Propositional Logic: Problems	Substitutions	Paradox of material Implication-Detail	Validity and Consequence in K: Illustration
S-4	SLO-1	Interpretations	Derived Rules of Propositional Logic: Introduction	Substitutions- Illustrations	Strong Generalization Theorem:Introduction	Axiomatic System KC
	SLO-2	Boolean conditions, Truth table	Derived Rules of Propositional Logic: Examples	Substitutions- Problems	Strong Generalization Theorem: Illustration	Axiomatic System KC: Illustration
S-5	SLO-1	Interpretations: Theorems, Conventions and Lemma	Derived Rules of Propositional Logic:Problems	Semantics of FL	Adequacy of FC to FL	Adequacy of KC to K
	SLO-2	Interpretations: Examples	Derived Rules of Propositional Logic:Problems	Semantics of FL: Illustration	Adequacy of FC to FL: Illustration	Adequacy of KC to K: Illustration
S-6	SLO-1	Models: Introduction to terminologies	Parse Tree	Translating into FL	Compactness of FL	Natural Deduction in K
	SLO-2	Equivalences and Consequences : Introduction to terminologies	Sub Formula	Translating into FL: Illustrations	Compactness of FL: Proof	Natural Deduction in K: Illustration
S-7	SLO-1	Equivalences and Consequences :	Soundness of Propositional Logic	Satisfiability and Validity	Laws in FL	Analytic Tableau for K

		Examples				
S-8	SLO-2	Deduction Theorem (DT)-Introduction	Soundness of Propositional Logic: Illustration	Satisfiability and Validity: Illustrations	Laws in FL: Illustration	Analytic Tableau for K: Illustration
	SLO-1	RA Theorem, Monotonicity Theorem (M)-Introduction	Completeness of Propositional Logic	Metatheorems: Introduction	Natural Deduction	Modalities
	SLO-2	Fitness Theorem	Completeness of Propositional Logic: Illustration	Metatheorems: Deduction, Substitution, Chaining	Natural Deduction: Illustration	Modalities: Illustration
S-9	SLO-1	Theorem-Paradox of material Implication	Gentzen sequent calculus	Metatheorems: Examples	Analytic Tableaux	Computation Tree Logic
	SLO-2	Replacement Laws	Gentzen sequent calculus: Illustration	Metatheorems: Problems	Analytic Tableaux: Illustration	Computation Tree Logic: Illustration

Learning Resources	1. Arindama Singh, "Logics for Computer Science", PHI Learning Private Ltd, 2nd Edition, 2018	4. Dana Richards & Henry Hamburger, "Logic And Language Models For Computer Science", Third Edition, World Scientific Publishing Co. Pte. Ltd, 2018.
	2. Wasilewska & Anita, "Logics for computer science: classical and non-classical", Springer, 2018	
	3. Huth M and Ryan M, "Logic in Computer Science : Modeling and Reasoning about systems", Cambridge University Press, 2005	5. <a href="https://www.cs.cornell.edu/courses/cs3110/2012sp/lectures/lec15-logic-contd/lec15.html">https://www.cs.cornell.edu/courses/cs3110/2012sp/lectures/lec15-logic-contd/lec15.html</a>

Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#		Theory	Practice
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice		
Level 1	Remember Understand	40 %	-	30 %	-	30 %	-	30 %	-	30%	-
Level 2	Apply Analyze	40 %	-	40 %	-	40 %	-	40 %	-	40%	-
Level 3	Evaluate Create	20 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Total	100 %		100 %		100 %		100 %		100 %	

# CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
Dr. Paventhan Arumugum, Director (R&D), ERNET India		Mr. T.Senthil Kumar, SRMIST
Mr Shiv Kumar Ganesh Full stack developer Altemetric, US		Dr. Kayalvizhi Jayavel, SRMIST
		Ms. Jeyasudha, SRMIST

Course Code	18CSE352T	Course Name	NEURO FUZZY AND GENETIC PROGRAMMING	Course Category	E	Professional Elective	L	T	P	C
							3	0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Computer Science and Engineering		Data Book / Codes/Standards	Nil	

Course Learning Rationale (CLR):	The purpose of learning this course is to:			Learning			Program Learning Outcomes (PLO)																	
CLR-1 :	Understand the fundamentals of Artificial Neural Networks			1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15			
CLR-2 :	Learn the various topologies and learning algorithms of ANN			Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3			
CLR-3 :	Understand the principles and fundamentals of Fuzzy Logic						L	H	-	H	L	-	-	-	L	L	-	H	-	H	-	-	-	-
CLR-4 :	Understand the Fuzzy Rule based systems						M	H	M	M	H	-	-	-	M	L	-	H	-	-	-	-	-	-
CLR-5 :	Understand the basic concepts and techniques of Genetic Algorithms						M	H	M	H	H	-	-	-	M	L	-	H	-	-	-	-	-	-
CLR-6 :	Utilize the Neural, Fuzzy and Genetic Algorithms for real-time application development						H	H	M	H	M	-	-	-	M	L	-	H	-	-	-	-	-	-
CLR-6 :							M	H	M	H	H	-	-	-	L	L	-	H	-	-	-	-	-	-
Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:																							
CLO-1 :	Acquire the knowledge on constructing a neural network			3	80	75																		
CLO-2 :	Identify the basic Neural net and learning algorithm to apply for a real time problem			3	85	75																		
CLO-3 :	Acquire the ability to use Fuzzy operators, membership functions, Fuzzification and Defuzzification Techniques			3	75	70																		
CLO-4 :	Gain Knowledge on applying the Fuzzy rules to different applications			3	85	80																		
CLO-5 :	Acquire the knowledge of fitness functions and Genetic operators			3	85	75																		
CLO-6 :	Apply the Genetic Algorithm to real-time applications			3	80	70																		

Duration (hour)	9		9		9		9		9	
S-1	SLO-1	Biological and Artificial Neuron	Delta Rule, Derivation of GDR	Crisp sets	Fuzzification of Input Variables, Application of Fuzzy operations	History of Evolutionary Computing, Genetic Algorithms, basic concepts	GA Cycle , Fitness Function,			
	SLO-2	History of ANN	Backpropagation Algorithm, Local Minima Problem	Fuzzy sets						
S-2	SLO-1	ANN architectures	Radial Basis Function Neural Network	Fuzzy membership functions	Evaluation of Fuzzy rules, Aggregation of output Fuzzy sets	Introduction to GA Operators Selection Operators, Crossover, Mutation Operations				
	SLO-2	Learning Algorithms	Pattern Association, Auto Associative nets	Operations of Fuzzy sets						
S-3	SLO-1	Activation Functions, Bias, Threshold and other parameters	Hetero Associative nets	Fuzzy Relations, Operations	Rule based systems, Conventional programs vs Rule based systems	Schema Theorem, Example				
	SLO-2	McCulloch Pitts model,	Bidirectional Associative Memory Network	Fuzzy Extension Principle	Fuzzy Propositions					
S-4	SLO-1	Simulation of Logic Functions	Hopfield network Competitive networks: Maxnet	Crisp Relations, Fuzzy relations, Properties, operations,	Fuzzification	Classification of Genetic Algorithm				
	SLO-2									
S-5	SLO-1	Perceptron Network	Self Organizing Map Network	Propositional Logic	Defuzzification	Holland Classifier Systems				
	SLO-2	Hebbian network	Learning Vector Quantization	Crisp Logic	Fuzzy Controller : Air conditioner control, Cruise Controller	Genetic Programming				
S-6	SLO-1	ADALINE networks	Adaptive Resonance Theory Network	Predicate Logic Rules of Inference	Fuzzy Decision making	Data Representation				
	SLO-2	MADALINE networks		Fuzzy Truth, Fuzzy Rules		Genetic Operators				
S-7,8	SLO-1	Practice of Neural Network tool :	Practice of Neural Network tool : Delta rule	Fuzzy Reasoning	Introduction to neuro fuzzy system-	Application of Genetic Algorithm				

		Simple Logic functions			Adaptive Neuro-Fuzzy Inference Systems Coactive Neuro-Fuzzy Modeling	
	SLO-2		Practice of Neural Network tool : Pattern Classification	Practice of Fuzzy Logic tool: Fuzzy functions	Recent Applications	Practice of Optimization and Genetic algorithm tool
S-9	SLO-1	Practice of Neural Network tool : XOR problem	Practice of Neural Network tool : Pattern Clustering	Practice of Fuzzy Logic tool: Fuzzy operations	Practice of Fuzzy Logic tool : Fuzzy controller design and applications	
	SLO-2					

Learning Resources	<ol style="list-style-type: none"> <li>1. Samir Roy, Udit Chakraborty, "Introduction to Soft Computing: Neuro-Fuzzy and Genetic Algorithms", Pearson Education, 2013.</li> <li>2. Michael Negnevitsky. Artificial Intelligence: A Guide to Intelligent Systems, 3rd Edition, Pearson Education, 2011.</li> <li>3. Laurene Fausett, "Fundamentals of Neural Networks, Architectures, Algorithms and Applications", Pearson Education, 2008.</li> </ol>	<ol style="list-style-type: none"> <li>4. Timothy J. Ross , "Fuzzy Logic with Engineering Applications", John Wiley &amp; Sons Ltd, 2010.</li> <li>5. David E. Goldberg, "Genetic Algorithms-In Search, optimization and Machine Learning", Pearson Education, 2008.</li> </ol>
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Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#		Theory	Practice
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice		
Level 1	Remember Understand	40 %	-	30 %	-	30 %	-	30 %	-	30%	-
Level 2	Apply Analyze	40 %	-	40 %	-	40 %	-	40 %	-	40%	-
Level 3	Evaluate Create	20 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Total	100 %		100 %		100 %		100 %		100 %	

# CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Mr. K. selvaraj, TCS, Bangalore	1. Dr. A.P. Shanthi, Professor, Dept. of Computer Science & Engineering, Anna University, chennai-600025	1. Dr. V. Ganapathy, SRM IST
2. Mr. Saju G Nair, IBM, Bangalore.	2. Dr. A. Kannan, Professor Dept. of Computer Science & Engineering, VIT, Vellore	2. Dr. D. Malathi, SRM IST
		3. Dr. Ferni Ukrit, SRM IST

Course Code	18CSE353T	Course Name	DIGITAL IMAGE PROCESSING	Course Category	E	Professional Elective	L	T	P	C
							3	0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Computer Science and Engineering		Data Book / Codes/Standards	Nil	

Course Learning Rationale (CLR):	The purpose of learning this course is to:			Learning			Program Learning Outcomes (PLO)																	
CLR-1 :	provide deep understanding of basic concepts of digital image acquisition			1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15			
CLR-2 :	provide deep Understanding of various digital image enhancement techniques			Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3			
CLR-3 :	Understand image restoration and segmentation methods						H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLR-4 :	provide understanding and implementation of image compression techniques						H	H	H	-	H	-	-	-	-	-	-	-	-	-	-	-	-	-
CLR-5 :	Provide understanding and knowledge of image recognition methods						H	H	M	-	H	-	-	-	-	-	-	-	-	-	-	-	-	-
							H	H	M	-	H	-	-	-	-	-	-	-	-	-	-	-	-	-
Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:																							
CLO-1 :	Understand basics of digital images and tools for image processing			2	80	85																		
CLO-2 :	Learn and implement image Enhancement techniques			2	75	80																		
CLO-3 :	Understand and Learn image Restoration and Segmentation Methods			2	85	80																		
CLO-4 :	Understand and implement Image Compression techniques			2	80	75																		
CLO-5 :	Learn and Implement Image Recognition methods			2	75	85																		

Duration (hour)	9		9		9		9		9	
S-1	SLO-1	Introduction	Introduction to Spatial Domain	Noise models – Mean Filters – Order Statistics	Wavelets – Subband coding – Multiresolution expansions	Boundary representation – Chain Code				
S-2	SLO-1	Origin- Steps in Digital Image Processing	Gray level transformations	Adaptive filters – Band reject Filters – Band pass Filters	Fundamentals of Compression – Image Compression methods - Error Free Compression	Polygonal approximation, signature, boundary segments				
S-3	SLO-1	Components	Histogram processing	Inverse Filtering – Wiener filtering Segmentation	Variable Length Coding – Bit-Plane Coding – Lossless Predictive Coding	Boundary description – Shape number				
S-4	SLO-1	Elements of Visual Perception	Basics of Spatial Filtering	Point, Line, and Edge Detection	Lossy Compression – Lossy Predictive Coding	Fourier Descriptor				
S-5	SLO-1	Image Sensing and Acquisition	Smoothing and Sharpening Spatial Filtering	Marr-Hildreth & Canny edge detector	Compression Standards-Huffman, Arithmetic coding, LZW coding, Run Length Encoding	Regional Descriptors				
S-6	SLO-1	Image Sampling and Quantization	Frequency Domain: Basics of filtering	Edge Linking and Boundary detection	Compression StandardsHuffman, Arithmetic coding, LZW coding, Run Length Encoding	Topological - Texture – Patterns and Pattern classes				
S-7	SLO-1	Relationships between pixels	Smoothing and Sharpening frequency domain filters	Local & Regional processing-Region based segmentation	Block Transform coding, Wavelet coding, JPEG standard	Recognition based on matching				
S-8	SLO-1	Introduction to Image processing toolbox in MATLAB	Smoothing and Sharpening frequency domain filters	Morphological processing- Watershed segmentation algorithm	MATLAB code for image compression: Huffam coding, Arithmetic coding, wavelet	MATLAB code for image representation				

					<i>coding</i>	
S-9	SLO-1	<i>Tool box practice</i>	<i>MATLAB code for histogram equalization</i>	<i>MATLAB code for restoring an image after degradation using adaptive and wiener filter</i>	<i>MATLAB code for image compression: Huffam coding,</i>	<i>MATLAB code for image recognition</i>
	SLO-2	<i>Exploring functions</i>	<i>MATLAB code for spatial and frequency domain filter.</i>	<i>Edge detection operators</i>	<i>Arithmetic coding, wavelet coding</i>	<i>MATLAB Practice exercises</i>

Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	40 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Understand										
Level 2	Apply	40 %	-	40 %	-	40 %	-	40 %	-	40%	-
	Analyze										
Level 3	Evaluate	20 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

# CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
<i>Madhan Thandayithapani kutiyappan, Assistant consultant, TCS - siruseri</i>	<i>Dr. S. Sridhar, Anna University</i>	<i>Dr. G.Niranjana. Associate Professor/CSE</i>
	<i>Dr. Senthil kumar, Annauniversity</i>	<i>Mr. Rajasekar Assistant Professor/IT</i> <i>Mr. James Joseph Assistant Professor/SWE</i>

Course Code	18CSE354T	Course Name	NETWORK SECURITY	Course Category	E	Professional Elective	L	T	P	C
							3	0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	CSE	Data Book / Codes/Standards	Nil		

Course Learning Rationale (CLR):		Learning			Program Learning Outcomes (PLO)															
CLR-1 :		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
The purpose of learning this course is to:		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3	
Understand the basic concepts of networking devices																				
Understand the concept of IP security																				
Understand the various methods and protocols to maintain E-mail security																				
Understand the various methods and protocols to maintain web security																				
Understand security measures for wireless and cell phone Communications																				
Course Learning Outcomes (CLO):		At the end of this course, learners will be able to:																		
CLO-1 :		2	80	85	H															
CLO-2 :		2	75	80	H															
CLO-3 :		2	85	80	H															
CLO-4 :		2	80	75	H							H								
CLO-5 :		2	75	85	H							H								

Duration (hour)	9	9	9	9	9	
S-1	SLO-1	Networking Devices(Layer1,2)	Overview of IPSEC- Security Associations, Security Association Database	Security Services for E-mail	SSL/TLS Basic Protocol	Wireless Security:IEEE 802.11 Wireless LAN
	SLO-2	Networking Devices(Layer 3)	Security Policy databases , AH and ESP	Security Services for E-mail	SSL/TLS Basic Protocol	Wireless Security:IEEE 802.11 Wireless LAN
S-2	SLO-1	Different types of network layer attacks	Tunnel and Transport mode	Establishing keys	computing the keys	Authentication
	SLO-2	Different types of network layer attacks	IP header Protection	Establishing Public and secret keys	computing the keys	Authentication and confidentiality
S-3	SLO-1	Firewall- ACL	IP and IPv6	Privacy	client authentication	Cellphone Security
	SLO-2	Packet Filtering	IPv4 and IPv6 header	End-to end Privacy, Privacy with distribution List Exploders	client authentication	GSM (2G) Security
S-4	SLO-1	DMZ, Alerts	Authentication Header	Authentication of the source	PKI as deployed by SSL	Security in UMTS (3G)
	SLO-2	Audit Trials	Mutable, Immutable and Mutable but predictable	Based on public key technology and secret keys and with distribution list	PKI as deployed by SSL	Security in UMTS (3G)
S-5	SLO-1	IDS	Encapsulation Security Payload(ESP)	Message Integrity	SSLAttacks fixed in v3	Wireless LAN Vulnerabilities
	SLO-2	Advantages and Disadvantages of IDS(Need of IPS)	Internet Key Exchange	Non-repudiation	SSLAttacks fixed in v3	Phishing
S-6	SLO-1	Advantages of IPS ove IDS	Phases of IKE	Introduction and Overview of PGP	Exportability	Buffer Overflow
	SLO-2	IPS	Phase I IKE- Modes and key types	Efficient Encoding	Exportability	Buffer Overflow
S-7	SLO-1	IPS Types- Signature based	Phase I IKE Protocols	Certificate and key revocation	Encoding	Format String Attacks
	SLO-2	Anomaly based, Policy based	Phase I IKE Protocols	Singature types, Private key, Fing types	Encrypted Record	Cross-site Scripting (XSS)
S-8	SLO-1	IPS Types - Honeypot based	Phase II IKE	Anomalies	Handshake messages	SQL Injection

	SLO-2	Applications	Phase II IKE	Object Format	Changecipher spec and Alerts	SQL Injection
S-9	SLO-1	Malicious Software	ISAKMP/IKE Encoding	S/MIME	SET	Case Studies: Secure Inter-branch Payment Transactions
	SLO-2	Malicious Software	ISAKMP/IKE Encoding	S/MIME	SET	Virtual Elections

Learning Resources	1.	Charlie Kaufman, Radia Perlman, Mike Speciner, Network Security, Prentice Hall of India, 2002.	3.	William Stallings, Cryptography and Network Security - Principles and Practice, 7th edition, Pearson Publication, 2017
	2.	Bernard Menezes - Network Security and Cryptography- Cengage Learning. 2010.	4.	Cryptography and network security , Atulkahate Tata McGraw-Hill Education, 2003

Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#		Theory	Practice
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice		
Level 1	Remember Understand	40 %	-	30 %	-	30 %	-	30 %	-	30%	-
Level 2	Apply Analyze	40 %	-	40 %	-	40 %	-	40 %	-	40%	-
Level 3	Evaluate Create	20 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Total	100 %		100 %		100 %		100 %		100 %	

# CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
Mr. M. Sudhakar, M.Tech, (Ph.D)-IIT, IT Infrastructure Service, Tata Consultancy Services.	Dr. P. Yogesh, Associate Professor, Dept of Information Science and Technology, College of Engineering, Guindy,	Dr. A. Jeyasekar, Associate Professor Dr. J. Femilda, Associate Professor Mrs. G. Sujatha, Assistant Professor



Course Code	18CSE356T	Course Name	DISTRIBUTED OPERATING SYSTEMS	Course Category	E	Professional Elective	L	T	P	C
							3	0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Computer Science and Engineering		Data Book / Codes/Standards	Nil	

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning			Program Learning Outcomes (PLO)														
CLR-1 :	To recognize the essential concepts of distributed system.	1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CLR-2 :	To comprehend about the communication that takes place in Distributed systems	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3
CLR-3 :	To realize the necessity of synchronization, consistency and Fault tolerance in a Distributed System.	H	M	M	H	M	M	H	M	-	-	H	M	-	H	-	-	-	-
CLR-4 :	To value the Process management, File systems, Shared memory	H	M	H	M	M	H	M	M	-	-	H	M	-	H	-	-	-	-
CLR-5 :	To acquire apparent scheme regarding distributed object-oriented based systems	H	M	H	M	M	H	M	M	-	-	H	M	-	H	-	-	-	-
Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:																		
CLO-1 :	Characterize the fundamental hardware and software concepts of distributed systems.	3	80	70															
CLO-2 :	Categorize layered protocols and comprehend the communications in distributed systems	3	85	75															
CLO-3 :	Implement synchronization of distributed systems using various algorithms.	3	75	70															
CLO-4 :	Demonstrate process scheduling and fault tolerance of distributed systems.	3	85	80															
CLO-5 :	Evaluate various Distributed Object-Oriented based systems.	3	85	75															

Duration (hour)	9		9		9		9		9	
S-1	SLO-1	Introduction- Distributed Systems	Fundamentals of Communication systems	Synchronization in Distributed Systems- Fundamentals of Clock Synchronization		Processes and Processors in Distributed Operating Systems - Threads		Distributed Shared memory - Introduction		
	SLO-2	Goals of Distributed Systems		Logical clock, Physical clock		Design issues of Threads package		Bus-Based Multiprocessors		
	SLO-2					Work Station Model		Switched Multiprocessors		
S-2	SLO-1	Hardware Concepts- Bus-based Multiprocessors	Layered Protocols	Algorithms for Clock synchronization		System Model - Introduction		Ring-based Multiprocessors		
S-3	SLO-1	Switched Multiprocessors	ATM networks	Mutual Exclusion-Centralized Algorithm		Using Idle Work Stations		Numa Multiprocessors		
	SLO-2							Comparison of Shared Memory Systems		
S-4	SLO-1	Bus-based Multicomputers	Client Server model - Blocking Primitives	Distributed Algorithm		Processor Pool Model, Hybrid Model		Consistency Models – Strict Consistency, Casual Consistency, PRAM Consistency		
	SLO-2		Non-Blocking Primitives	Token Ring Algorithm		Processor Allocation – Allocation Model		Weak Consistency, Release Consistency, Entry Consistency		
S-5	SLO-1	Switched Multicomputers	Buffered Primitives	Comparison of all three algorithms		Design issues for processor Allocation Algorithms		Page Based Distributed Shared Memory – Replication, granularity		
	SLO-2		Unbuffered Primitives	Importance of Election Algorithm		Example of processor Allocation Algorithms		Finding the Owner, Finding the Copies		
S-6	SLO-1	Software Concepts-Network Operating System	Reliable primitives	Bully Algorithm		Scheduling in Distributed Systems		Page Replacement		
	SLO-2		Unreliable primitives	Ring Algorithm		Load Balancing and Sharing Approach		Synchronization		
S-7	SLO-1	True Distributed Systems	Message passing and its related issues	Atomic Transaction- Introduction		Fault Tolerance-Component Faults		Shared – Variable Distributed Shared		

	SLO-2			Transaction Model, Concurrency Control	System Failures	memory Object Based Distributed Shared memory – DOO Architecture
S-8	SLO-1	Multiprocessors Timesharing Systems	Remote Procedure Call and its related issues	Deadlock in Distributed Systems	Synchronous versus Asynchronous Systems	Distributed Object-Oriented Process
	SLO-2			Distributed Deadlock Detection	Fault tolerance Using Active Replication, Primary-backup	Distributed Object-oriented Communication
S-9	SLO-1	Design Issues-Distributed Systems	Case Studies: SUN RPC, DEC RPC	Distributed Deadlock Prevention	Real Time Distributed Systems-Communication	Case Study - Amoeba
	SLO-2				Real Time Scheduling	Mach-OS, Chorus

Learning Resources	<ol style="list-style-type: none"> <li>Andrew S. Tanenbaum, "Distributed Operating Systems" Pearson Education, 2011.</li> <li>Pradeep K. Sinha "Distributed Operating Systems Concepts and Design" PHI 2012.</li> <li>Mukesh Singhal, Niranjan G Shivratr "Advanced concepts in Operating Systems", Mc Graw Hill International 2011.</li> <li><a href="http://www.seas.gwu.edu/~jstanton/courses/cs251/">http://www.seas.gwu.edu/~jstanton/courses/cs251/</a></li> <li><a href="http://cse.yeditepe.edu.tr/~sbaydere/courses_new/cse532/">http://cse.yeditepe.edu.tr/~sbaydere/courses_new/cse532/</a></li> </ol>
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#### Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#		Theory	Practice
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice		
Level 1	Remember Understand	40%	-	30%	-	30%	-	30%	-	30%	-
Level 2	Apply Analyze	40%	-	40%	-	40%	-	40%	-	40%	-
Level 3	Evaluate Create	20%	-	30%	-	30%	-	30%	-	30%	-
	Total	100 %		100 %		100 %		100 %		-	

# CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

#### Course Designers

Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
JP Vinjamoori, Director, Pavartha Software Pvt.Ltd, <a href="mailto:jp@pavarthasoftware.com">jp@pavarthasoftware.com</a>	Dr. E.Sivasankar, NIT, Trichy	Mrs. S. Aruna, Dr.G. Maragatham, Mrs. A. Jackulin Mahriba, SRMIST

Course Code	18CSE357T	Course Name	BIOMETRICS			Course Category	E	Professional Elective							L	T	P	C																									
													3	0	0	3																											
Pre-requisite Courses	Nil		Co-requisite Courses	Nil		Progressive Courses	Nil																																				
Course Offering Department	Computer science			Data Book / Codes/Standards	Nil																																						
Course Learning Rationale (CLR):	The purpose of learning this course is to:					Learning			Program Learning Outcomes (PLO)																																		
CLR-1 :	Understand the concept of authentication using biometrics.					1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15																				
CLR-2 :	Gain knowledge on the basics of biometric traits, sensors and data acquisition					Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3																				
CLR-3 :	Gain knowledge on design of biometric security systems																							H	M	H	H	-	-	H	-	-	-	-	-	-	-	-	-	-	-		
CLR-4 :	Acquire knowledge on pattern recognition systems																							H	H	H	H	-	-	H	-	-	-	-	-	-	-	-	-	-	-	-	
CLR-5 :	Introduce the various feature extraction and matching techniques for different biological traits.																							H	M	M	M	-	-	M	-	-	-	-	-	-	-	-	-	-	-	-	
CLR-6 :	Understand the real time application of biometrics																							H	M	M	M	-	H	-	H	-	-	-	-	-	-	-	-	-	-	-	-
CLR-6 :	Understand the real time application of biometrics																							H	H	L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:					1	80	85	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-																			
CLO-1 :	Acquire the knowledge on various biometric traits					1	80	85	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-																			
CLO-2 :	Acquire the ability to identify pattern recognition system and its features					1	75	80	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-																			
CLO-3 :	Understand the basic ideas about physical and behavioural biometric traits					1	85	80	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-																			
CLO-4 :	Apply the knowledge of biometrics on developing identification system.					2	80	75	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-																			
CLO-5 :	Apply the knowledge for designing biometric systems					2	75	85	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-																			
CLO-6 :	Acquire the knowledge on authentication systems for real time security applications					1	80	85	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-																			
Duration (hour)	9		9		9		9		9		9		9		9		9		9		9		9																				
S-1	SLO-1	Introduction of biometric systems	Biometrics Sensors and Data Acquisition	Introduction to multibiometrics	Biometric system authentication	Biometric Authentication Applications																																					
	SLO-2	Biometric functionalities: verification, identification	Biometric data acquisition and database	Sources of multiple evidence	physiological and behavioral properties of biometric system,	access control like a lock or an airport check-in area																																					
S-2	SLO-1	The design cycle of biometric systems	Biometrics Pre-processing	Acquisition sequence	Software biometrics systems	immigration and naturalization																																					
	SLO-2	Building blocks of a generic biometric system	The related biometrics preprocessing technologies	Processing sequence	Hardware biometrics systems	welfare distribution																																					
S-3	SLO-1	Introduction to unimodal system	Image restoration	Fusion level	Security of biometric systems	military application																																					
	SLO-2	Introduction to Multimodal biometric system	Image segmentation	Sensor level fusion	Advisory, insider, infrastructure attacks	banking, e.g., check cashing, credit card, ATM																																					
S-4	SLO-1	Biometric system errors	Pattern extraction and classification	Feature level fusion	Attacks at the user interface	computer login; intruder detection; smart card																																					
	SLO-2	Performance measures	Pattern classification	Score level fusion	impersonation, obfuscation, spoofing	multi-media Communication; WWW and an electronic purse																																					
S-5	SLO-1	Image processing basics	Fingerprint Recognition and acquisition	Rank level fusion	Attacks on biometric processing	sensor fusion; decision fusion																																					
	SLO-2	what is image, acquisition, type, point operations, Geometric transformations	Fingerprint features, matching and synthesis	Decision level fusion	Attacks on system module and interconnections	categorization: e.g., age and gender																																					
S-6	SLO-1	First and second derivative	Face recognition and acquisition	Features Matching and Decision Making	Counter measure: Biometric template security	industrial automation																																					

	SLO-2	steps in edge detection, smoothening, enhancement, thresholding, localization,	Face detection, feature extraction and matching	Feature matching: null and alternative hypothesis $h_0, h_1$ , Error type I/II, Matching score distribution, FM/FNM, ROC curve, DET curve, FAR/FRR curve.	Countermeasure:spoof detection	gesture interpretation;
S-7	SLO-1	Robert's method, Sobel's method, Perwitts	Iris recognition and acquisition	Introduction to Various matching methods:	Challenges in biometric systems like fool proofing, false positives	efficient enrollment
	SLO-2	Laplacian of Gaussian, Zero crossing	Iris Segmentation, normalization and matching	LDA	Developing Tools for Comparing fingerprints	audio-visual tracking
S-8	SLO-1	Low level feature extraction, Describing image motion	Ear recognition	PCA, Eigen vectors and values, 2D-PCA,	Enhancing pattern when data is minimum	stock market;
	SLO-2	High level feature extraction ,Template matching	Ear detection	generalization to p-dim, covariance and correlation, algebra of PCA, projection of data	Biometric failures in special cases like( too much moisture in hands which system can't read)	on-line shopping
S-9	SLO-1	Hough transform for lines	Hand geometry features	Introduction to decision theory and their examples	Mini project: Fingerprint, Face detection	compact embedded systems
	SLO-2	Hough transform for circles and ellipses	palmpoint features	Explanation – examples	Mini project: signature ,iris detection	other commercialized services

Learning Resources	<ol style="list-style-type: none"> <li>1. James wayman, Anil k. Jain , Arun A. Ross , Karthik Nandakumar, – Introduction to. Biometricsll, Springer, 2011</li> <li>2. Mark S. Nixon, Alberto S. Aguado, Feature Extraction and image processing for computer vision, Third Edition, , Elsevier 2012</li> <li>3. Digital Image Processing using MATLAB, By: Rafael C. Gonzalez, Richard Eugene Woods, 2nd Edition, Tata McGraw-Hill Education 2010</li> </ol>	<ol style="list-style-type: none"> <li>4. Guide to Biometrics, By: Ruud M. Bolle, Sharath Pankanti, Nalini K. Ratha, Andrew W. Senior, Jonathan H. Connell, Springer 2009</li> <li>5. Pattern Classification, By: Richard O. Duda, David G. Stork, Peter E. Hart, Wiley 2007</li> <li>6. Shimon K. Modi , – Biometrics in Identity Management :concepts to applicationsll, Artech House 2011</li> </ol>
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Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember Understand	40 %	-	30 %	-	30 %	-	30 %	-	30%	-
Level 2	Apply Analyze	40 %	-	40 %	-	40 %	-	40 %	-	40%	-
Level 3	Evaluate Create	20 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Total	100 %		100 %		100 %		100 %		100 %	

# CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
<ol style="list-style-type: none"> <li>1. Raghuraghavendra s, Chief Executive Officer at Forensic &amp; Biometric Investigation Services FBIS Chennai, Tamil Nadu, India Chennai Area, India</li> </ol>	<ol style="list-style-type: none"> <li>1. Dr. J.Dhalia Sweetlin Designation: Assistant Professor [Sr Grade] Madras Institute of Technology, MIT Road, Radha Nagar, Chromepet, Chennai, Tamil Nadu 600044, India. Email: jdsweetlin@mitindia.edu Area of Specialization: Image Processing, Soft Computing</li> </ol>	<ol style="list-style-type: none"> <li>1. Dr. C. Malathy, SRMIST</li> <li>2. M. Gayathri, SRMIST</li> <li>3. Ms. Meenakshi/IT Dept, SRMIST</li> </ol>

Course Code	18CSE358T	Course Name	PATTERN RECOGNITION TECHNIQUES	Course Category	E	Professional Elective	L	T	P	C
							3	0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	CSE	Data Book / Codes/Standards	Nil		

Course Learning Rationale (CLR):	The purpose of learning this course is to:			Program Learning Outcomes (PLO)																
CLR-1 :	Understand the fundamentals of Pattern Recognition techniques	Learning	1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CLR-2 :	Learn Statistical models of Pattern Recognition	Level of Thinking (Bloom)	1	2	3	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3
CLR-3 :	Understand the principles of Clustering approaches to Pattern Recognition	Expected Proficiency (%)	1	2	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLR-4 :	Understand the Syntactic Pattern Recognition techniques	Expected Attainment (%)	1	2	3	H	H	-	-	H	-	-	-	-	-	-	-	-	-	-
CLR-5 :	Understand the Neural Network approach to Pattern Recognition		1	2	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:																			
CLO-1 :	Acquire the knowledge on various biometric traits		2	80	85	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-2 :	Acquire the ability to identify pattern recognition system and its features		2	75	80	H	H	-	-	H	-	-	-	-	-	-	-	-	-	-
CLO-3 :	Understand the basic ideas about physical and behavioural biometric traits		2	85	80	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-4 :	Apply the knowledge of biometrics on developing identification system.		2	80	75	-	H	-	-	H	-	-	-	-	-	-	-	-	-	-
CLO-5 :	Apply the knowledge for designing biometric systems		2	80	75	-	H	-	-	H	-	-	-	-	-	-	-	-	-	-

Duration (hour)	9		9		9		9		9	
S-1	SLO-1	Pattern and features	Introduction to StatPR, Statistical models,	Formulation of unsupervised problems	Syntactic Pattern Recognition, Grammar based approaches,	Neural Networks fundamentals, Learning in Neural networks,				
	SLO-2	Classification, Description, Pattern Mappings	Gaussian case and Class Dependence	Illustration	Formal Grammars, Types of Grammars	Physical Neural Networks				
S-2	SLO-1	Patterns and Feature Extraction	Discriminant Functions- Uniform Densities	Unsupervised Learning Approaches	String generation as Pattern Description	Artificial Neural Networks model, activation functions, weights				
	SLO-2	Examples	Classifier Performance, Risk and Errors	Illustration	Example					
S-3	SLO-1	Classifiers	Supervised learning – Parametric estimation	Clustering for unsupervised learning and classification	Recognition by String Matching and Parsing,	Neural Network based Pattern Associators, CAM				
	SLO-2	Example	Maximum Likelihood Estimation	Example	Example	Linear Associative Mappings, Different approaches				
S-4	SLO-1	Decision Regions	Bayesian parameter estimation	c-means algorithm	Cocke-Younger-Kasami Parsing Algorithm	Heteroassociative memory design				
	SLO-2	Boundaries	Example	Illustration	Illustration	Examples				
S-5	SLO-1	Training in pattern recognition systems	Nonparametric approaches-	Learning Vector Quantization,	Augmented Transition Networks, High Dimensional Grammars,	Hebbian learning				
	SLO-2	Learning in pattern recognition systems	Density estimation	Example	Example	Example				
S-6	SLO-1	Pattern recognition approaches	Parzen Windows	Formal Characterization of General Clustering Procedures	Stochastic Grammars and applications	Feedforward Network Architecture, Training in Feedforward networks,				
	SLO-2	Statistical pattern recognition, Example	k-nn Nonparametric estimation	Explanation on procedure	Example	Explanation				
S-7	SLO-1	Syntactic pattern recognition	Nearest Neighbor Rule	Clustering Strategies	Graph based structural representations	GDR, Derivation of Delta Rule				
	SLO-2	Examples	Example	Different scenarios	Graph Isomorphism	Explanation				

S-8	SLO-1	Neural pattern recognition	Linear Discriminant Functions, Fisher's Linear Discriminant	Cluster Swapping Approaches	Attributed Graphs, Match Graphs,	Backpropagation Algorithm,
	SLO-2	Comparison	Discrete and Binary Classification problems	Examples	Examples	Explanation
S-9	SLO-1	Black Box approaches	Techniques to directly obtain Linear Classifiers	Hierarchical clustering procedure	Cliques, Structural Unification using attributed graphs	Pattern Associator for Character Classification
	SLO-2	Reasoning driven pattern recognition	Illustration	Example	Examples	Example

Learning Resources	1.	Robert J, Schalkoff, "Pattern Recognition: Statistical, Structural and Neural Approaches", John Wiley & Sons Inc., New York, Reprint 2014.	2.	Earl Gose, Richard Johnsonbaugh, Steve Jost, "Pattern Recognition and Image Analysis", Prentice Hall of India Private Ltd., New Delhi – 110 001, 1999.
			3.	Duda R.O. and Hart P.E., "Pattern Classification and Scene Analysis", Wiley, New York, 1973

Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#		Theory	Practice
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice		
Level 1	Remember	40 %	-	30 %	-	30 %	-	30 %	-	30%	-
Level 2	Understand										
	Apply	40 %	-	40 %	-	40 %	-	40 %	-	40%	-
Level 3	Analyze										
	Evaluate	20 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

# CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
Mr. Deepan Raj, Visteon, Chennai	Dr. T. Nagarajan, Professor and Head, Dept. of IT, SSN college of Engineering.	1. Dr. M. Thenmozhi, SRMIST
		2. Dr. S. Prabakaran, SRMIST
		3. Dr. Alice Nithya, SRMIST

Course Code	18CSE359T	Course Name	NATURAL LANGUAGE PROCESSING	Course Category	E	Professional Elective	L	T	P	C
							3	0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	CSE	Data Book / Codes/Standards	Nil		

Course Learning Rationale (CLR):		The purpose of learning this course is to:			Learning			Program Learning Outcomes (PLO)																		
CLR-1 :	CLR-2 :	CLR-3 :	CLR-4 :	CLR-5 :	CLR-6 :	1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15			
Teach students the leading trends and systems in natural language processing.	Make them understand the concepts of morphology, syntax, semantics and pragmatics of the language and that they are able to give the appropriate examples that will illustrate the above mentioned concepts.	Teach them to recognize the significance of pragmatics for natural language understanding.	Enable students to be capable to describe the application based on natural language processing and to show the points of syntactic, semantic and pragmatic processing.	To conceive basics of knowledge representation, inference, and relations to the artificial intelligence.	To understand natural language processing and to learn how to apply basic algorithms in this field	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3			
Understand approaches to syntax and semantics in NLP.	Understand approaches to discourse, generation, dialogue and summarization within NLP.	Understand current methods for statistical approaches to machine translation.	Understand machine learning techniques used in NLP, including the probabilistic context-free grammars and unsupervised methods, as applied within NLP	Understand the knowledge of various levels of analysis involved in NLP	Gain knowledge in automated Natural Language Generation and Machine Translation				2	80	85	H	H	H	H	H	-	-	-	H	M	M	H	H	H	H
									2	75	80	H	H	H	H	H	-	-	-	H	M	M	H	H	H	H
									2	85	80	H	L	M	H	H	-	-	-	H	M	M	H	H	H	H
									2	80	75	H	H	H	H	H	-	-	-	H	M	M	H	H	H	H
									2	75	85	H	H	H	H	H	-	-	-	H	M	M	H	H	H	H

Duration (hour)	9		9		9		9		9	
S-1	SLO-1	Introduction to Natural Language Processing	Syntax Parsing	Semantic Relations	Information Extraction and its approaches		Introduction to Probabilistic Approaches			
	SLO-2	Steps – Morphology – Syntax – Semantics	Dependency Parsing	Semantic Role Labeling			Statistical Approaches to NLP Tasks			
S-2	SLO-1	Morphological Analysis (Morphological Parsing)	Semantics	Semantic Frames	Information Retrieval		Sequence Labeling			
	SLO-2	Stemming – Lemmatization	Semantic Parsing	Ontology and Semantics						
S-3	SLO-1	Parts of Speech Tagging	Word Sense Disambiguation	Semantic Network and Knowledge Graph	Semantic Search		Problems - Similarity Measures			
	SLO-2									
S-4	SLO-1	Approaches on NLP Tasks (Rule-based, Statistical, Machine Learning)	Lexical Disambiguation	Intent Detection and Classification	Summarization		Word Embeddings			
	SLO-2				Extractive Vs Abstractive, Summarization					
S-5	SLO-1	N-grams	Structural Disambiguation	Paraphrase Extraction	Information Fusion		CBOW			
	SLO-2									
S-6	SLO-1	Multiword Expressions	Word, Context and Sentence-level Semantics	Discourse	Single and Multi-document		Skip-gram			
	SLO-2			Coreference Resolution	Summarization – Question Answering					
S-7	SLO-1	Collocations (Association Measures, Coefficients and Context Measures)	Pronoun Resolution	Text Coherence	Introduction to Chatbot Applications		Sentence Embeddings			
	SLO-2				Retrieval based- Conversation based					

S-8	SLO-1	Vector Representation of Words	Semantic Representation of text	Discourse Structure	NLU and NLG	Recurrent Neural Networks (RNN)
	SLO-2			Coherence		
S-9	SLO-1	Language Modeling	Introduction to Semantic Relations	Discourse Planning	Machine Translation	Long Short-Term Memory (LSTM)

Learning Resources	1. Daniel Jurafsky and James H. Martin, "Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech Recognition", Prentice Hall, 2nd Edition, 2018.	3. James Allen, Benjamin Cummings, "Natural Language Understanding", 2nd edition, 1995
	2. C. Manning and H. Schütze, "Foundations of Statistical Natural Language Processing", MIT Press, Cambridge, MA, 1999	4. Yoav Goldberg, "Neural Network Methods for Natural Language Processing." 5. <a href="http://mccormickml.com/2106/04/19/word2vec-tutorial-the-skip-gram-model/">http://mccormickml.com/2106/04/19/word2vec-tutorial-the-skip-gram-model/</a> 6. <a href="https://nlp.stanford.edu/pubs/glove.pdf">https://nlp.stanford.edu/pubs/glove.pdf</a>

Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#		Theory	Practice
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice		
Level 1	Remember	40 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Understand										
Level 2	Apply	40 %	-	40 %	-	40 %	-	40 %	-	40%	-
	Analyze										
Level 3	Evaluate	20 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

# CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Dr. J. Balaji, Associate Manager, Allstate Solutions Pvt Ltd, jagank.balaji@gmail.com	1. Dr. G. Nagappan, Professor, nagappan@saveetha.ac.in	1. Dr. M. Ferni Ukrit, SRMIST
		2. Dr. A. Pandian, SRMIST
		3. Ms. K. Meenakshi, SRMIST



Course Code	18CSE360T	Course Name	INFORMATION STORAGE AND MANAGEMENT	Course Category	E	Professional Elective	L	T	P	C
							3	0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Computer Science and Engineering		Data Book / Codes/Standards	Nil	

Course Learning Rationale (CLR):		Learning			Program Learning Outcomes (PLO)														
CLR-1 :		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
The purpose of learning this course is to:																			
CLR-1 :	Understand the components of storage infrastructure.				Engineering Knowledge														
CLR-2 :	Gain knowledge to evaluate storage architectures including storage subsystems				Problem Analysis														
CLR-3 :	Understand the business continuity, backup and recovery methods.				Design & Development														
CLR-4 :	Acquire knowledge on information security framework				Analysis, Design, Research														
CLR-5 :	Introduce the working principle of storage infrastructure with monitoring principles				Modern Tool Usage														
CLR-6 :	Understand the structure of cloud computing and its techniques				Society & Culture														
					Environment & Sustainability														
					Ethics														
					Individual & Team Work														
					Communication														
					Project Mgt. & Finance														
					Life Long Learning														
					PSO - 1														
					PSO - 2														
					PSO - 3														

Course Learning Outcomes (CLO):		Learning		
CLO-1 :		1	2	3
At the end of this course, learners will be able to:				
CLO-1 :	Acquire the knowledge on the components of storage infrastructure	3	80	70
CLO-2 :	Acquire the ability to evaluate storage architectures including storage subsystems	3	85	75
CLO-3 :	Understand the business continuity, backup and recovery methods.	3	75	70
CLO-4 :	Appreciate the concepts of storage security and information security applied to virtual machine	3	85	80
CLO-5 :	Apply the knowledge for storage infrastructure	3	85	75
CLO-6 :	Acquire the knowledge on structure of cloud computing and its techniques	3	80	70

Duration (hour)	9		9		9		9		9	
S-1	SLO-1	Introduction to Information Storage Management	Virtualization and Cloud Computing : Fiber Channel: Overview	Business Continuity And Back Up Recovery Business Continuity: Information Availability.	Storage Security And Management :	Cloud Computing:Cloud Enabling Technologies				
	SLO-2	Evolution of Storage Architecture	SAN and its Evolution	BC Terminology, BC Planning life cycle	Information Security Framework	Characteristics of Cloud Computing				
S-2	SLO-1	Data Centre Infrastructure	Components of FC SAN, FCConnectivity, FC Architecture	Failure Analysis, Business Impact Analysis	Risk Triad	Benefits of Cloud Computing				
	SLO-2	Virtualization and Cloud Computing	IPSAN-iSCSI components	BC Technology Solutions	Storage Security Domains	Cloud Service Models				
S-3	SLO-1	Key challenges in managing information.	iSCSI Protocol Stack iSCSI Names	Backup and Archive: Backup Purpose	Security Implementations in Storage Networking	Cloud Deployment models				
	SLO-2	Data Center Environment: Application	NAS: General Purpose Servers versus NAS Devices	Backup Considerations	Securing Storage Infrastructure in Virtualized and Cloud Environments	Cloud Infrastructure Mechanism: Logical Network Perimeter				
S-4-5	SLO-1	Database Management System (DBMS)	Benefits of NAS- File Systems and Network File Sharing	Backup Granularity , Recovery considerations	RSA and VMware Security Products	Virtual Server , Cloud Storage Device				
	SLO-2									
S-6	SLO-1	Host : Connectivity, Storage	Components of NAS	Backup Methods, Backup Architecture	Monitoring the Storage Infrastructure	Cloud Usage Monitor				
	SLO-2	Disk Drive Components, Disk Drive Performance	NAS I/O Operation	Backup and Restore Operations	Monitoring Parameters,	Resource Replication				
S-7	SLO-1	Intelligent Storage System	NAS Implementations	Backup Topologies	Components Monitored, Monitoring examples	Ready Made environment				
	SLO-2	Components of an Intelligent Storage System	NAS File Sharing Protocols	Backup in NAS Environments	Storage Infrastructure Management Activities	Container				

S-8	SLO-1	Storage Provisioning	Object Based Storage Devices	Backup Targets, Data Deduplication for Backup	Storage Infrastructure Management Challenges, Storage Management Examples	Cloud Challenges
	SLO-2	Types of Intelligent Storage Systems	Content Addressed Storage	Backup in Virtualized Environments	Storage Allocation to a New Server/Host,	Cloud Adoption Considerations
S-9	SLO-1	Creation of Virtual storage machine, Navigation of storage system .	Configuration and Tracing of FC scan and iSCSI scan	Sharing Files between host and Virtual Machines, Usage of Backup techniques	Creation of an Linux Instance in Public Cloud, Generate a private key, Access using SSH client	Usage of Cloud services with open source cloud tools (like Eucalyptus, Openstack, Open Nebula and others)
	SLO-2					

Learning Resources	1. EMC Corporation, "Information Storage and Management", 2nd edition Wiley India, ISBN13: 978-1118094839	3. UifTroppen Rainer Wolfgang Muller, "Storage Networks Explained", India, Wiley, 2010, ISBN13: 978-0470741436
	2. Thomas Erl, "Cloud Computing: Concepts, Technology & Architecture", Prentice Hall, 2013, ISBN: 9780133387568	

Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	40%	-	30%	-	30%	-	30%	-	30%	-
	Understand										
Level 2	Apply	40%	-	40%	-	40%	-	40%	-	40%	-
	Analyze										
Level 3	Evaluate	20%	-	30%	-	30%	-	30%	-	30%	-
	Create										
	Total	100 %		100 %		100 %		100 %		100%	

# CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
	Dr.V.Masillamani	1. Dr.B.Amutha SRMIST
		2. Dr.A.Shanthini, SRMIST

Course Code	18CSE451T	Course Name	WIRELESS SENSOR NETWORKS	Course Category	E	Professional Elective	L	T	P	C
							3	0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	CSE	Data Book / Codes/Standards	Nil		

Course Learning Rationale (CLR):	The purpose of learning this course is to:			Program Learning Outcomes (PLO)																	
CLR-1 :	Understand basic sensor network concepts			1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CLR-2 :	Know physical layer issues, Medium Access Control Protocols			Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3
CLR-3 :	Comprehend network and transport layer characteristics and protocols						H	H	H	H	M	M	M	M	M	H	L	H	H	H	H
CLR-4 :	Understand the network management and Middleware services						H	H	H	H	M	M	M	M	M	H	L	H	H	H	H
Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:																				
CLO-1 :	Understand the basic ideas about sensor network concepts with Applications and Apply the knowledge for WSN tools			2	80	85	H	H	H	H	M	M	M	M	M	H	L	H	H	H	H
CLO-2 :	Acquire the knowledge on wireless transmission technology ,hardware and Medium Access Protocols			2	75	80	H	H	H	H	M	M	M	M	M	H	L	H	H	H	H
CLO-3 :	Understand the basic ideas about Wireless Sensor Networks Routing protocols and network - transport layer characteristics			2	85	80	H	H	H	H	M	M	M	M	M	H	L	H	H	H	H
CLO-4 :	Apply the knowledge for network management and Middleware services			2	80	75	H	H	H	H	M	M	M	M	M	H	L	H	H	H	H

Duration (hour)	9		9		9		9		9	
S-1	SLO-1	Introduction to computer and wireless sensor networks	Wireless Transmission Technology and systems	Overview-Wireless Mac Protocols		Design Issues in WSN routing- Data Dissemination and Gathering		WSN middleware principles- Routing Challenges in WSN		
	SLO-2									
S-2	SLO-1	Motivation for a network of Wireless Sensor nodes -	Radio Technology Primer	Characteristics of MAC protocols in Sensor networks		Flooding		Middleware architecture		
	SLO-2	Sensing and sensors	Available Wireless Technologies					Data related functions, Architecture		
S-3	SLO-1	Challenges and constraints	Hardware- Telosb	Contention free MAC Protocols		Flat Based Routing – SAR		Existing middleware		
	SLO-2					Directed Diffusion		MILAN, IrisNet		
S-4	SLO-1	Node architecture	Hardware -Micaz notes	MAC Protocols -Characteristics		MCFA Coherent processing		AMF,DSWare		
	SLO-2	Sensing sub system		Traffic Adaptive Medium Access		Non-Coherent Processing		CLMF		
S-5	SLO-1	Processor sub system	Time Synchronization- Clock	Y-MAC		Hierarchical Routing- LEACH,TEEN, APTEEN,PEGASIS		Operating systems for wireless sensor networks		
	SLO-2	Communication interfaces-- prototypes		Low energy Adaptive Clustering						
S-6	SLO-1	Application of Wireless sensors	Synchronization Problems	Contention based MAC Protocols		Query Based Routing		Performance and traffic management		
	SLO-2					Negotiation Based Routing				
S-7	SLO-1	WSN Tools- Overview and Limitations	Basics of time synchronization	Sensor MAC		Geographical Based Routing		Fundamentals of network security		
	SLO-2		Time synchronization protocols	Timeout MAC and pattern MAC						
S-8	SLO-1	Contiki -Introduction	Localization	MAC protocols in ContikiIOS simulator		Routing protocol simulation in contiki		Network security Challenges		
	SLO-2		Ranging Techniques	Nullmac in Contiki simulator		RPL objective function &simulation using DGRM model cooja				
S-9	SLO-1	Characteristics of Contiki WSN simulator	Range based Localization Range Free	CSMA in Contiki simulator		RPL(Routing Protocol for Low-Power and		Attacks Protocols mechanisms for security		

		Localization		Lossy Networks ) Border Router simulation in Contiki 2.7 OS
	SLO-2	Event driven Localization		

Learning Resources	1. Kazem Sohraby, Daniel manoli , "Wireless Sensor networks- Technology, Protocols and Applications", Wiley InterScience Publications 2013.	5. Bhaskar Krishnamachari , " Networking Wireless Sensors", Cambridge University Press, 2005
	2. Waltenequs Dargie, Christian Poellabauer , "Fundamentals of Wireless Sensor Networks, Theory and Practice", Wiley Series on wireless Communication and Mobile Computing, 2011	6. <a href="https://www.amazon.in/Guide-Wireless-Sensor-Networks-ebook/dp/B072R53JJM">https://www.amazon.in/Guide-Wireless-Sensor-Networks-ebook/dp/B072R53JJM</a>
	3. S.Swapna Kumar, "A Guide to Wireless Sensor Networks", kindle Edition, USP publications,2017	7. <a href="https://anrg.usc.edu/contiki/index.php/Contiki_tutorials">https://anrg.usc.edu/contiki/index.php/Contiki_tutorials</a>
	4. C.S Raghavendra, Krishna M.Sivalingam, Taieb znati , "Wireless Sensor Networks", Springer Science 2010.	8. file:///C:/Users/Administrator.RD27/Downloads/Fundamentals-of-Wireless-Sensor-Networks-Waltenequs-Dargie.pdf

Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	40 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Understand										
Level 2	Apply	40 %	-	40 %	-	40 %	-	40 %	-	40%	-
	Analyze										
Level 3	Evaluate	20 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

# CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1.Mr.Anirban Chowdhry, Director, Frugal Labs	1. Dr. P.T.V. Bhuvaneshwari, Professor, MIT campus, Anna University	1. Dr. Revathi Venkatraman, SRMIST 2. Dr.N.Snehalatha, SRMIST 3. Dr.MB.Mukesh krishnan, SRMIST

Course Code	18CSE452T	Course Name	NETWORK PROTOCOLS AND PROGRAMMING	Course Category	E	Professional Elective	L	T	P	C
							3	0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	CSE	Data Book / Codes/Standards	Nil		

Course Learning Rationale (CLR):	The purpose of learning this course is to:			Program Learning Outcomes (PLO)																	
CLR-1 :	Describe the importance of various Internet protocols like ARP, RARP, ICMP, Multicasting and multi routing, SCTP			1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CLR-2 :	Understand the transport layer protocols , application layer protocol and its characteristics			Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3
CLR-3 :	Learn and Understand IPV6 technologies																				
CLR-4 :	Work with client server sockets and develop related applications to communicate with each other.																				
CLR-5 :	Understand the wide area network protocols																				
CLR-6 :	Learn the basics of MPLS protocol																				
Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:																				
CLO-1 :	Identify the basics of different types of network and transport layer protocols			2	80	85	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-2 :	Design and implement the socket programming			2	75	80	H	H	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-3 :	Enumerate the types of application layer protocols			2	85	80	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-4 :	Analyze and compare the IPv4 and IPv6 protocols			2	80	75	H	H	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-5 :	Familiarize with wide area technologies			2	75	85	H	-	-	H	-	-	-	-	-	-	-	-	-	-	-
CLO-6 :	Describe the working of MPLS protocol			2	80	85	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Duration (hour)	9		9		9		9		9	
S-1	SLO-1	IP header	Byte ordering	DNS	IPV6 Overview	DSL				
	SLO-2	IP fragmentation	Byte ordering conversion functions	DNS in the Internet,	IPV6 Features	Other DSL Technology				
S-2	SLO-1	ARP	System calls	DNS Resolution	IPV6 Addressing Modes	DSL Benefits				
	SLO-2	RARP	Sockets	DNS Messages	IPV6 Address Types	Cable Technology				
S-3	SLO-1	ICMP -introduction	System calls used with Sockets	TELNET	Introduction	Compare DSL Vs Cable				
	SLO-2	ICMP-Messages	Iterative and concurrent server	SSH	Address Space Allocation	Frame Relay				
S-4	SLO-1	Debugging tools	Socket Interface	FTP	Global Unicast Addresses	ATM Introduction				
	SLO-2	ICMP package	Structure and Functions of Socket	TFTP	Autoconfiguration	ATM Cell Format				
S-5	SLO-1	UDP Datagram	Remote Procedure Call	WWW Architecture	Renumbering	ATM Layer				
	SLO-2	UDP characteristics	RPC Model, Features	WWW Documents	IPV6 Routing Protocols	AAL Layer				
S-6	SLO-1	TCP Header	TCP Client Server Program	HTTP	Introduction	ATM Application				
	SLO-2	TCP connection establishment process	Input, Output Processing Module	HTTP Request and Reply	IPV6 Packet Format	PPP				
S-7	SLO-1	TCP Error Control	UDP Client Server Program	DHCP Operation	Comparison between IPV4 and IPV6 Header	PPP Services, Components				
	SLO-2	TCP Congestion Control	UDP Control block table & Module	DHCP Configuration	IPV4 to IPV6 Tunneling	PPP frame and byte stuffing				
S-8	SLO-1	TCP Flow Control	UDP Input & Output Module	SMTP	IPV4 to IPV6 Translation Techniques	HDLC				
	SLO-2	Multicasting	SCTP Sockets	POP3	NAT Protocol Translation	HDLC Transfer Modes, Frame				

S-9	SLO-1	Multicasting and Multicast Routing Protocol	SCTP Services and Features, Packet Format	IMAP	IPv6 Mobility	Types of HDLC Frame
	SLO-2	Stream Control Transmission Protocol	SCTP Client/Server	MIME	Protocols Changed to Support IPv6	MPLS

Learning Resources	1. Behrouz A. Forouzan, "TCP/IP Protocol Suite" 4 <sup>th</sup> edition, 2013, McGraw-Hill ISBN: 0073376043 2. Douglas E. Comer, "Internetworking with TCP/IP, Principles, protocols, and architecture, Vol 15th Edition, 2006 ISBN: 0131876716, ISBN: 978-0131876712"	3. Richard Stevens, "Unix Network Programming, vol. 1, 3rd edition, 2003, McGraw-Hill ISBN 0-07-246060-1"
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Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	40 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Understand										
Level 2	Apply	40 %	-	40 %	-	40 %	-	40 %	-	40%	-
	Analyze										
Level 3	Evaluate	20 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

# CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Mr. Thamaraiselvam, zoho, thamaraiselvam.s@zohocorp.com	1. Dr. Ema, Anna University Chennai, umamesh@auist.net	1. Dr. G. Usha, SRMIST, Dr. J. Kalaivani, SRMIST
2. Mr. Mithun, Cognizant, Mithun.SS@cognizant.com	2. Dr. Kunvar Singh, NIT Trichy, kunwar@nitt.edu	2. Mr. J. Godwin Pon, SRMIST

Course Code	18CSE453T	Course Name	NETWORK ROUTING ALGORITHMS	Course Category	E	Professional Elective	L	T	P	C
							3	0	0	3

Pre-requisite Courses	18CSC302J	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Computer Science and Engineering		Data Book / Codes/Standards	Nil	

Course Learning Rationale (CLR):	The purpose of learning this course is to:			Learning			Program Learning Outcomes (PLO)																	
CLR-1:	Understand how addressing and routing are tied together and different architectural components are related to routing.			1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15			
CLR-2:	Gain knowledge on the need for routers, its functionality and different architectures.			Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3			
CLR-3:	Understand fundamental basis of various algorithms in centralized and distributed point of view.						H	M	-	-	-	-	L	-	-	-	-	-	M	-	H	-	-	-
CLR-4:	Apply the knowledge of IP addressing in various routing algorithms.						H	H	M	M	L	-	-	-	-	-	-	-	L	H	-	-	-	
CLR-5:	Understand the various types of key routing protocols used in wireless networks.						H	H	L	M	M	-	-	-	M	-	-	L	H	-	-	-		
CLR-6:	Gain knowledge on past experiences and prepare for next generation networks and routing						H	H	H	H	H	L	-	M	M	-	-	H	-	-	-			
CLR-6:	Gain knowledge on past experiences and prepare for next generation networks and routing						H	H	H	M	M	L	-	-	-	-	-	H	-	-	-			
Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:			2	80	85	H	M	-	-	-	-	-	-	-	-	-	-	-	-	-			
CLO-1:	Acquire the knowledge of how data transfer happens in conventional networks			2	75	80	H	H	M	M	L	-	-	-	-	L	H	-	-	-				
CLO-2:	Comprehend Router Architectures and IP Address Lookup Algorithms			2	85	80	H	H	L	M	M	-	-	-	M	-	L	H	-	-				
CLO-3:	Compare routing techniques and protocols			2	80	75	H	H	H	H	H	L	-	M	M	-	H	-	-	-				
CLO-4:	Examine how different dimensions of routing differ for different types of network			2	75	85	H	H	H	H	M	-	-	-	M	-	H	-	-	-				
CLO-5:	Apply various routing algorithms in wireless network scenario.			2	80	85	H	H	H	M	M	L	-	-	-	-	H	-	-	-				
CLO-6:	Understand various routing paradigms in next generation			2	80	85	H	H	H	M	M	L	-	-	-	-	H	-	-	-				

Duration (hour)	8		9		9		9		10		
S-1	SLO-1	Network Routing: An Introduction to Routing algorithms	Router Architectures: Basic Forwarding Functions	Bellman-Ford algorithm: Centralized View	Routers, Networks, and Routing Information: Some Basics	Routing in Wireless Networks: Internet based mobile ad-hoc networking					
	SLO-2	Functions of Router	Routing table versus forwarding table	Distance Vector Approach: Distributed View	Routing Table, Communication of Routing Information	Classifications of routing protocols					
S-2	SLO-1	IP addressing	Types of router	Dijkstra's Algorithm	Routing Information Protocol, Version 1 (RIPv1)	Table-Driven Routing Protocols: Destination Sequenced Distance-Vector Routing Protocol					
	SLO-2	On Architecture: Service Architecture	Elements of Router	Comparison of Bellman-Ford and Distance Vector Approach	Routing Information Protocol, Version 2 (RIPv2)	Cluster-Head Gateway Switch Routing Protocol					
S-3	SLO-1	Protocol architecture stack	Packet Flow	Shortest Path Computation with Candidate Path Caching	Interior Gateway Routing Protocol (IGRP)	On-Demand Routing Protocols: Dynamic Source Routing Protocol					
	SLO-2		Packet Processing	Widest Path Computation with Candidate Path Caching	Enhanced Interior Gateway Routing Protocol (EIGRP), Route Redistribution	Ad Hoc On-Demand Distance-Vector Routing Protocol					
S-4	SLO-1	Network Topology Architecture	Shared CPU architecture, Shared forwarding Engine Architecture	Widest Path Algorithm	OSPF: Protocol Features	Hybrid Routing Protocols: Core Extraction Distributed Ad Hoc Routing Protocol					
	SLO-2	Network Management Architecture	Shared Nothing Architectures, Clustered Architectures	k-Shortest Paths Algorithm	OSPF Packet Format	Zone Routing Protocol					
S-5	SLO-1	Public Switched Telephone Network	Impact of Addressing on lookup	Routing Protocol, Routing Algorithm, and Routing Table	Integrated IS-IS	Routing Protocols With Efficient Flooding Mechanisms : Preferred Link-Based Routing Protocols					

			Longest Prefix Matching	Routing Information Representation and Protocol Messages	Similarities and Differences Between IS-IS and OSPF	Optimized Link State Routing
S-6	SLO-1	Communication Technologies	Naïve Algorithms, Binary Tries	Distance Vector Routing Protocol	IP Traffic Engineering: Traffic, Stochasticity, Delay, and Utilization	Hierarchical Routing Protocols
					Applications' View	Power-Aware Routing Protocols
S-7	SLO-1	Standard Committees – International Telecommunication Union	Multi-bit Tries	Link State Routing Protocol	Traffic Engineering: An Architectural Framework	Toward Next Generation Routing: Quality of Service Routing
	SLO-2	Internet Engineering Task Force, MFA Forum	Compressing multi-bit strides		Traffic Engineering: A Four-Node Illustration	
S-8	SLO-1	Type Length Value	Search By Length Algorithms	Path Vector Routing Protocol	BGP Operations, configuration, faces of BGP	Multiprotocol Label Switching(MPLS)
	SLO-2	Network Protocol Analyzer	Search By value approaches		BGP Decision Process	Generalized MPLS
S-9	SLO-1		Hardware Algorithms	Network Flow Modeling: Single-Commodity Network Flow	Internal BGP Scalability	Routing and Traffic Engineering with MPLS
	SLO-2		Comparing Different Approaches	Multicommodity Network Flow: Three-Node Example	Protocol Message Format	
S-10	SLO-1					PSTN Call Routing Using the Interne
	SLO-2					

Learning Resources	<ol style="list-style-type: none"> <li>1. D.Medhi and K.Ramasamy, <i>Network Routing : Algorithms, Protocols and Architectures</i>, Morgan Kaufmann Publishers, First Edition 2007.</li> <li>2. C.Siva Ram Murthy and B.S.Manoj, <i>Adhoc Wireless Networks</i>, Pearson Education, 2007.</li> <li>3. D.Medhi and K.Ramasamy, <i>Network Routing : Algorithms, Protocols and Architectures</i>, Morgan Kaufmann Publishers, Second Edition 2017.</li> </ol>	<ol style="list-style-type: none"> <li>4. Steen Strub M, <i>Routing in Communication networks</i>, Prentice Hall International, 1995.</li> <li>5. <i>Internetworking Technologies Handbook</i>, Inc. Cisco Systems, ILSG Cisco</li> </ol>
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Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember Understand	40 %	-	30 %	-	30 %	-	30 %	-	30%	-
Level 2	Apply Analyze	40 %	-	40 %	-	40 %	-	40 %	-	40%	-
Level 3	Evaluate Create	20 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Total	100 %		100 %		100 %		100 %		100 %	

# CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
Mr. T.Bernald , Senior Consulatant , TCS Chennai. bernald.t@tcs.com (waiting for approval)	Dr. S.Anbuchelian, Anna University. anbuchelian@annauniv.edu	1. Dr.Femilda Josephin J S, SRMIST
		2. Mr.Rajesh Babu, SRMIST
		3. Mr. J.Godwin, SRMIST



Course Code	18CSE454T	Course Name	HIGH PERFORMANCE COMPUTING	Course Category	E	Professional Elective	L	T	P	C
							3	0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Computer Science Engineering			Data Book / Codes/Standards	Nil

Course Learning Rationale (CLR):		Learning			Program Learning Outcomes (PLO)																	
CLR-1 :		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15			
The purpose of learning this course is to:		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3			
CLR-1 : To learn about Modern Processors and concepts					H	H	-	-	-	-	-	-	-	-	-	H	-	-	-	-	-	-
CLR-2 : To understand the basic concepts of optimizations					-	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	H
CLR-3 : To learn about Parallel Computers and programming					-	-	H	-	-	-	-	-	M	-	-	L	-	-	-	-	-	-
CLR-4 : To understand the basic concepts of parallelization					-	H	-	-	H	-	-	-	H	-	-	H	-	-	H	-	-	-
CLR-5 : To Study about Memory Parallel Programming using OpenMP					-	-	-	H	-	L	L	-	-	-	-	-	-	-	-	-	-	-
CLR-6 : To Study about Memory Parallel Programming using and MPI		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	H	H	-			
Course Learning Outcomes (CLO):		At the end of this course, learners will be able to:																				
CLO-1 : Acquire the knowledge of Modern processors and concepts		2	80	85																		
CLO-2 : Understand the basic ideas about Optimizations		2	75	80																		
CLO-3 : Acquire the ability to identify parallel computers		2	85	80																		
CLO-4 : Appreciate the concepts of parallelization		2	80	75																		
CLO-5 : Apply the knowledge on parallel programming using Open MP		2	75	85																		
CLO-6 : Acquire the knowledge on parallel programming using MPI		2	80	85																		

Duration (hour)	9		9		9		9		9	
S-1	SLO-1	Stored Program Computer Architecture	Scalar profiling- Function- and line-based runtime profiling	Taxonomy of parallel computing paradigms	Introduction to OpenMP		Distributed-memory parallel programming with MPI- Message passing			
	SLO-2	General-ptupose cache-based microprocessor architecture	Hardware performance counters .	Shared-memory computers	Parallel execution		introduction to MPI			
S-2	SLO-1	Performance based metrics and Benchmarks	Manual instrumentation	Cache coherence	Data scoping		Messages and point-to-point Communication, Collective Communication			
	SLO-2	Transistors galore:	Common sense optimizations- Do less work!	UMA – ccNUMA	OpenMP worksharing for loops		Nonblocking point-to-point Communication			
S-3	SLO-1	Moore's Law	Avoid expensive operations!	Distributed-memory computers	Synchronization		Virtual topologies			
	SLO-2	Pipelining	Shrink the working set!	Hierarchical (hybrid) systems	Reductions		Example: MPI parallelization of a Jacobi solver			
S-4	SLO-1	Superscalarity	Simple measures, large impact- Elimination of common subexpressions	Networks- Basic performance characteristics of networks	Loop scheduling, Tasking		MPI implementation			
	SLO-2	SIMD	Avoiding branches	Buses, Switched and fat-tree networks	Miscellaneous		Performance properties, MPI performance tools			
S-5	SLO-1	Memory hierarchies	Using SIMD instruction sets	Mesh networks, Hybrids	Case study: OpenMP-parallel Jacobi algorithm		Communication parameters			
	SLO-2	Cache	The role of compilers	Parallelism- Data parallelism	Advanced OpenMP: Wavefront		Synchronization, serialization, contention			

					parallelization	
S-6	SLO-1	Cache mapping	General optimization options	Functional parallelism	Efficient OpenMP programming	Implicit serialization and synchronization
	SLO-2	Prefetch	Inlining, Aliasing	Parallel scalability	Profiling OpenMP programs	Contention
S-7	SLO-1	Multicore processors	Computational accuracy	Factors that limit parallel execution	Performance pitfalls	Reducing Communication overhead
	SLO-2	Multithreaded processors	Register optimizations, Using compiler logs	Scalability metrics, Simple scalability laws	Ameliorating the impact of OpenMP worksharing constructs	Optimal domain decomposition
S-8	SLO-1	Vector processors-	C++ optimizations- Temporaries	Parallel efficiency, Serial performance versus strong scalability	Determining OpenMP overhead for short loops	Aggregating messages
	SLO-2	Design principles	Dynamic memory management	Refined performance models	Serialization	Collective Communication
S-9	SLO-1	Maximum performance estimates	Loop kernels and iterators	Choosing the right scaling baseline	False sharing	Nonblocking vs. asynchronous Communication,
	SLO-2	Programming for vector architectures	Storage order- Case study: Jacobi algorithm and Dense matrix transpose.	Load imbalance	Case study: Parallel sparse matrix-vector multiply	Understanding intranode point-to-point Communication

Learning Resources	<ol style="list-style-type: none"> <li>Georg Hager, Gerhard Wellein, "Introduction to High Performance Computing for Scientists and Engineers", Chapman &amp; Hall/CRC Computational Sciences series, 2011.</li> <li>John Levesque, Gene Wagenbreth, "High Performance Computing: Programming and Application" CRC Press, 2010</li> </ol>	<ol style="list-style-type: none"> <li>Kai Hwang, Zhiweixu "Scalable Parallel Computing: Technology, Architecture, Programming",</li> <li>Charles Severance, Kevin Dowd, "High Performance Computing", O'Reilly Media, 2nd Edition, 1998.</li> </ol>
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Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#		Theory	Practice
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice		
Level 1	Remember	40 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Understand										
Level 2	Apply	40 %	-	40 %	-	40 %	-	40 %	-	40%	-
	Analyze										
Level 3	Evaluate	20 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

# CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Mr. Kesavan, HCL Technologies	1. Dr. Surendran Rajendran, AMA International University, Bahrain	1. J. Godwin Ponsam, SRMIST
2. Mr. R. Celein, Symmantec India Limited		2. Mr. Sivakumar SRMIST
		3. Mr. Jothikumar, SRMIST

Course Code	18CSE455T	Course Name	DATABASE SECURITY AND PRIVACY	Course Category	E	Professional Elective	L	T	P	C
							3	0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	CSE	Data Book / Codes/Standards	Nil		

Course Learning Rationale (CLR):		Learning			Program Learning Outcomes (PLO)															
The purpose of learning this course is to:		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3	
CLR-1 :	Understand the fundamentals of security relates to information				H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLR-2 :	how security is maintained in information systems				H	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLR-3 :	Understand the concept of security models in database				H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLR-4 :	Implementation of virtual private dtabase				H	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLR-5 :	Learn the procedures of database auditing				H	-	-	H	-	-	-	-	-	-	-	-	-	-	-	-
CLR-6 :	Implementation of data mining algorithms for PPDM				H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Course Learning Outcomes (CLO):		At the end of this course, learners will be able to:																		
CLO-1 :	Acquire the knowledge of information system and information security	2	80	85																
CLO-2 :	Able to manage the security of information system as well as database	2	75	80																
CLO-3 :	Able to design and develop the security model in database	2	85	80																
CLO-4 :	Able to implement VPD in various database	2	80	75																
CLO-5 :	Able to audit the database activities, users, security	2	75	85																
CLO-6 :	Apply the security mechanism in PPDM using various algorithms	2	80	85																

Duration (hour)	9	9	9	9	9	
S-1	SLO-1	Security Architecture: Introduction	Administration of Users-Introduction	Database Application Security Models: Introduction-	Auditing Database Activities-introduction	Privacy Preserving Data Mining Techniques: Introduction
	SLO-2	Information Systems	Authentication	Types of Users	Oracle Database Activities	Data Mining Techniques:
S-2	SLO-1	Database Management Systems	Creating Users	-Security Models	Oracle Database Activities	Privacy Preserving Data Mining Algorithms
	SLO-2	Information Security Architecture	SQL Server User	Application Types	Creating DLL Triggers with Oracle	Privacy Preserving Data Mining Algorithms
S-3	SLO-1	- Database Security	Removing, Modifying Users	-Application Security Models	Creating DLL Triggers with Oracle	General Survey-Data Mining Techniques
	SLO-2	Asset Types and value	Default users	Data Encryption	Auditing Database Activities with Oracle	Randomization Methods
S-4	SLO-1	Security Methods	Remote Users	Virtual Private Databases: Introduction	Auditing Database Activities with Oracle	Randomization Methods
	SLO-2	Operating System Security Fundamentals: Introduction	Database Links	-Overview of VPD	Auditing Server Activity with SQL Server 2000	Group Based Anonymization
S-5	SLO-1	Operating System Overview	Linked Servers	Implementation of VPD using Views	Auditing Server Activity with SQL Server 2000	Group Based Anonymization
	SLO-2	Security Environment	Remote Servers	Application Context in Oracle	Auditing Server Activity with SQL Server 2000	Distributed Privacy Preserving Data Mining
S-6	SLO-1	Security Components	Practices for Administrators and Managers-	Implementing Oracle VPD-	Auditing Server Activity with Oracle	Distributed Privacy Preserving Data Mining
	SLO-2	Authentication Methods	Profiles, Password Policies, Privileges and Roles: Introduction	Implementing Oracle VPD	Auditing Server Activity with Oracle	Curse of Dimensionality

S-7	SLO-1	User Administration	Defining and Using Profiles	Viewing VPD Policies	Security and Auditing	Application of Privacy Preserving Data Mining
	SLO-2	Password Policies	Designing and Implementing Password Policies	VPD using views	Security and Auditing	Application of Privacy Preserving Data Mining
S-8	SLO-1	Vulnerabilities	Best Practices	Application contexts using Data Dictionary	Casestudy: project security and auditing	Casestudy: on PPDM
	SLO-2	Vulnerabilities	Granting and Revoking User Privileges	Policy manager implementation	Casestudy: project security and auditing	Casestudy: on PPDM
S-9	SLO-1	Email Security	Creating, Assigning and Revoking UserRoles	Policy Manager Implementing Row and Column level Security with SQL Server	Casestudy: project security and auditing	Casestudy: on PPDM
	SLO-2	Internet security	Best practices	Policy Manager Implementing Row and Column level Security with SQL Server	Casestudy: project security and auditing	Casestudy: on PPDM

Learning Resources	1. Hassan A. Afyouni, "Database Security and Auditing", Third Edition, Cengage Learning, 2009. 2. Ron Ben Natan, "Implementing Database Security and Auditing", Elsevier Digital Press, 2005	3. Charu C. Aggarwal, Philip S Yu, "Privacy Preserving Data Mining": Models and Algorithms, Kluwer Academic Publishers, 2008
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Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#		Theory	Practice
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice		
Level 1	Remember	40 %	-	30 %	-	30 %	-	30 %	-	30%	-
Level 2	Understand	40 %	-	40 %	-	40 %	-	40 %	-	40%	-
	Apply										
Level 3	Analyze	20 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Evaluate										
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

# CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Mr. Somu Chockalingam, Founder and President, Doyensys, Chennai	Dr. K. Vivekanandan, Professor, Pondicherry Engineering College	1. Dr. B. Muruganathan, SRMIST
		2. Ms. Thenmozhi, SRMIST
		3. M. Maheswari, SRMIST

Course Code	18CSE456T	Course Name	SOFTWARE DEFINED NETWORKS	Course Category	E	Professional Elective	L	T	P	C
							3	0	0	3

Pre-requisite Courses	18CSC302J	Co-requisite Courses	Nil	Progressive Courses	
Course Offering Department	CSE	Data Book / Codes/Standards	Nil		

Course Learning Rationale (CLR):		The purpose of learning this course is to:			Learning			Program Learning Outcomes (PLO)																	
CLR-1 :	CLR-2 :	CLR-3 :	CLR-4 :	CLR-5 :	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15			
CLR-1 :	cover topics more advanced than a typical undergraduate networking course	CLR-2 :	prepare students for a market that is going to demand computer scientists and software engineers to deliver the next generation of network switches	CLR-3 :	describe the principles by which large computer networks and applications atop them are designed and maintained	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3		
CLR-4 :	Make students understand the state-of-the art networking technologies proposed in literature or used throughout industry in a variety of areas	CLR-5 :	Make students learn to critique research literature through a number of paper reviews and attempt to improve the state-of-the-art through minor and major projects	H	M				H	-	H	-	-	-	-	-	-	-	-	-	-	H	H	H	H
CLO-1 :	have a knowledge of the technology evolution leading to SDN as well as the Open Source role in SDN and OpenFlow specifications	CLO-2 :	gain a knowledge of the advantages and disadvantages of SDN, API approaches, Hypervisor overlays, and Data Center SDN, SDN WAN etc	H	M				H	-	H	-	-	-	-	-	-	-	-	-	-	H	H	H	H
CLO-3 :	Understand different network virtualization techniques and can deploy SDN/NFV applications	CLO-4 :	understand the economics of SDN and its impacts in the marketplace	H	M				H	-	H	-	-	-	-	-	-	-	-	-	-	H	H	H	H
				H	M				H	-	H	-	-	-	-	-	-	-	-	-	-	H	H	H	H

Duration (hour)	9		9		9		9		9	
S-1	SLO-1	Introduction	Why SDN? Genesis of SDN	Alternative definitions of SDN	Emerging SDN Models	SDN Ecosystem				
	SLO-2	How to Read a Paper (S. Keshav)	How SDN Works	Potential drawbacks of Open SDN	Protocol Models: NETCONF, BGP, MPLS	White-box switching				
S-2	SLO-1	Ho to Review a Paper (Timothy Roscoe), How to Disagree (Paul Graham)	SDN Evolution, SDN Basics	SDN via APIs	Controller Models	Open Sourcing SDN				
	SLO-2	Networking Basics: Switching, Addressing, Routing	SDN Architecture	SDN via Hypervisor-Based Overlays	Application Models: Proactive, Declarative, External	Open Networking Foundation				
S-3	SLO-1	Paper Reading: 4D	Plane Separation	SDN via Opening Up the Device	SDN in Datacenters: Multitenancy, Failure Recovery	OpenDaylight				
	SLO-2	Paper Reading: 4D	Simple Device and Centralized Control	Building our own SDN Switch	SDN in Internet eXchange Points (IXPs)	The ONOS Project				
S-4	SLO-1	Paper Reading: ALF	Network Automation and Virtualization	SDN on Raspberry Pi, Zodiac Fx	Tunneling and Path Technologies, Ethernet Fabrics in the Data Center	Hypervisors: Background, Types				
	SLO-2	Paper Reading: ALF	Openness, Northbound and Southbound APIs	Ryu on Raspberry Pi, Zodiac Fx	SDN Use Cases, Open SDN versus Overlays in the Data Center	OpenStack Deployment				
S-5	SLO-1	Switching Architecture: Data, Control, and Management Planes	Paper Reading: OpenFlow: Enabling Innovation in Campus	Network Function Virtualization (NFV)	Real-World Data Center Implementations, SDN in Other Environments	OpenStack Orchestration				

			Networks			
	SLO-2	Hardware Lookup	Review 1	Review 2	Review 3	Review 4
S-6	SLO-1	Forwarding Rules	OpenFlow, Switch-Controller Interaction	SDN vs. NFV	Wide Area Networks	OpenSwitch
	SLO-2	Dynamic Forwarding Tables	Flow Table, Packet Matching	OPNFV	Paper Reading: B4: Experience with a Globally-Deployed Software Defined WAN, SIGCOMM, 2013	Reactive versus Proactive Applications
S-7	SLO-1	Autonomous Switches and Routers	Actions and Packet Forwarding	Service Creation and Chaining	Service Provider and Carrier Networks	Analyzing Simple SDN Applications
	SLO-2	Internet Architecture	Extensions and Limitations	NFV Orchestration	Campus Networks	Other SDN Applications
S-8	SLO-1	Control-Data Plane Separation	Paper Reading: P4: Programming Protocol-Independent Packet Processors	Creating Network Virtualization Tunnels	Hospitality Networks, Mobile Networks	Future of SDN
	SLO-2	Packet Scheduling	SDN Controllers: POX, Ryu/Mininet Programming	Offloading Flows in the Data Center	In-Line Network Functions	SDN Security
S-9	SLO-1	Paper Reading: The Road to SDN: An Intellectual History of Programmable Networks	SDN Controllers: OpenDaylight, Mininet Programming	Access Control for the Campus	Optical Networks	Use Cases
	SLO-2	Project Proposal Due	SDN Controllers: ONOS, Mininet Programming	Traffic Engineering for Service Providers	SDN vs. P2P/Overlay Networks	Group Project Presentation

Learning Resources	1. Software Defined Networks: A Comprehensive Approach, 2 <sup>nd</sup> Edition Morgan Kaufmann, 2016 2. SDN: Software Defined Networks, Thomas D. Nadeau, Ken Gray, O'Reilly Media, 2013.	3. Network Function Virtualization, Ken Gray, Thomas D. Nadeau, Morgan Kaufmann, 2016
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Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#		Theory	Practice
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice		
Level 1	Remember	40 %	-	30 %	-	30 %	-	30 %	-	30%	-
Level 2	Understand	40 %	-	40 %	-	40 %	-	40 %	-	40%	-
	Apply	40 %	-	40 %	-	40 %	-	40 %	-	40%	-
Level 3	Analyze	20 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Evaluate	20 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Create	20 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Total	100 %		100 %		100 %		100 %		100 %	

# CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers														
Experts from Industry				Experts from Higher Technical Institutions				Internal Experts						
								1. Dr. Fernilda						
								2. Mr. K. Venkatesh						
								3. Mr. KarthickNanmaran						
Course Code	18CSE457T	Course Name	SEMANTIC WEB			Course Category	E	Professional Elective			L	T	P	C
											3	0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Computer Science and Engineering		Data Book / Codes/Standards	Nil	

Course Learning Rationale (CLR):		The purpose of learning this course is to:			Learning			Program Learning Outcomes (PLO)														
CLR-1 :	CLR-2 :	CLR-3 :	CLR-4 :	1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
Learn how the Semantic Web allows new uses of data	Understand how semantic technologies promote data portability	Become familiar with semantic standards-RDF,OWL	Make use of semantic programming techniques to both enrich web application development	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3	
				1	80	85	H	L	H	-	H	-	-	-	-	-	-	H	H	H	M	
				3	75	80	H	H	-	-	H	-	-	-	-	-	-	H	H	H	M	
				3	85	80	H	H	H	-	H	-	-	-	-	-	-	H	-	-	H	
				3	80	75	H	H	-	-	H	-	-	-	-	-	-	H	H	H	H	
Course Learning Outcomes (CLO):		At the end of this course, learners will be able to:																				
CLO-1 :	CLO-2 :	CLO-3 :	CLO-4 :																			
Apply flexible approach for integrating and future-proofing systems and data	Program the Semantic Web provides a standard	Incorporate existing data sources into semantically aware applications and publish rich semantic data	Make the machines to find, share, and combine data on the Web																			

Duration (hour)	9		9		9		9		9	
S-1	SLO-1	The Semantic Web Vision	Querying the Semantic Web	Web Ontology Language	Logic and Inference: Rules	Applications				
	SLO-2	Motivation for the Semantic Web	SPARQL Infrastructure	Requirements for Ontology Languages	Logic and Rules	e-commerce				
S-2	SLO-1	Semantic Web Technologies	Matching Patterns	OWL Syntax	Rules on the Semantic Web					
	SLO-2	Explicit Metadata		Formal Semantics	Monotonic Rules	Adoption				
S-3	SLO-1	Ontologies	Filters	Expressivity	Monotonic Rules: Syntax	Publication				
	SLO-2	RDF,OWL			Rules, Facts	News website application				
S-4	SLO-1	Logics-Principles of reasoning	Constructs for Dealing with an Open World	Reasoning Support	Logic Programs	Adoption				
	SLO-2	The Semantic Web versus Artificial Intelligence			Monotonic Rules: Semantics	Publication				
S-5	SLO-1	A Layered Approach	Organizing Result Sets	Compatibility of OWL2 with RDF/RDFS	Predicate Logic Semantics	Constructing Ontologies Manually				
	SLO-2			OWL2 Full: RDF-Based Semantics	OWL2 RL	Reusing Existing Ontologies				
S-6	SLO-1	RDF: Data Model	Other Forms of SPARQL Queries	OWL2 DL: Direct Semantics	Rule Interchange Format: RIF	Semiautomatic Ontology Acquisition				
	SLO-2				RIF-BLD					
S-7	SLO-1	RDF/XML	Querying Schemas	The OWL2 primitives	Compatibility with RDF and OWL	Ontology Mapping				
	SLO-2	RDFS: Adding Semantics		OWL2 Syntax	Semantic Web Rules Language (SWRL)					
S-8	SLO-1	Classes and Properties	Adding Information with SPARQL Update	OWL2 Property Types						
	SLO-2	Class Hierarchies and Inheritance	Inserting and Loading Triples	OWL2 Property Axioms						
S-9	SLO-1	Property Hierarchies	Deleting Triples	OWL2 Class Axioms	Rules in SPARQL: SPIN	SemanticWeb Application Architecture				
	SLO-2	RDF Schema	Case study	Individual Facts	RuleML					

Learning 1. Grigoris Antoniou and Frank Van Harmelen,-A Semantic Web Primer - The MIT Press, Cambridge, 3. John Hebel, Matthew Fisher, Ryan Blace, Andrew Perez-Lopez, Mike Dean Semantic Web Programming.

Resources	<i>Massachusetts London, England, Edition 3,2012</i> 2. <i>Toby Segaran, Colin Evans, Jamie Taylor, Programming the Semantic Web Build Flexible Applications with Graph Data, O'Reilly Media,2009</i>	<i>1st Edition,Wiley, 2009.</i> 4. <i>Thomas B. Passin, Explorer's Guide to the Semantic Web, Manning, 2004</i>
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Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	40 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Understand										
Level 2	Apply	40 %	-	40 %	-	40 %	-	40 %	-	40%	-
	Analyze										
Level 3	Evaluate	20 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

# CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. <i>Dr.Harisekharan,CTO,Sri SeshaaTechnologies Pvt. Ltd., Chennai</i>	1. <i>Dr.J.Suresh, SSN College of Engineering</i>	<i>Dr.G.Vadivu</i>
	2. <i>Dr. Sharmila Shankar, Crescent Institute of Science and Technology</i>	<i>Dr.C.N.Subalalitha</i>
		<i>Ms.S.Veena</i>



Course Code	18CSE458T	Course Name	WIRELESS AND MOBILE COMMUNICATION	Course Category	E	Professional Elective	L	T	P	C
							3	0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	
Course Offering Department	Computer Science and Engineering		Data Book / Codes/Standards	Nil	

Course Learning Rationale (CLR):		Learning			Program Learning Outcomes (PLO)															
CLR-1 :		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
The purpose of learning this course is to:																				
CLR-1 : Analyze the fundamental of transmission and cellular systems																				
CLR-2 : Apply skills in real time engineering problems and can have capability to evaluate the transmission errors																				
CLR-3 : Comprehend the concept of mobile network, transport layer and wireless technologies																				
CLR-4 : Differentiate the various types of cellular standard by their unique services.																				
CLR-5 : Grasp GSM, GPRS, Handover and Localization techniques																				
CLR-6 : Apply skills in various Routing protocols																				
Course Learning Outcomes (CLO):		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3	
At the end of this course, learners will be able to:																				
CLO-1 : Apply Wireless Technology concepts to Engineering problems related to Communication		3	80	70	H	H	H	H	H	H	H	H	H	H	M	H	H	H	H	H
CLO-2 : Improve their knowledge on Digital and analog Modulation techniques.		3	85	75	H	H	H	H	H	H	H	H	H	H	M	H	H	H	H	H
CLO-3 : Equip themselves familiar with principle of Mobile Communication		3	75	70	H	H	H	H	H	H	H	H	H	H	M	H	H	H	H	H
CLO-4 : Familiarize with Digital Cellular Standards		3	85	80	H	H	H	H	H	H	H	H	H	H	M	H	H	H	H	H
CLO-5 : Acquaint with routing protocols		3	85	75	H	H	H	H	H	H	H	H	H	H	M	H	H	H	H	H
CLO-6 : Expose to the emerging wireless technologies		3	80	70	H	H	H	H	H	H	H	H	H	H	M	H	H	H	H	H

Duration (hour)	9	9	9	9	9
S-1	SLO-1	Introduction to wireless Communication	Cellular Concept	Introduction to GSM	Mobile IP
	SLO-2	Elements of wireless Communication system	Cell area	Frequency Bands and Channels	IP packet delivery
S-2	SLO-1	Frequencies for radio Communication	Signal strength	Frames in GSM	Tunneling – Reverse Tunneling
	SLO-2	Signals, Noise – Types of Noise	Cell parameter	Planes and layers of GSM	IPv6
S-3	SLO-1	Introduction to modulation and demodulation	Capacity of Cell	Protocols	DHCP
	SLO-2	Signals in the modulation	Co channel interference	Localization and calling	Tridition TCP
S-4	SLO-1	Introduction to Analog modulation schemes	Frequency reuse	Handoff – Short messaging system	Congestion control
	SLO-2	Amplitude Modulation Frequency modulation	Cell splitting Cell sectoring	GPRS EDGE	Classical TCP Snooping ,
S-5	SLO-1	Phase Modulation Introduction to Analog modulation schemes	Multiple Radio access protocols	3G CELLULAR SystemsMMS	Mobile TCPFast retransmit / Fast recovery
	SLO-2	Amplitude Shift Keying Frequency Shift Keying Phase Shift Keying- BPSK, QPSK	Frequencydivision Multiple Access	UMTS Release and standards UMTS system architecture UTRAN	MANET characteristicsROUTING
S-6	SLO-1	Multiplexing and multiple access techniques	Time division Multiple Access Fixed ALOHA , Slotted ALOHA	Handover	Transaction oriented TCP TCP over 2.5/3G wireless Networks
S-7	SLO-1	Frequency-division multiplexing	Multiple Access with Collision Avoidance	Satellite System Infrastructure- GEO,	AODV Routing VANETCommunications in VANET
			Space division Multiple Access Code	Satellite System Infrastructure- GEO,	Introduction to WAP WAP Architecture
					Wireless Sensor Networks
					Wireless Datagram ProtocolWireless
					RFID TechnologyTwo tags of RFID

			division Multiple Access	LEO, MEO	Transaction Protocol	
	SLO-2	Time-division multiplexing	Spread ALOHA multiple Access	Limitations of GPS	Wireless Session Protocol	Wi-Fi Standards
S-8	SLO-1	Code-division multiplexing	OFDM	GPS Beneficiaries of GPS	Wireless Transport Layer Security	WiMax Standards
	SLO-2	Spread spectrum modulation	Variants of OFDM			
S-9	SLO-1	frequency hopping Spread spectrum	Comparison of Multiple Access Technique	4G Cellular systems	Wireless Markup Language	Fem-to-Cell Network
	SLO-2	Direct Sequence Spread spectrum		4G Standards ( LTE/WiMax)	Push Architecture	Push-to-talk technology for SMS

Learning Resources	1. Roy Blake, "Wireless Communication Technology" CENGAGE learning, Sixth indian reprint 2013.	6. Gray J.Mullet "Wireless TeleCommunication System and Networks", CENGAGE learning, reprint 2014.
	2. Dharma Prakash Agarwal, Qing-An Zeng, "Introduction to Wireless and Mobile Systems" CENGAGE learning, First edition 2014.	
	3. Jochen Schiller, "Mobile Communications", Addison Wesley, 2 <sup>nd</sup> edition 2011.	7. Upena Dalal, "Wireless Communication" Oxford University Press, First edition 2009.
	4. Singal TL, "Wireless Communication", Tata McGraw Hill Education Private Limited.	8. Kaveh Pahlavan & Prashant Krishnamurthy, "Wireless Networks" PHI 2002.
	5. G.I.Papadimitriou, A.S.Pomportsis, P.Nicopolitidis, M.S.Obaidat, "Wireless Networks", John Wiley and Sons, 2003	9. Martyn Mallick, "Mobile and Wireless Design Essentials", Wiley Dreamtech India Pvt.Ltd., 2014.

Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#		Theory	Practice
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice		
Level 1	Remember	40 %	-	30 %	-	30 %	-	30 %	-	30%	-
Level 2	Understand										
	Apply	40 %	-	40 %	-	40 %	-	40 %	-	40%	-
Level 3	Analyze										
	Evaluate	20 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

# CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
Dr.Madan Lakshmanan	Prof. Subra Ganesan	Dr.S.Suresh
Senior Scientist	Professor, Electrical and Computer Engineering	Mrs.Jeya
CEERI, CSIR, Chennai (R&D Industry)	Oakland University, USA	Mr.H.Karthikeyan

Course Code	18CSE459T	Course Name	SERVICE ORIENTED ARCHITECTURE	Course Category	E	Professional Elective	L	T	P	C
							3	0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Computer Science and Engineering		Data Book / Codes/Standards	Nil	

Course Learning Rationale (CLR):	The purpose of learning this course is to:			Learning			Program Learning Outcomes (PLO)																		
CLR-1 :	Learn service oriented analysis techniques			1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15				
CLR-2 :	Learn technology underlying the service design			Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3				
CLR-3 :	Learn advanced concepts in building SOA						H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLR-4 :	Understand the Java Web services						H	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLR-5 :	To know about various Web services specification standards						H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLR-6 :							H	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
							H	-	-	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:			2	80	85	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			
CLO-1 :	Acquire the knowledge on service oriented design technology			2	75	80	H	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-			
CLO-2 :	Acquire the ability to identify web services in SOA			2	85	80	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			
CLO-3 :	Understand the basic ideas about building SOA			2	80	75	H	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-			
CLO-4 :	Appreciate the concepts of standards and security on SOA			2	75	85	H	-	-	H	-	-	-	-	-	-	-	-	-	-	-	-			
CLO-5 :	Apply the knowledge in Java based web service			2	80	85	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			
CLO-6 :	Acquire the knowledge on ASP .NET based web services.			2	80	85	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			

Duration (hour)	9		9		9		9		9	
S-1	SLO-1	Introduction to SOA , Defining SOA	Introduction to Web Services	Phases of the SOA delivery lifecycle	SOA support in J2EE	Introduction to WS-BPEL				
	SLO-2	Necessity of SOA.	Primitive SOA	SOA Delivery Strategies Top- down strategy, Bottom-up strategy	SOA platform basics and building blocks	Basic terms used in the BPEL terminology				
S-2	SLO-1	SOA timeline from XML to Web services to SOA	Web Service Framework with respect to SOA	Agile strategy with Pros and cons	Overview of Java API for XML- based web services(JAX- WS)	WS-Coordination overview				
	SLO-2	History about XML	Logical components of the Web services framework	Objectives and service-oriented process steps	Java Architecture for XML binding (JAXB)	WS-Choreography				
S-3	SLO-1	Web Services and SOA	Service descriptions with WSDL layout	Benefits of a business-centric SOA	Building web services and client with examples	WS-Policy with SOA				
	SLO-2	Service Oriented Enterprise (SOE)	Meta data and service contracts	Service- oriented design	Introduction to Java API for XML Registries(JAXR)	WS Security				
S-4	SLO-1	Analyze the past architectures	Messaging with SOAP protocol and SOAP nodes	Introduction to WSDL language basics	Java API for XML based RPC (JAX-RPC)	Notification and Eventing				
	SLO-2	Scope Of SOA	SOAP message path	Define the structure of WSDL	Web Services Interoperability	Transaction Management				
S-5	SLO-1	SOA Reference Model	Message exchange Patterns and Coordination	Implement sample WSDL file	SOA support in .NET	Case study-SOA in cloud				
	SLO-2	Key Service characteristics of SOA	Web Services a Activity Management,	Introduction to SOAP basics	NET Platform overview	research focus on SOA and issues				

S-6	SLO-1	Anatomy of SOA	Coordination types and protocols	SOAP language basics	ASP.NET Page Handling	Comparative Analysis of SOA and Cloud Computing
	SLO-2	SOA architecture	ACID properties	Structure of SOAP	Post back vs Non post back events	
S-7	SLO-1	Components in SOA interrelate	Analyze atomic transaction with SOA	Implement SOAP style web services in Java.	ASP.NET web services	Case Study On Vehicle management system- create a service for identify the vehicle by entering the vehicle number.
	SLO-2	SOA component and specific behaviors	Business activities and protocols	SOA Composition	Creating a Web Site Using Visual Studio IDE	
S-8	SLO-1	Relationships among these components	Orchestration	service layers and standards	ASP.NET Programming Basics	Case Study on Online Healthcare System- Design an API to help healthcare providers collect, store, retrieve and exchange patient healthcare information more efficiently and enable better patient care.
	SLO-2	Technical Benefits of SOA	Choreography	Entity-centric business service design: List the step-by-step process	Creating a Web Site Using Visual Studio IDE	
S-9	SLO-1	Business Benefits of SOA	Service layer configuration scenarios	Application service design: process steps	Case Studies: Implement the Small Business Customer Management application as a web applications using ASP.NET	Case study on Simple Library Management System using API to get, post, edits and update book data from server.
	SLO-2	Principles of service orientation	Application Service Layer	Task centric business service design process steps	Web Services Enhancements (WSE)	

Learning Resources	1. Thomas Erl, "Service-Oriented Architecture: Concepts, Technology, and Design", Pearson Education, 2009.	4. Achieving Service-Oriented Architecture: Applying an Enterprise Architecture Approach, Rick Sweeney, 2010
	2. Eric Newcomer, Lomow, "Understanding SOA with Web Services", Pearson Education, 2005	
	3. James McGovern, Sameer T yagi, Michael E Stevens, Sunil Mathew, Java Web Services Architecture", Elsevier, 2003.	4. Sandeep Chatterjee, James Webber, "Developing Enterprise Web Services, An Architect's Guide", Pearson Education, 2005.

Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#		Theory	Practice
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice		
Level 1	Remember	40 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Understand										
Level 2	Apply	40 %	-	40 %	-	40 %	-	40 %	-	40%	-
	Analyze										
Level 3	Evaluate	20 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

# CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts

Course Code	18CSE460T	Course Name	NETWORK DESIGN AND MANAGEMENT	Course Category	E	Professional Elective	L	T	P	C
							3	0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Computer Science Engineering		Data Book / Codes/Standards	Nil	

Course Learning Rationale (CLR):	The purpose of learning this course is to:
CLR-1 :	Understand the various type of Networks and the Network Management basics
CLR-2 :	Understand the Network Management Standards
CLR-3 :	Understand the working of Simple Network Management Protocol and its various versions
CLR-4 :	Understand the working of Remote Monitoring
CLR-5 :	Understand the Network Management Applications
CLR-6 :	To Understand Network Designing and Planning

	Learning		
	1	2	3
	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLO-1 :	1	70	75
CLO-2 :	1	75	80
CLO-3 :	1	85	80
CLO-4 :	2	75	70
CLO-5 :	2	75	80
CLO-6 :	3	70	75

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:
CLO-1 :	Acquire knowledge on networks and network management
CLO-2 :	Gain knowledge of the various standards
CLO-3 :	Gain knowledge on the working of SNMP protocol and its various applications
CLO-4 :	To apply the network management tools and gather information from the network
CLO-5 :	To Familiarize with the working of various management applications
CLO-6 :	Apply the knowledge to create an efficient network

Program Learning Outcomes (PLO)														
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3
H	-	-	-	-	-	-	-	-	-	-	-	-	-	-
H	-	-	-	-	-	-	-	-	-	-	-	-	-	-
H	-	-	-	M	-	-	-	M	-	-	-	-	-	-
H	-	-	-	M	-	-	-	M	-	-	-	-	-	-
H	-	-	-	-	-	-	-	-	-	-	-	-	-	-
H	H	H	H	H	-	-	-	H	-	-	-	-	-	-

Duration (hour)	9	9	9	9	9	
S-1	SLO-1	Telephone Network Management	Introduction to SNMP	Remote Monitoring	Network Management Applications	Network Design and Planning
	SLO-2	Distributed Computing Environment	SNMP v1 model	RMON SMI and MIB	Fault Management -Architecture	Network Design for Enterprise Network
S-2	SLO-1	TCP/IP Based Networks	Organization Model	RMON1	Fault location ,Fault isolation	Network Design Process
	SLO-2	Communication Protocols and Standards	System overview	RMON2	Algorithm	Data Collection
S-3	SLO-1	Protocol Layer and Services	SNMP v1 Information model	System Utilities for Management	Self-healing	Data Generation
	SLO-2	Challenges of IT Managers	Structure of Management Information	Tools	Avoiding failures	Traffic Generators
S-4	SLO-1	Network Management	Managed Objects	Network Statistics Measurement Systems	Configuration setting,	Cost Generators
	SLO-2	Network and System Management	MIB-Object Group	Traffic Load	Configuration discovery and Change Control	Topology
S-5	SLO-1	Network Management System Platform	System Group, Interfaces Group, Address Translation group	Protocol Statistics	Configuration Management Applications	Architecture
	SLO-2	Current status and future of Network Management	IP Group, ICMP Group, TCP Group, UDP Group	Data and Error Statistics	Patch Management	Graph
S-6	SLO-1	Network Management Standards	SNMP v1Communication model	Network Management System	Approaches for Performance Management	Link
	SLO-2	Network Management Model - Organizational model	Functional model	Components, Requirements	Performance Monitoring and Reporting	Algorithms
S-7	SLO-1	Information Model	SNMPv2	System Management	Performance trouble shooting,	Network Design Techniques
	SLO-2	Management Information Trees	System Architecture, MIB, Protocol	Network Management Applications	Capacity Planning	Performance Analysis

S-8	SLO-1	Communication Model	SNMPv3	Configuration Management	Account Management	Queuing Essentials
	SLO-2	ASN.1	Architecture, Applications, MIB	Inventory Management	Report Management-System and User Reports	Loss and Delay
S-9	SLO-1	Terminology, Symbols and Conventions	User Based Security Model	Performance Management	Policy Management	Reliability
	SLO-2	Functional Model	Access Control	Tools	Service Level Management	Network Cost

Learning Resources	1. Mani Subramanian "Network Management Principles and Practice", Second Edition, Pearson Publication, 2012.	3. Greg Tomsho, Ed Tittel, David Johnson, "Guide to Network Essentials", Fifth Edition, Cengage Learning, 2010 4. Teresa C. Piliouras, "Network Design Management and Technical Perspectives", Second Edition, 2004
	2. DineshChandraVerma, "Principles of Computer Systems and Network Management", Springer, 2009.	

Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#		Theory	Practice
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice		
Level 1	Remember	40 %	-	40 %	-	20 %	-	30 %	-	40%	-
	Understand										
Level 2	Apply	40 %	-	40 %	-	40 %	-	40 %	-	40%	-
	Analyze										
Level 3	Evaluate	20 %	-	20 %	-	40 %	-	30 %	-	20%	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

# CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Mr. Vivekanandan, Nokia Technology Specialist, anandanviv1@gmail.com	1.	1. Dr.B.Amutha, SRMIST
2. Mr. Santhosh Kumar.S, Associate Consultant, TCS, santhosh.sansoft@gmail.com	2.	2. Dr.N.Snehalatha, SRMIST

Course Code	18CSE387T	Course Name	GENETIC ALGORITHM AND ITS APPLICATIONS		Course Category	E	Professional Elective				L	T	P	C																											
											3	0	0	3																											
Pre-requisite Courses	Nil		Co-requisite Courses	Nil		Progressive Courses	Nil																																		
Course Offering Department	Computer Science and Engineering			Data Book / Codes/Standards	Nil																																				
Course Learning Rationale (CLR):	The purpose of learning this course is to:				Learning			Program Learning Outcomes (PLO)																																	
CLR-1 :	Evolutionary Computation and Genetic Algorithms				1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15																			
CLR-2 :	Terminologies and operators of GA and				Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project wgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3																			
CLR-3 :	Advanced Operators and Techniques in GA and Classification of Genetic Algorithms																						L	H	-	H	L	-	-	-	-	L	L	-	H	-	-	-			
CLR-4 :	Genetic Programming and Genetic Algorithm Optimization problems																						M	H	L	H	L	-	-	-	-	M	L	-	H	-	-	-			
CLR-5 :	Applications of Genetic Algorithms																						M	H	M	H	L	-	-	-	-	M	L	-	H	-	-	-			
Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:																																								
CLO-1 :	Provides a introduction to genetic algorithm including fundamentals of genetic concepts				3	80	75																																		
CLO-2 :	To have a clear view of genetic operators				3	85	75																																		
CLO-3 :	To explore Genetic Algorithm optimization problems				3	80	75																																		
CLO-4 :	Discuss applications of Genetic Algorithms for various optimization problems.				3	85	80																																		
Duration (hour)	9		9		9		9		9		9		9		9		9		9		9		9																		
S-1	SLO-1	The Historical Development of Evolutionary Computing. Genetic Algorithms and Genetic Programming	Terminologies and operators of GA.Key elements, Individuals, Genes, Fitness, Populations. Data Structures.	Diploidy, Dominance etc. Inversion and Reordering. Order Crossover and Cycle crossover.	Genetic programming (GP). Comparison of GP and other algorithms. Genetic operators. Tree based GP, Representation of GP.	Specific Applications of Genetic Algorithms. GA in network synthesis, Control systems engineering and Fuzzy based speed control of Brushless DC motor.																																			
S-2	SLO-1	Features of Evolutionary Computation	Breeding, Selection, Crossover, Mutation and Replacement.	Micro operators: Segregation and translocation, Duplications and Deletion, Sexual determination.	Attributes in GP. Steps of GP, Characteristics of GP. What are Human Competitive, High-Return, Routine, and Machine Intelligence?	Feature selection in machine learning using GA. Designing texture filters with GA.																																			
S-3	SLO-2	Advantages of Evolutionary computation.																																							
S-3	SLO-1	Genetic algorithms-Biological background. Cell, Chromosomes, Genetics, Reproduction and Natural selection.	Search Termination or Convergence criteria.	Non-binary representation, Multi-objective optimization, combined optimization and Knowledge based techniques.	Applications of Genetic Programming	GA based knowledge acquisition in Image Processing. Object localization in image using GA.																																			
S-4	SLO-2																																								
S-4	SLO-1	Search space, GA world, Evolution and optimization	Best individual, Worst individual, Sum of fitness and Medium fitness.	Classification of GAs. Simple Genetic algorithms (SGA). Parallel and distributed GAs.	GA Optimization problems: Fuzzy optimization problems, Multi objective Reliability Design Problem. Network and bicriteria reliability problems.	Data mining applications such as feature selection in data mining, GA in intrusion detection, etc.																																			
S-5	SLO-2	Evolution and genetic algorithms. Conventional optimization and search techniques.	Why do genetic algorithms work? Building block hypothesis	Master-slave, Fine-grained parallel GAs. Multiple-Deme Parallel GAs.	Combinatorial Optimization problems. Linear integer model,	Applications in wireless networks for topology planning. GA application in ATM network.																																			

S-6	SLO-1	Gradient based, Random search, Stochastic Hill climbing	A Macro mutation hypothesis. An adaptive mutation hypothesis.	Hierarchical Parallel algorithms. Hierarchical Genetic Algorithms: Crossover, Initialization heuristics. Remove sharp algorithms.	Applications of combinatorial optimization methods.	VLSI design applications Genetic layout optimization using GA.
	SLO-2					
S-7	SLO-1	Simulated Annealing, Symbolic AI. A simple Genetic Algorithm.	The schema theorem	Adaptive GA., Initialization, Evaluation function, Selection operators, Crossover operators, and mutation operators.	Network design and Routing problems	Introduction to Particle Swarm Optimization [PSO] and Ant Colony Optimization [ACO].
	SLO-2		Optimal allocation of Trials. Implicit Parallelism			
S-8	SLO-1	Comparison of GA with other optimization techniques.	Advanced operators and techniques in GA,	Independent sampling GA and Breeding Phase.	Planning of passive optical networks, Packet switched networks,	Examples on PSO and ACO.
S-9		Limitations of GA.	Convergence problems in GA	Niched pareto genetic algorithm	Optimal topological design of all terminal networks.	Comparison of GA with PSO and ACO

Learning Resources	<ol style="list-style-type: none"> <li>1. S.N. Sivanandam and S.N. Deepa , "Introduction to Genetic Algorithms", Springer, 2nd edition (2008)</li> <li>2. Mitsuo Gen and Runwei Cheng, "Genetic Algorithms and Engineering Optimization", John Wiley, Fourth edition (2010)</li> </ol>	<ol style="list-style-type: none"> <li>3. Michael Negnevitsky, "Artificial Intelligence, A Guide to Intelligent Systems", Second edition ((2005))</li> </ol>
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Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember Understand	40 %	-	30 %	-	30 %	-	30 %	-	30%	-
Level 2	Apply Analyze	40 %	-	40 %	-	40 %	-	40 %	-	40%	-
Level 3	Evaluate Create	20 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Total	100 %		100 %		100 %		100 %		100 %	

# CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
Mr. K. Selvaraj, Caterpillar, Bangalore	Dr. A.P. Shanthi, CSE, Anna University, Chennai	1.Dr. V. Ganapathy SRMIST
	Dr. A. Kannan, CSE, VIT, Vellore.	2.Dr. D. Rajeswari SRMIST
		3.S. Saranya SRMIST



Course Code	18CSE388T	Course Name	ARTIFICIAL NEURAL NETWORKS	Course Category	E	Professional Elective	L	T	P	C
							3	0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Computer Science and Engineering		Data Book / Codes/Standards	Nil	

Course Learning Rationale (CLR):		Learning			Program Learning Outcomes (PLO)															
CLR-1 : Connect Biology with Computers		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
CLR-2 : Understand components of artificial neural networks		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3	
CLR-3 : Understand supervised learning network paradigms																				
CLR-4 : Understand unsupervised learning network paradigms																				
Course Learning Outcomes (CLO):		At the end of this course, learners will be able to:																		
CLO-1 :	Know the purpose of Artificial Neural Networks	1	80	85	H	L	-	-	H	-	-	-	-	-	-	-	H	L	L	-
CLO-2 :	Apply the concepts of activation, propagation functions	2	75	80	H	H	-	-	H	-	-	-	-	-	-	-	H	H	H	H
CLO-3 :	Work with supervised learning network paradigm	3	85	80	H	H	H	-	H	-	-	-	-	-	-	-	H	H	H	H
CLO-4 :	Work with unsupervised learning network paradigm	3	80	75	H	H	-	-	H	-	-	-	-	-	-	-	H	H	H	H

Duration (hour)	9		9		9		9		9	
S-1	SLO-1	Why neural network?	Components of artificial neural networks	Learning and training samples	Radial basis functions	Unsupervised learning network paradigms				
	SLO-2	Basics of Artificial Neural Networks	The concept of time in neural networks	Paradigms of Learning	Information processing of an RBF network	Structure of a self-organizing map(SOM)				
S-2	SLO-1	A brief history of neural networks Biological neural networks	Connections	Using training samples	Training of RBF networks	Functionality				
	SLO-2	Biological neural networks	Propagation function	Gradient Optimization Procedure	Growing of RBF networks	Training				
S-3	SLO-1	Biological neural networks	Activation	Hebbian learning rule	Topology function					
	SLO-2	The vertebrate nervous system	Threshold value, Activation function	Supervised learning network paradigms	Compare multilayer perceptrons and RBF	Decreasing Learning Rate				
S-4	SLO-1	peripheral nervous system	Common activation functions	The perceptron, back propagation and its variants	Recurrent perceptron-like networks	Variations of SOMs				
	SLO-2	Cerebrum, cerebellum, diencephalon, brainstem	Output function, Learning strategies	Singlelayer perceptron	Jordan networks	Neural gas				
S-5	SLO-1	The Neuron	Network topologies	Linear Separability	Elman networks	Multi-SOM				
	SLO-2	Feedforward networks	Recurrent networks	Multilayer perceptron	Training recurrent networks	Multi-neural gas				
S-6	SLO-1	Components	Completely linked networks	Backpropagation of error	Unfolding in time	Growing neural gas				
	SLO-2	Electrochemical processes	Bias neuron	Selecting learning rate	Teacher forcing	Adaptive resonance theory(ART)				
S-7	SLO-1	Receptor cells- Various types	Representing Neurons	Resilient Backpropagation	Recurrent backpropagation	Task and structure of an ART network				
	SLO-2	Information processing within nervous system	Orders of Activation	Adaption of Weights	Resonance					
S-8	SLO-1	Light Sensing organs	Synchronous activation	Variations in Backpropagation	Evolutionary algorithms	Learning process of an ART network				
	SLO-2	Neurons in living organisms	Asynchronous activation	Multilayer perceptron						
S-9	SLO-1	Transition to technical neurons	input and output of data							
	SLO-2									

Learning Resources	1. David Kriesel, <i>A Brief Introduction to Neural Networks</i> , dkriesel.com, 2005	3. Raul Rojas, <i>Neural Networks: A Systematic Introduction</i> , 1996.
	2. Gunjan Goswami, <i>Introduction to Artificial Neural Networks</i> , S.K. Kataria & Sons, 2012	4. S. Sivanandam, <i>Introduction to Artificial Neural Networks</i> , 2003

Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	40 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Understand										
Level 2	Apply	40 %	-	40 %	-	40 %	-	40 %	-	40%	-
	Analyze										
Level 3	Evaluate	20 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

# CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Dr. Harisekharan, CTO, Sri Seshaa Technologies Pvt. Ltd., Chennai	1. Dr. J. Suresh, SSN College of Engineering	Dr. G. Vadivu
	2. Dr. Sharmila Shankar, Crescent Institute of Science and Technology	Dr. D. Rajeswari
		Dr. M. S. Abirami

Course Code	18CSE389T	Course Name	FUZZY LOGIC AND ITS APPLICATIONS	Course Category	E	Professional Elective	L	T	P	C
							3	0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Computer Science & Engg	Data Book / Codes/Standards			

Course Learning Rationale (CLR):		The purpose of learning this course is to:			Learning			Program Learning Outcomes (PLO)																																
					1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15																		
CLR-1 :	Understand the Fuzzy Logic Basics				Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3																		
CLR-2 :	Gain knowledge on the Machine learning concepts																						H	M	-	H	-	-	-	-	-	-	-	-	-	-	H	L	H	M
CLR-3 :	Gain knowledge on Fuzzy based clustering concepts																						H	H	-	H	-	-	-	-	-	-	-	-	-	-	H	L	H	M
CLR-4 :	Acquire knowledge on Fuzzy Integrated classification																						H	-	-	H	-	-	-	-	-	-	-	-	-	-	H	L	H	M
CLR-5 :	Understanding Neuro-Fuzzy Modeling concepts																						H	H	-	H	-	-	-	-	-	-	-	-	-	-	H	L	H	M
CLR-5 :	Acquiring better understanding on Fuzzy logic usage																						H	-	-	H	-	-	-	-	-	-	-	-	-	-	H	L	H	M
CLR-6 :	Understanding the fuzzylogics in Machine learning																						H	-	H	H	H	-	-	-	-	-	-	-	-	-	H	L	H	M
Course Learning Outcomes (CLO):		At the end of this course, learners will be able to:			2	80	85																																	
CLO-1 :	Acquire the knowledge on Basics of Fuzzy Logic				2	80	85																																	
CLO-2 :	Understand the basic concepts in Machine learning				2	75	80																																	
CLO-3 :	Apply the knowledge of Clustering in Fuzzy logics				2	85	80																																	
CLO-4 :	Apply the concept of Classification in Fuzzy Logics				2	80	75																																	
CLO-5 :	Acquire the knowledge on Neuro-Fuzzy reasoning				2	75	85																																	
CLO-6 :	Acquire the insight of Neuro-Fuzzy Modeling				2	75	85																																	

Duration (hour)	9	9	9	9	9	
S-1	SLO-1	Fuzzy Logic Introduction : Comparison of traditional logic and fuzzy logic	Machine learning : Importance of ML	Fuzzy Clustering Basics: Cluster analysis Objective function-based cluster analysis, Fuzzy analysis of data	Fuzzy Integral Classification: Introduction and Notation , Reduction vs. Ordering	Neuro Fuzzy Modeling : ANFIS – Adaptive Neuro Fuzzy Inference system
	SLO-2	Basic History of Fuzzy Logic	Types of Machine Learning : Supervised Learning-Unsupervised Learning, reinforcement Learning	Special objective functions, A principal clustering algorithm	The Borda Count	ANFIS - architecture
S-2	SLO-1	The case of Imprecision, A Historical perspective	The Curse of dimensionality Overfitting and linear regression	Classical Fuzzy Clustering Algorithms : The fuzzy c-means algorithm	The Average Rule , The Median Alternative	Hybrid learning algorithm
	SLO-2	The Utility of Fuzzy systems, Limitations of Fuzzy systems		The Gustafson-Kessel algorithm	The Product Rule, The MaxMax and MaxMin Rules	Coactive Neuro fuzzy modeling : Towards generalized ANFIS
S-3	SLO-1	Fuzzy sets and membership	Bias and Variance Learning Curve		The Intersection Method , The Union Rule	Framework
	SLO-2	Chance Vs Fuzziness		The Gath-Geva algorithm	Logistic Regression : The Logit Transform and Maximum Likelihood Estimation	Neuron functions for adaptive networks
S-4	SLO-1	Classical sets and Fuzzy sets : Operations on classical sets, properties of classical sets	Classification	Computational effort	Separate Weight Sets	Fuzzy membership functions Vs Receptive field units
	SLO-2	Operations on fuzzy sets, properties of	Error and noise	Linear and Ellipsoidal Prototypes : The fuzzy	Model Selection by Local Accuracy	Non-linear rule

		fuzzy sets		c-varieties algorithm		
S-5	SLO-1	Classical relations : Cartesian product, crisp relations	Measuring(dis)similarity-Evaluating the output of clusteringmethod	The adaptive fuzzy clustering algorithm	Maximizing the Fuzzy Integral : What Does This Have to Do with Classifier Combination?	Neuro-fuzzy spectrum
	SLO-2	Fuzzy relations: cardinality of fuzzy relations, operations on fuzzy relations	Hierarchical clustering, Agglomerativeclustering - Divisiveclustering	Algorithms by Gustafson/Kessel and Gath/Geva	Pairwise Coupling - Pairwise Threshold Optimization	Analysis of Adaptive learning capability : Convergence based on the steepest descend method alone
S-6	SLO-1	Properties of fuzzy relations	K-Meansclustering		Comparing the Combination Methods :Small Training Set, Three Models	Interpretability spectrum
	SLO-2	Tolerance and Equivalence relations: crisp tolerance		Cluster Estimation Models :AO membership functions	Large Training Set, Three Models	Evolution of antecedents
S-7	SLO-1	Fuzzy Tolerance	Perceptrons	ACE membership functions	Small Training Set, Three Good Models , One Worthless	Evolution of consequence
	SLO-2	Properties of Membership functions, Fuzzification and defuzzification – Features of the memberfunction	Feedforwardnetworks.	Hyperconic clustering (dancing cones)	Large Training Set, Three Good Models, One Worthless	Evolving partitions
S-8	SLO-1	Various forms	MultilayerNetworks and Back PropagationAlgorithms	Cluster Validity : Global validity measures	Small Training Set, Worthless and Noisy Models Included	Neuro Fuzzy Control : Feedback control systems and Neuro fuzzy control
	SLO-2	Defuzzification of crisp sets	Linear Models – Linear regression, Logistic regression	Solid clustering validity measures, Shell clustering validity measures	Large Training Set, Worthless and Noisy Models Included	Expert control
S-9	SLO-1	Lamda cuts of fuzzy relations, Defuzzification to scalars	Tree learning : Decision trees	Local validity measures : The compatible cluster merging algorithm, The unsupervised FCSS algorithm	Fuzzy Association rules	Inverse learning, specialized learning
	SLO-2	Conclusion : Benefits of Fuzzy in comparison with crisp	Conclusion : Summary of ML concepts	Conclusion : Fuzzy based clustering merits	Conclusion : Fuzzy based classifier benefits	Conclusion : Summary / benefits of Neuro-fuzzy systems

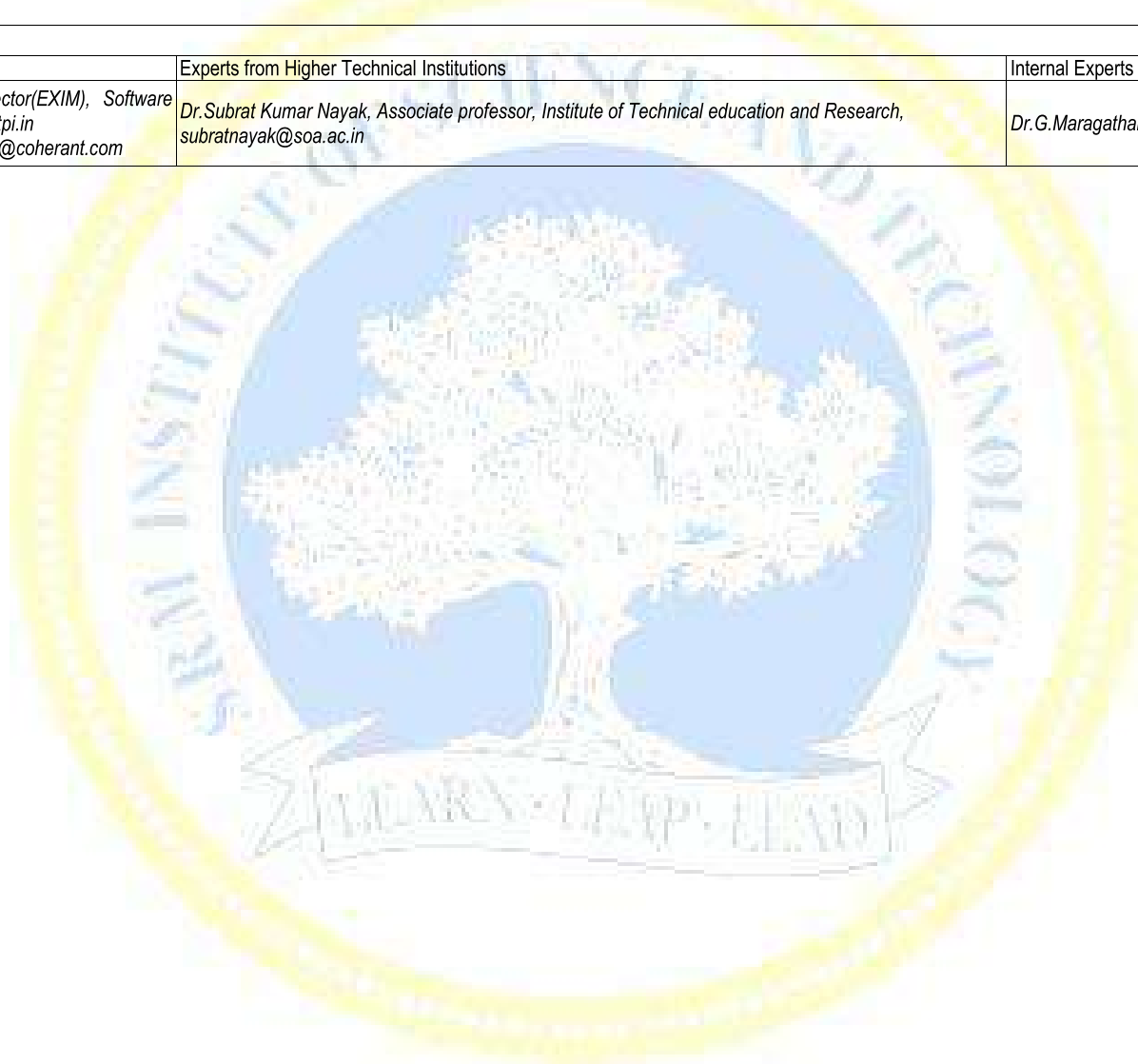
Learning Resources	<ol style="list-style-type: none"> <li>Vojislav Kecman, Learning and soft computing: Support vector Machines, Neural networks and Fuzzy logic models, A Bradford Book, The MIT Press., 2001, ISBN : 0-262-11255-8</li> <li>Timothy J. Ross, University of New Mexico, USA., Fuzzy Logic with Engineering Applications, 3<sup>rd</sup> Edition, Wiley, 2010. ISBN 978-0-470-74376-8</li> <li>Frank Höppner, Frank Klawonn, Rudolf Kruse and Thomas Runkler: Fuzzy Cluster Analysis, Wiley (1999)ISBN 0-471-98864-2</li> <li>Timothy Masters, Assessing and Improving Prediction and Classification Theory and Algorithms in C++, ISBN-13 (pbk): 978-1-4842-3335-1 ISBN-13 (electronic): 978-1-4842-3336-8 ,<a href="https://doi.org/10.1007/978-1-4842-3336-8">https://doi.org/10.1007/978-1-4842-3336-8</a>, 2018.</li> <li>Jyh-Shing, Roger Jang, Chuen-Tsai sun, Eiji Mizutani., Neuro fuzzy and soft computing – A computational approach to learning and machine intelligence, Prentice Hall (1997) , ISBN : 0-13-2610663</li> <li>Kevin P. Murphy, "Machine Learning: A Probabilistic Perspective", MIT Press, 2012</li> <li>Ethem Alpaydin, "Introduction to Machine Learning", Prentice Hall of India, 2005</li> <li>Tom Mitchell, "Machine Learning", McGraw-Hill, 1997.</li> </ol>
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Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember Understand	40 %	-	30 %	-	30 %	-	30 %	-	30%	-
Level 2	Apply Analyze	40 %	-	40 %	-	40 %	-	40 %	-	40%	-
Level 3	Evaluate	20 %	-	30 %	-	30 %	-	30 %	-	30%	-

Create							
Total	100 %	100 %	100 %	100 %	100 %	100 %	100 %

# CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. <i>Dr.R.Gokulakrishnan, Additional Director(EXIM), Software Technology Parks of India , r.gokul@stpi.in</i> 2. <i>Dr.Prabhu, Coherent , US., prabu.balu@coherent.com</i>	<i>Dr.Subrat Kumar Nayak, Associate professor, Institute of Technical education and Research, subratnayak@soa.ac.in</i>	<i>Dr.G.Maragatham , Dr. Manas Ranjan ,Ms.A.Saranya</i>



Course Code	18CSE390T	Course Name	COMPUTER VISION	Course Category	E	Professional Elective	L	T	P	C
							3	0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Computer Science and Engineering		Data Book / Codes/Standards	Nil	

Course Learning Rationale (CLR):	The purpose of learning this course is to:			Learning			Program Learning Outcomes (PLO)														
CLR-1 :	Recognize and describe both the theoretical and practical aspects of computing with images. Connect issues from Computer Vision to Human Vision			1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CLR-2 :	Describe the foundation of image formation and image analysis. Understand the basics of 2D and 3D Computer Vision.			Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO -1	PSO -2	PSO -3
CLR-3 :	Become familiar with the major technical approaches involved in computer vision. Describe various methods used for registration, alignment, and matching in images.																				
CLR-4 :	Get an exposure to advanced concepts leading to object and scene categorization from images.																				
CLR-5 :	Build computer vision applications.																				
CLR-5 :	Recognize and describe both the theoretical and practical aspects of computing with images. Connect issues from Computer Vision to Human Vision																				

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:			3	80	75	L	H	-	H	L	-	-	-	L	L	-	H	-	-	-
CLO-1 :	Provide an introduction to computer vision including fundamentals of image formation			3	85	75	M	H	L	H	L	-	-	-	M	L	-	H	-	-	-
CLO-2 :	Provide a clear view of image formation			3	80	75	M	H	M	H	L	-	-	-	M	L	-	H	-	-	-
CLO-3 :	Provide a clear view of image processing			3	85	80	M	H	M	H	L	-	-	-	M	L	-	H	-	-	-
CLO-4 :	Provide knowledge about Computational photography			3	80	75	H	H	M	H	L	-	-	-	M	L	-	H	-	-	-
CLO-5 :	Provide knowledge about Image rendering			3	80	75															

Duration (hour)	9		9		9		9		9	
S-1	SLO-1	Introduction to Computer Vision	Points and patches-An Introduction	Active contours	Triangulation	Motion models				
	SLO-2	Image formation	Feature detectors	Snakes	Two-frame structure from motion	Planar perspective motion				
S-2	SLO-1	Geometric primitives	Feature descriptors	Dynamic snakes and CONDENSATION	Projective reconstruction	Rotational panoramas				
	SLO-2	2D,3D Transformations			Self-calibration					
S-3	SLO-1	3D to 2D Projection	Feature matching	Scissors	Perspective and projective factorization	Gap closing				
	SLO-2	Lighting, Reflectance and shading		Level Sets	Bundle adjustment					
S-4	SLO-1	Sampling and aliasing	Feature tracking	Split and merge	Exploiting sparsity	Cylindrical and spherical coordinates				
	SLO-2	Image processing Point operators								
S-5	SLO-1	Pixel transforms	Edge detection	Mean shift and mode finding	Constrained structure and motion	Bundle adjustment				
	SLO-2	Color transforms								
S-6	SLO-1	Histogram equalization	Edge linking	Normalized cuts	Hierarchical motion estimation	Parallax removal				
	SLO-2									
S-7	SLO-1	Linear filtering	Successive approximation	Graph cuts and energy-based methods	Fourier-based alignment	Recognizing panoramas				
	SLO-2	Non Linear filtering	Hough transforms							
S-8	SLO-1	Fourier transforms	Hough transforms	2D and 3D feature-based alignment	Incremental refinement	Compositing				
S-9	SLO-1	Two-dimensional Fourier transforms, Wiener filtering	Vanishing points	Pose estimation	Case Study	Case Study				

Learning Resources	1. Richard Szeliski, "Computer Vision: Algorithms and Applications", Springer, 2010.	3. S. Nagabhushana, "Computer Vision and Image Processing", New Age International Pvt. Ltd.; First edition (2005)
	2. Forsyth/Ponce, "Computer Vision: A Modern Approach", Pearson Education India; 2nd edition (2015)	4. Rafael C. Gonzales "Digital Image Processing", Pearson Education; Fourth edition (2018)

Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	40 %	-	30 %	-	30 %	-	30 %	-	30 %	-
	Understand										
Level 2	Apply	40 %	-	40 %	-	40 %	-	40 %	-	40 %	-
	Analyze										
Level 3	Evaluate	20 %	-	30 %	-	30 %	-	30 %	-	30 %	-
	Create										
Total		100 %		100 %		100 %		100 %		100 %	

# CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
	Dr. A.P. Shanthi , CEG Campus Anna University	1. Dr. V. Ganapathy, SRMIST 2. T. Senthil Kumar, SRMIST

Course Code	18CSE479T	Course Name	STATISTICAL MACHINE LEARNING	Course Category	E	Professional Elective			
						L	T	P	C
						3	0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	CSE	Data Book / Codes/Standards	Nil		

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning			Program Learning Outcomes (PLO)																	
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15			
CLR-1 :	Understand the Fuzzy Logic Basics	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3			
CLR-2 :	Gain knowledge on the Machine learning concepts				H	-	-	-	-	-	-	-	-	-	-	-	-	-	H	H	-	-
CLR-3 :	Gain knowledge on Fuzzy based clustering concepts				H	H	-	-	-	-	-	-	-	-	-	-	-	-	H	H	-	-
CLR-4 :	Acquire knowledge on Fuzzy Integrated classification				H	H	H	H	-	-	-	-	-	-	-	-	-	-	H	H	M	H
CLR-5 :	Understanding Neuro-Fuzzy Modeling concepts				H	-	H	H	-	-	-	-	-	-	-	-	-	-	H	H	M	H
CLR-5 :	Acquiring better understanding on Fuzzy logic usage				H	-	H	H	-	-	-	-	-	-	-	-	-	-	H	H	M	H
CLR-6 :	Understanding the fuzzylogics in Machine learning				H	-	H	H	-	-	-	-	-	-	-	-	-	-	H	H	M	H
CLO-1 :	Acquire the knowledge on statistical machine learning techniques.	1	80	85																		
CLO-2 :	Acquire the ability to build model based on logistic regression and random forest techniques	1	75	80																		
CLO-3 :	Understand the basic ideas of probability and work on probabilistic approaches like Naive Bayes, Bayes Theorem	1	85	80																		
CLO-4 :	Apply the knowledge of Kernel functions in practical applications	3	80	75																		
CLO-5 :	Apply the knowledge of K-means clustering on real world examples	3	75	85																		
CLO-6 :	Acquire the knowledge on using PCA and SVD with Scikit-learn	2	80	85																		

Duration (hour)	9	9	9	9	9
S-1	SLO-1	Statistical terminology for model building and validation-Machine Learning, Major differences between statistical modeling and machine learning	Comparison between regression and machine learning models	K-nearest neighbors-KNN voter example	Support Vector Machines and Neural Networks-Support vector machines working principles-Maximum margin classifier
	SLO-2		Compensating factors in machine learning models	Curse of dimensionality-Curse of dimensionality with 1D, 2D, and 3D example	
S-2	SLO-1	Steps in machine learning model development and deployment	Assumptions of linear regression	Curse of dimensionality with 3D example	Support vector classifier
	SLO-2		Steps applied in linear regression modeling		
S-3	SLO-1	Statistical fundamentals and terminology for model building and validation	Example of simple linear regression from first principles	KNN classifier with breast cancer Wisconsin data example	Support vector machines
	SLO-2				
S-4	SLO-1	Bias versus variance trade-off, Train and test data	Machine learning models - ridge and lasso regression-Example of ridge regression machine learning, Example of lasso regression machine learning model	Naive Bayes	Kernel functions
	SLO-2				
S-5	SLO-1	Linear regression versus gradient descent	Logistic Regression Versus Random Forest-Maximum likelihood estimation	Probability fundamentals-Joint probability	Artificial neural networks - ANN
	SLO-2	Machine learning losses			
					Principal component analysis - PCA-PCA working methodology from first principles



S-6	SLO-1	When to stop tuning machine learning models	Terminology involved in logistic regression	Understanding Bayes theorem with conditional probability	Forward propagation and backpropagation	PCA applied on handwritten digits using scikit-learn
	SLO-2		Applying steps in logistic regression modeling			
S-7	SLO-1	Train, validation, and test data Cross-validation	Random forest-Example of random forest using German credit data	Naive Bayes classification	Optimization of neural networks- Stochastic gradient descent - SGD	Singular value decomposition - SVD
	SLO-2		Grid search on random forest			
S-8	SLO-1	Grid Search	Variable importance plot	Laplace estimator	Introduction to deep learning-Solving methodology	SVD applied on handwritten digits using scikit-learn
	SLO-2					
S-9	SLO-1	Machine learning model overview	Comparison of logistic regression with random forest	Naive Bayes SMS spam classification example	Deep learning software	SVD applied on handwritten digits using scikit-learn
	SLO-2					

Learning Resources	<ol style="list-style-type: none"> <li>Pratap Dangeti, "Statistics for Machine Learning", Packt Publishing Ltd., 2017.</li> <li>Masashi Sugiyama, "Introduction to Statistical Machine Learning", Elsevier, 2016</li> </ol>	<ol style="list-style-type: none"> <li>Gareth James, Daniela Witten, Trevor Hastie and Robert Tibshirani, "An Introduction to Statistical Learning with Applications in R", Springer, 2015</li> <li>Hastie Trevor, "The Elements of Statistical Learning: Data Mining, Inference, and Prediction", Springer-Verlag New York Inc, February 2009</li> </ol>
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Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#		Theory	Practice
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice		
Level 1	Remember Understand	40 %	-	30 %	-	30 %	-	30 %	-	30%	-
Level 2	Apply Analyze	40 %	-	40 %	-	40 %	-	40 %	-	40%	-
Level 3	Evaluate Create	20 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Total	100 %		100 %		100 %		100 %		100 %	

# CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Dr. Harisekharan, CTO, Sri Seshaa Technologies Pvt. Ltd., Chennai	1. Dr. Bagavandas, Centre for Statistics, SRMIST	1. Dr. G. Vadivu
2. Mr. S. Sudarsun – Chief Scientist, Co-Founder, Buddhhealth	2. Dr. Sampath, Professor, Department of Statistics, Madras University	2. Dr. C. Lakshmi
		3. Dr. G. Manju

Course Code	18CSE480T	Course Name	NATURE INSPIRED COMPUTING TECHNIQUES	Course Category	E	Professional Elective	L	T	P	C
							3	0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Computer Science and Engineering		Data Book / Codes/Standards	Nil	

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning	Program Learning Outcomes (PLO)																
CLR-1 :	To Understand the basics of Natural systems	1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CLR-2 :	To appreciate the concepts of Natural systems and its applications	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3
CLR-3 :	To understand newBasic Natural systems functions(operations)																		
CLR-4 :	To understand the fundamentals of nature inspired techniques which influence computing																		
CLR-5 :	To understand an Integration of Hardware and software in Natural applications.																		
CLR-6 :	To Understand practical implementation of Natural design considerations.																		

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3
CLO-1 :	Illustrate the basic concepts of Swarm Intelligenceprocesses	3	80	70	L	H	L	H	L	L	M	L	L	L	M	L	L	L	L
CLO-2 :	Examine the principle of Immuno computing techniques	3	85	75	L	H	L	H	L	L	M	L	L	L	M	L	L	L	L
CLO-3 :	Skills for planning, estimating, and resourcing for Natural design considerations	3	75	70	L	H	L	H	L	L	M	L	L	L	M	L	L	L	L
CLO-4 :	Manage the scope changes of nature inspired techniques which influence computing	3	85	80	L	H	L	H	L	L	M	L	L	L	M	L	L	L	L
CLO-5 :	Ability to identify optimization Techniques as a means to provide functionality and value to apply context in specific case studies	3	85	75	L	H	L	H	L	L	M	L	L	L	M	L	L	L	L
CLO-6 :	Ability to understand the needs and familiarize the DNA Computing	3	80	70	L	H	L	H	L	L	M	L	L	L	M	L	L	L	L

Duration (hour)	9		9		9		9		9	
S-1	SLO-1	Introduction	Evolutionary Computing	Swarm Intelligence	Introduction to Immune System	DNA Computing				
	SLO-2	Overview of Philosophy		Introduction						
S-2	SLO-1	Nature to Nature Computing	Hill Climbing	Ant Colony Optimization	Physiology and main components	DNA Molecule				
	SLO-2			Ant Foraging Behavior						
S-3	SLO-1	A Brief Overview of Three Branches	Simulated Annealing	Ant Colony Optimization	Pattern Recognition and Binding	Adleman's experiment				
	SLO-2	Individuals, Entities and agents		SACO algorithm						
S-4	SLO-1	Parallelism and Distributivity Interactivity	Simulated Annealing	Ant Colony Algorithm (ACA)	Immune Network Theory	PAM Model				
	SLO-2				Danger Theory					
S-5	SLO-1	Adaptation- Feedback	Genetics Principles	scope of ACO algorithms	Immune Algorithms	Splicing Systems				
	SLO-2									
S-6	SLO-1	Self-Organization	Standard Evolutionary Algorithm	Swarm Robotics	Genetic algorithms	From Classical to DNA Computing				
	SLO-2	Complexity, Emergence	Genetic Algorithms							
S-7	SLO-1	Bottom-up Vs Top-Down Approach	Reproduction	Social Adaptation of Knowledge	Bone Marrow Models	Universal DNA Computers				
	SLO-2		Crossover Mutation							
S-8	SLO-1	Determination	Evolutionary Programming	Particle Swarm Optimization	Forest's Algorithm	Scope of DNA Computing				
	SLO-2									

S-9	SLO-1	Chaos and Fractals	Genetic Programming	Particle Swarm Optimization	Artificial Immune Networks	Lipton's Solution to SAT Problem
	SLO-2					

Learning Resources	<ol style="list-style-type: none"> <li>1. Leandro Nunes de Castro, "Fundamentals of Natural Computing, Basic Concepts, Algorithms and Applications", Chapman &amp; Hall/CRC, Taylor and Francis Group, 2007.</li> <li>2. Floreano D. and Mattiussi C., "Bio-Inspired Artificial Intelligence: Theories, Methods, and Technologies", MIT Press, Cambridge, MA, 2008.</li> </ol>	<ol style="list-style-type: none"> <li>3. Albert Y. Zomaya, "Handbook of Nature-Inspired and Innovative Computing", Springer, 2006</li> <li>4. Marco Dorigo, Thomas Stutzle, "Ant Colony Optimization", PHI, 2005.</li> </ol>
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Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#		Theory	Practice
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice		
Level 1	Remember	40 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Understand										
Level 2	Apply	40 %	-	40 %	-	40 %	-	40 %	-	40%	-
	Analyze										
Level 3	Evaluate	20 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

# CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Mr. Lokesh Peta, Head Developer, OE Connection, Newbury-UK; Mail: peta.lokesh@gmail.com	Prof. A. Amuthan, Professor, Pondicherry Engineering College, amuthan@pec.edu	Dr. G. Maragatham / Mr. C. Santhana Krishnan Dr. C. Lakshmi

Course Code	18CSE481T	Course Name	APPLIED MACHINE LEARNING	Course Category	E	Professional Elective	L	T	P	C
							3	0	0	3

Pre-requisite Courses	18CSE392T	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	CSE	Data Book / Codes/Standards			

Course Learning Rationale (CLR):	The purpose of learning this course is to:			Learning			Program Learning Outcomes (PLO)															
CLR-1 :	Analyze the text data using Machine Learning			1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
CLR-2 :	Analyze the audio data using Machine Learning			Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3	
CLR-3 :	Analyze Time series and Sequential data using Machine Learning																					
CLR-4 :	Analyze the Image Content using Machine Learning																					
CLR-5 :	Visualize the data																					
Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:																					
CLO-1 :	Identifying patterns in text using topic modeling			3	75	80	H	M	H	-	H	-	-	-	-	-	-	H	H	H	H	
CLO-2 :	Building a speech recognizer			3	75	80	H	M	H	-	H	-	-	-	-	-	-	H	H	H	H	
CLO-3 :	Extracting statistics from time series data, Building Conditional Random Fields for sequential text data			3	75	80	H	M	H	-	H	-	-	-	-	-	-	H	H	H	H	
CLO-4 :	Building an object recognizer			3	75	80	H	M	H	-	H	-	-	-	-	-	-	H	H	H	H	

Duration (hour)	9	9	9	9	9	
S-1	SLO-1	Text Feature Engineering Introduction	Speech Recognition Introduction	Dissecting Time Series and Sequential Data	Image Content Analysis	Biometric Face Recognition
	SLO-2	Cleaning text data	Reading audio data	Introduction	Computer Vision	Face detection from the image and video
S-2	SLO-1	Preprocessing data using tokenization	Plotting audio data	Transforming data into the time series format Pandas and Numpy to convert Time Series data	Operating on images using OpenCV- Python	Capturing and processing video from a webcam Resizing and Scaling
	SLO-2	Tagging and categorising words	Transforming audio signals into the frequency domain	Plotting time series data	Learn to extract and load the image	Building a face detector using Haar cascades
S-3	SLO-1	Sequential tagging, Backoff tagging	Apply Fourier transform signal and plot	Slicing time series data Operating on time series data	Detecting edges Histogram equalization	determine the location of a face in the video frames captured from the webcam
	SLO-2	Creating features from text data- Stemming,	Generating audio signals with custom parameters	Plotting sliced time series data	Sobel filter, Laplacian edge detector, Canny edge detector	Face detector on the grayscale image
S-4	SLO-1	Lemmatising	Generate the time axis	Operating on time series data	Histogram equalization	Building eye and nose detectors
	SLO-2	Bagging using random forests	Synthesizing music	Extracting statistics from time series data	Visualize gray scale image	Face cascade classifier
S-5	SLO-1	Implementing bag of words	Construct the audio sample -amplitude and frequency	Correlation coefficients	Detecting corners	Visualize eye and nose detector
	SLO-2	Testing prepared data	synthesizer function	Plotting and understanding correlations	Understand the output corner detection image	Performing Principal Components Analysis

S-6	SLO-1	Analyze the results	Extracting frequency domain features	Building Hidden Markov Models for sequential data	Detecting SIFT feature points	PCA in face recognition systems
	SLO-2	Building a text classifier	MFCC and filter bank features	Prepare the Time Series data	SIFT feature detection	Convert the dataset from a five-dimensional set to a two-dimensional set
S-7	SLO-1	Analyzing the sentiment of a sentence	Building Hidden Markov Models	Train Gaussian HMM	Visualize the feature detected image	Kernel Principal Components Analysis
	SLO-2	Implement the sentiment analysis of a sentence	HMM training and prediction	Visualizing the model	Building a Star feature detector	Perform Kernel PCA
S-8	SLO-1	Identifying patterns in text using topic modeling	Building a speech recognizer	Building Conditional Random Fields for sequential text data	Detect features using the Star feature detector	Plot the PCA-transformed data
	SLO-2	Implement identifying patterns in text using topic modeling	MFCC features	CRF Model	Visualize keypoints on the input image	Plot Kernel PCA-transformed data
S-9	SLO-1	Case study- Twitter Data	Case study	Analyzing stock market data using Hidden Markov Models	Creating features using visual codebook and vector quantization	Performing blind source separation
	SLO-2	Case study- Twitter Data	Case study	Train the HMM and visualize	Method to quantize the data points	Independent Components Analysis

Learning Resources	1. Prateek Joshi and co, Python: Real World Machine Learning, Packt Publishing, 2016 2. Sebastian Raschka, Python Machine Learning, Packt Publishing, 2013.	3. Richert Coelho, Building Machine Learning Systems with Python, Packt Publishing, 2016 4. Michael Bowles, Machine Learning in Python, Wiley & Sons, 2015
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Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#		Theory	Practice
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice		
Level 1	Remember	40 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Understand										
Level 2	Apply	40 %	-	40 %	-	40 %	-	40 %	-	40%	-
	Analyze										
Level 3	Evaluate	20 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

# CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
Dr. Harisekharan, CTO, Sri Seshaa Technologies Pvt. Ltd., Chennai	Dr. J. Suresh, SSN College of Engineering	1. Dr. G. Vadivu
Mr. S. Sudarsun – Chief Scientist, Co-Founder, Buddhealth	Dr. Sharmila Shankar, Crescent Institute of Science and Technology	2. Mr. Karthik Nanmaran
		3. Dr. Renukadevi

Course Code	18CSE482T	Course Name	COMPUTATIONAL NEUROSCIENCE	Course Category	E	Professional Elective	L	T	P	C
							3	0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Computer Science & Engg		Data Book / Codes/Standards	Nil	

Course Learning Rationale (CLR):		Learning			Program Learning Outcomes (PLO)															
The purpose of learning this course is to:		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
CLR-1 :	Understand to knowWhat happens in your brain when you make a decision	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3	
CLR-2 :	Gain knowledge mathematical and computational models that are used in the field of theoretical neuroscience				L	H	L	H	H	-	-	-	L	L	-	H	L	H	H	
CLR-3 :	Basics of adaptively and learning,				H	H	L	M	L	-	-	-	M	L	-	H	L	H	H	
CLR-4 :	Acquire knowledge on Basic models of cognitive processing.				H	H	M	H	L	-	-	-	M	L	-	H	L	H	H	
CLR-5 :	Acquire knowledge on implementation model for neuro models				M	H	M	H	L	-	-	-	M	L	-	H	L	H	H	
CLR-6 :	Acquire knowledge on various computational algorithm				H	H	M	H	L	-	-	-	M	L	-	H	L	H	H	
Course Learning Outcomes (CLO):		At the end of this course, learners will be able to:																		
CLO-1 :	To Design Models of single neurons , and small networks	3	80	70	L	H	L	H	H	-	-	-	L	L	-	H	L	H	H	
CLO-2 :	Implementation of all simple as well as more complex numerical computations with few neurons.	3	85	75	H	H	L	M	L	-	-	-	M	L	-	H	L	H	H	
CLO-3 :	Analyse connected networks in the mean-field limit	3	75	70	H	H	M	H	L	-	-	-	M	L	-	H	L	H	H	
CLO-4 :	Formalize biological facts into mathematical models	3	85	80	M	H	M	H	L	-	-	-	M	L	-	H	L	H	H	
CLO-5 :	Understand a simple mathematical model of memory formation in the brain	3	85	75	H	H	M	H	L	-	-	-	M	L	-	H	L	H	H	
CLO-6 :	Understand a simple mathematical model of decision processes	3	80	70	L	H	-	H	L	-	-	-	L	L	-	H	L	H	H	

Duration (hour)	9	9	9	9	9	
S-1	SLO-1	History of Computational Neuroscience	Four components of Neural Signaling	From artificial neural network to realistic neural networks - Introduction	Memory Classification Scheme – Declarative, Non-declarative	Hebbian Learning-Hebbian versus Perceptron Learning-
	SLO-2	Models in Computational Neuroscience	Four components of Neural Signaling	Modelling the ventral stream	Auto-associative network and hippo campus - Learning and retrieval phase	Learning by Error Minimization
S-2	SLO-1	Computational Theory of the Brain	Neurotransmission	Modelling the dorsa and auditory stream	Point-attractor neural networks - Network dynamics and training	Gradient Descent Learning
	SLO-2	Biological Background	Population dynamics	Mechanical behavior of ceramics- flexural strength -The Perceptron .	Signal-to-noise analysis - Noisy weights and diluted attractor networks	Stabilizing Hebbian Learning
S-3	SLO-1	Basic synaptic mechanisms and dendritic processing	Modeling the average behavior of neurons	Mapping function	Sparse attractor neural networks and correlated patterns-Sparse patterns and expansion recoding	Principal Component Analysis (PCA)- Eigenvectors-Eigenvalues- Covariance matrix
	SLO-2	The generation of action potentials	Hodgkin	Multi-layer Perceptron	Control of sparseness in attractor networks	Singular Value Decomposition
S-4	SLO-1	Stimulation and rising phase	Modeling the average behavior of neurons	Back-propagation – Initution , Derivation	Chaotic networks-Attractors	Limits and Extensions of PCA
	SLO-2	Peak and falling phase	Huxley Model	Back-propagation –Loss Function	Lyapunov functions - The Cohen-Grossberg theorem	Variations of Hebbian Learning
S-5	SLO-1	After hyperpolarization and Refractory Period	Spiking neuron models - Single	Back-propagation – Limitation	Asymmetrical networks	Nonlinear Hebbian learning
	SLO-2	Hodgkin and Huxley equations - Intro	Spiking neuron models - Detailed	Support Vector Machines - Introduction	Non-monotonic networks	Linsker's Model of the Visual System
S-6	SLO-1	Neuron - axons, dendritesetc, thefour components ofNeural Signaling	Spiking neuron models – 2D Model	Support Vector Machines - Classification	Complementary memory systems	Application of Lateral Inhibition

	SLO-2	Neurotransmission: neurotransmitter, receptor, ion channel, channel gating	Integrate and firing model -Leaky integrate-and-fire model	Support Vector Machines - Regression	Distributed model of working memory- Limited capacity of working memory	Lateral Geniculate Nucleus
S-7	SLO-1	Electrophysiology -Nernst potential, resting potential, Goldman-Hodgkin-Katz voltage equation, outline of the Hodgkin-Huxley model.	Integrate and firing model -Nonlinear integrate-and-fire model	Support Vector Machines – Kernel Function	The spurious synchronization hypothesis	Striate Cortex
	SLO-2	Modeling ion1 channel kinetics, activation and inactivation gates	Integrate and firing model -Stimulation by synaptic currents	Self-organizing Maps - Introduction	The interacting-reverberating-memory hypothesis	Linsker's model for orientation columns
S-8	SLO-1	Complete formulation of Hodgkin-Huxley model. Relation between output firing and constant input current. Discussion of regimes. Software demo.	noise in spiking neuron model – part I	Self-organizing Maps - Variable	Motor Learning and Control	Reinforcement Learning -Elements of Reinforcement Learning
	SLO-2	Compartmental models: Cable theory	noise in spiking neuron model – part II	Self-organizing Maps - Algorithm	Feedback controller	Markov decision process-Dynamic programming algorithms for solving MDPs
S-9	SLO-1	Compartmental models: Cable theory – Cable Equation	compartmental modeling - I	Self-organizing Maps – SOM Initialization	Forward and inverse model controller	Algorithms for large state spaces
	SLO-2	Physical Shape of Neurons and Neuron Simulators	compartmental modeling -II	Self-organizing Maps – Kohonen Algorithm	The cerebellum and motor control	Gradient temporal difference learning

Learning Resources	<ol style="list-style-type: none"> <li>1. Thomas Trappenberg, "Fundamentals of Computational Neuroscience", Oxford University Press, January 2010</li> <li>2. Peter Dayan &amp; LF Abbot, "Theoretical Neuroscience: Computational and Mathematical Modeling of Neural Systems", MIT Press, 2005</li> </ol>	<ol style="list-style-type: none"> <li>3. Richard S. Sutton and Andrew G. Barto, "Reinforcement Learning-An Introduction", 2<sup>nd</sup> Edition, The MIT Press, 2018</li> </ol>
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Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#		Theory	Practice
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice		
Level 1	Remember	40 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Understand										
Level 2	Apply	40 %	-	40 %	-	40 %	-	40 %	-	40%	-
	Analyze										
Level 3	Evaluate	20 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

# CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
<ol style="list-style-type: none"> <li>1. Mr. Venkatesan venkatesan.g@tcs.com</li> <li>2. Ganesan, Associate Consultant, Tata Consultancy Services, Australia</li> </ol>	Dr. Sarulatha.K, Pondicherry Engg college, charuladha@pec.edu.in / Prof. Godfrey Winster, Saveetha Engineering College, godfreywinster@saveetha.ac.in	1. Dr. G. Maragatham / Dr. C. Vijayakumaran

Course Code	18CSE483T	Course Name	INTELLIGENT MACHINING	Course Category	E	Professional Elective	L	T	P	C
							3	0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	CSE	Data Book / Codes/Standards	Nil		

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning			Program Learning Outcomes (PLO)														
CLR-1 :	Understand the fundamentals of Artificial Intelligence	1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CLR-2 :	Learn basics of Intelligent machining, sensors and machining process	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3
CLR-3 :	Understand the design of Intelligent Systems - RTOS																		
CLR-4 :	Understand the computational methods, optimization and reasoning about physical system																		
CLR-5 :	Understand implications of Artificial Intelligence in various real time applications																		

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Learning			Program Learning Outcomes (PLO)															
CLO-1 :	Acquire the knowledge on the fundamentals of Artificial intelligence and its problem solving approaches	2	80	85	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-2 :	Acquire the knowledge on fundamentals of Intelligent Machining and machining process	2	75	80	H	H	H	H	H	H	-	-	-	-	-	H	-	-	-	-
CLO-3 :	Acquire knowledge on the design of Intelligent Systems and RTOS	2	85	80	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-4 :	Acquire knowledge on computational methods and optimization	2	80	75	-	H	-	-	H	-	-	-	-	-	-	-	-	-	-	-
CLO-5 :	Apply the knowledge on Real time applications	2	75	85	-	H	-	-	H	-	-	-	-	-	-	-	-	-	-	-

Duration (hour)	9		9		9		9		9	
S-1	SLO-1	Introduction to Artificial Intelligence and its techniques	Introduction Intelligent Machining, Basics	Representation of Intelligent systems	Computational methods and optimization		Case Study - Autonomous Vehicle (Driver Less Car )			
	SLO-2	Problem Solving with Artificial Intelligence	Open Architecture Machine Control	Control for the Evolution of VLSI Designs						
S-2	SLO-1	AI Models, Data acquisition and learning aspects of AI	Manufacturing Automation Protocol	An Object-Oriented Approach	Neural Network Modelling		Case Study - Defect Prediction , Wear and Tear Prediction in Mechanical devices			
	SLO-2	Problem Solving - Problem Solving Process, Formulating Problems	The Evolution of Intelligent Machining							
S-3	SLO-1	Problem types and Characteristics	MOSAIC - NGC	Tools and Techniques for Conceptual Design	Fuzzy set theory		Case Study - Flying Drones			
	SLO-2	Problem Space and Search	OSACA - SERCOS	Design Compilers						
S-4	SLO-1	Intelligent Agent	Components of Intelligent Machining	Labelled Interval Calculus	Machining Optimization		Case Study -Cogito			
	SLO-2	Rationality and Rational agent with performance measures	Introduction sensors - Machining Process	Knowledge Representations for Design Improvisation						
S-5	SLO-1	Flexibility and Intelligent Agents	Sensing and Monitoring	A knowledge-based Framework for Design	Objective Functions and Constraints		Case Study - Alexa , SIRI			
	SLO-2	Task Environment and its Properties	Signal Processing		Optimization Techniques					
S-6	SLO-1	Types of Agents	Transforming Data into Information	Introduction to RTOS - Hardware	Reasoning about physical system		Case Study - Smarter Home robots			



			Examples	Components		
	SLO-2	Other aspects of agents	Machining Process Control			
S-7	SLO-1	Constraint satisfaction problem (CSP)	Practical Uses of Machine Learning	Design Principles of RTOS - Interrupt Processing - task Management	Temporal Qualitative Analysis	Case Study -Application of AI in CAD/CAM
	SLO-2	Crypto Arithmetic puzzles	Machine Learning Process Control Strategies			
S-8	SLO-1	CSP as a search problem-constraints and representation	Programmable Logic Controllers (PLC)	Task Scheduling -Synchronization tools	Reasoning about Geometry	Case Study - Streamlining Drug Discovery
	SLO-2	CSP- backtracking and Role of heuristic	Closed Loop Process Control Systems	Task Communication - Memory Management		
S-9	SLO-1	CSP - Froward Checking and constraint propogation	Introduction to Adaptive Control	File System	Study of Heuristic knowledge for automatic configuration Generation and Innovation	Case Study - Betterment (Financial Advisor)
	SLO-2	CSP-Intelligent backtracking	Commercially Available Software	Tracing and Debugging		

Learning Resources	1. Farid Meziane, Sunil Vadera, Khiary Kobbacy and Nathan Proudlove, "Intelligent Systems in Manufacturing: Current Developments and Future Prospects", (unit 1)	5. K.C.Wang, " Embedded and Real-Time Operating Systems (Chapter 10.6- Unit 3)
	2. How Netflix Uses Analytics To Select Movies, Create Content, and Make Multimillion Dollar Decisions Author: Zach Bulygo(unit 1)	
	3. Digital Signal Processing: A Practical Guide for Engineers and Scientists, Steven Smith (unti 2)	7. Machining: Fundamentals and Recent Advances, J. Paulo Davim, Springer. (Chapter 12-unit 4)
	4. Artificial Intelligent in Engineering Design: Volume 1 , Gerard Meurant, Springer (Chapter 2,3,5,6,9 - unit3)	8. 8.Artificial Intelligent in Engineering Design: Volume 2 , Gerard Meurant, Springer (Chapter 10-14 - unit 5)

Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#		Theory	Practice
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice		
Level 1	Remember Understand	40 %	-	30 %	-	30 %	-	30 %	-	30%	-
Level 2	Apply Analyze	40 %	-	40 %	-	40 %	-	40 %	-	40%	-
Level 3	Evaluate Create	20 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Total	100 %		100 %		100 %		100 %		100 %	

# CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
Dr. Mariappan, Engineering Leader, Amazon, India	Khanna Nehemiah H, Professor, Ramanujam Computing Center, Anna University	1.Dr.C.Lakshmi, SRMIST
		2. Dr.S Prabakaran, SRMIST
		3. Dr. M. Thenmozhi, SRMIST

Course Code	18CSE484T	Course Name	DEEP LEARNING	Course Category	E	Professional Elective			
						L	T	P	C
						3	0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Computer Science and Engineering		Data Book / Codes/Standards	Nil	

Course Learning Rationale (CLR):	The purpose of learning this course is to:
CLR-1 :	Understand the concepts of Neural Networks and Deep Learning
CLR-2 :	Understand Deep neural network and layered learning approach
CLR-3 :	Study and understand CNN and RNN for deep learning
CLR-4 :	Learn and understand Auto Encoders and its applications
CLR-5 :	Understand concept of transfer learning and its applications with keras

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:
CLO-1 :	Apply basic mathematical concepts in Deep Learning
CLO-2 :	Work with powerful framework for supervised learning
CLO-3 :	Deal with Convolution Neural Networks
CLO-4 :	Analyze various types efficient data encoders
CLO-5 :	Apply various network models in deep learning

Learning		
1	2	3
Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
2	80	85
3	75	80
2	85	80
2	80	75
3	75	85

Program Learning Outcomes (PLO)														
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3
H	L	-	-	H	-	-	-	-	-	-	H	H	-	-
H	H	-	-	H	-	-	-	-	-	-	H	H	H	M
H	H	H	-	H	-	-	-	-	-	-	H	H	H	H
H	H	-	-	H	-	-	-	-	-	-	H	H	H	H
H	H	H	H	H	-	-	-	-	-	-	H	H	H	H

Duration (hour)	9		9		9		9		9	
S-1	SLO-1	Historical trends in deep learning – Machine Learning basics	Introduction to Simple DNN	Convolution Neural Networks Introduction	Encoder	Deep Architectures in Vision				
	SLO-2	Learning algorithms – Supervised and Unsupervised Training	Platform for Deep Learning	Convolution Operation	Decoder	AlexNet to ResNet				
S-2	SLO-1	Linear Algebra for machine learning	Deep Learning Software Libraries	Motivation	Auto Encoders Introduction	Transfer Learning				
	SLO-2	Testing - Cross Validation	Deep Feed Forward Networks Introduction	Pooling	Auto Encoders					
S-3	SLO-1	Dimensionality Reduction	Learning XOR	Normalization	Under Complete Auto Encoder	Siamese Networks				
	SLO-2	Over fitting /Under Fitting	Gradient-Based Learning	Applications in Computer Vision - ImageNet	Regularized Auto Encoder					
S-4	SLO-1	Hyper parameters and validation sets	Various Activation Functions, ReLU, Sigmoid – Error Functions	Sequence Modelling –VGGNet, LeNet	Stochastic Auto Encoder	Metric Learning				
	SLO-2	Estimators – Bias - Variance	Architecture Design	Recurrent Neural Networks	Denoising Auto Encoder					
S-5	SLO-1	Loss Function-- Regularization	Differentiation Algorithms	RNN topologies- Difficulty in Training RNN	Contractive Auto Encoder	RCNNs with keras				
	SLO-2	Biological Neuron – Idea of Computational units	Regularization methods for Deep Learning		Auto Encoder Applications					
S-6	SLO-1	McCulloch-Pitts units and Thresholding logic	Early Stopping	Long Short Term Memory	Dimensionality Reduction and Classification using Auto encoders	CNN-RNN				

	SLO-2	Linear Perceptron	Drop Out		Recommendation	
S-7	SLO-1	Perceptron Learning Algorithm	Difficulty of training deep neural networks	Bidirectional LSTMs	Optimization for Deep Learning-Optimizers-RMS prop for RNNs	Applications in captioning and Video tasks
	SLO-2	Convergence theorem for Perceptron Learning Algorithm				
S-8	SLO-1	Linear Separability	Greedy layer wise training	Bidirectional RNNs	SGD for CNNs	3D CNNs
	SLO-2	Multilayer perceptron –The first example of network with Keras code				
S-9	SLO-1	Backpropagation	Optimization methods for Neural Networks-Adagrad, Adam	Application case study -Handwritten digits recognition using deep learning, LSTM with Keras – sentiment Analysis	Application case study – Image dimensionality reduction using encoders LSTM with Keras – sentiment Analysis	Application case study – Image recognition using RCNN and transfer learning
	SLO-2					

Learning Resources	<ol style="list-style-type: none"> <li>1. Ian Goodfellow, Yoshua Bengio, Aaron Courville, "Deep Learning", MIT Press, 2016.</li> <li>2. Kevin P. Murphy, "Machine Learning: A Probabilistic Perspective", MIT Press, 2012.</li> </ol>	<ol style="list-style-type: none"> <li>3. Neural Networks: A Systematic Introduction, Raul Rojas, 1996.</li> <li>4. Christopher and M. Bishop, "Pattern Recognition and Machine Learning", Springer Science Business Media, 2006.</li> <li>5. Jason Brownlee, "Deep Learning with Python", ebook, 2016.</li> </ol>
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Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#		Theory	Practice
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice		
Level 1	Remember	40 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Understand										
Level 2	Apply	40 %	-	40 %	-	40 %	-	40 %	-	40%	-
	Analyze										
Level 3	Evaluate	20 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

# CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1.	1.	1. Dr.E.Poovammal
2.	2.	2. Dr.G.Vadivu
		3. Mr.Joseph James

Course Code	18CSE485T	Course Name	ROBOTICS: COMPUTATIONAL MOTION PLANNING	Course Category	E	Professional Elective	L	T	P	C
							3	0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Computer Science and Engineering		Data Book / Codes/Standards	Nil	

Course Learning Rationale (CLR):	The purpose of learning this course is to:			Program Learning Outcomes (PLO)																																					
CLR-1:	Acquire knowledge of Bug algorithms and configuration Space	Learning			1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15																			
CLR-2:	Acquire knowledge of Potential functions and Navigations	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3																						
CLR-3:	Acquire knowledge of Sampling Algorithms																																								
CLR-4:	Gain knowledge of filtering techniques																																								
CLR-5:	Gain knowledge about Trajectory and Motion Planning																																								
CLR-6:	Design motion plan for Robot in the path specified																																								
Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:																																								
CLO-1:	Apply knowledge of Bug algorithms and configuration Space	3	80	70	M	H	-	H	L	-	-	-	L	L	-	H	-	-	-																						
CLO-2:	Apply knowledge of Potential functions and Navigations	3	85	75	M	H	L	M	L	-	-	-	M	L	-	H	-	-	-																						
CLO-3:	Apply knowledge of Sampling Algorithms	3	75	70	M	H	M	H	L	-	-	-	M	L	-	H	-	-	-																						
CLO-4:	Gain knowledge of filtering techniques	3	85	80	M	H	M	H	L	-	-	-	M	L	-	H	-	-	-																						
CLO-5:	Gain knowledge about Trajectory and Motion Planning	3	85	75	H	H	M	H	L	-	-	-	M	L	-	H	-	-	-																						

Duration (hour)	9		9		9		9		9	
S-1	SLO-1	Over view of Motion Planning	Potential Function: Addictive Attractive/Repulsive Potential	Sampling - Based Algorithms- Probabilistic Road Maps: Basic PRM	Linear Kalman Filtering		Trajectory Planning : Preliminaries			
	SLO-2	Bug1 And Bug 2	Gradient Descent	Implementation of basic PRM						
S-2	SLO-1	Tangent Bug	Computing Distance From Implementation In The Plane	PRM sampling Strategies	Kalman Filter : Example		Decoupled Trajectory Planning			
	SLO-2	Implementation: The Tangent Line		PRM connection Strategies						
S-3	SLO-1	Distance On Gradient	Local Minima Problem	Single-Query Sampling Based Planners: Expensive Spaces Trees	Bayesian Methods : Localization		Direct Trajectory Planning: Optimal Control			
	SLO-2	Continuation Method	Wave-Front Planner	Rapidly Exploring Random Trees	Basic Idea Probabilistic Localization		Nonlinear Ptimization			
S-4	SLO-1	Robot Configuration Specification	Navigation Potential Function: Sphere- Space	Connection Strategies and SBL Planner	Probabilistic Localization As Recursive Bayesian Filtering		Grid-Based Search			
	SLO-2		Star-Space							
S-5	SLO-1	Circular Mobile Robot	Potential Functions for Rigid-Body Robots	Integration Of Planners Sampling Based Roadmap	Derivation Of Probabilistic Localization		Nonholonomic And Underactuated Systems : preliminaries			
	SLO-2	Two joint planer arm	Path Planning for Articulated Bodies				Control Systems			
S-6	SLO-1	Dimension Of The Configuration Space	Visibility Graph	Analysis Of PRM	Representation Of Posterior		Controllability			
	SLO-2									
S-7	SLO-1	Topology of configuration space: Homeomorphisms and Diffeomorphisms	Deformation Retracts : Generalized Voronoi Diagram	Control based Planning	Sensor Model		Motion Planning: Optimal Control			
	SLO-2			Multiple Robots						

S-8	SLO-1	Differentiable Manifolds	Retract -Like Structure: Generalized Voronoi Graph	Manipulation Planning	Mapping:: Mapping with known locations	Steering Chained -Form Systems Using Sinusoids
	SLO-2					
S-9	SLO-1	Examples	Piecewise Retracts: The Rod Hierarchical Generalized Voronoi Graph Silhouette Methods	Assembly Planning	Bayesian Simultaneous Localization and Mapping	Nonlinear Optimization
	SLO-2					

Learning Resources	<ol style="list-style-type: none"> <li>Howie M. Choset, Seth Hutchinson, Kevin M. Lynch, George Kantor, Wolfram Burgard, Lydia E. Kavraki, Sebastian Thrun, "Principles of Robot Motion: Theory, Algorithms, and Implementation"</li> <li>Jean-Claude Latombe, "Robot Motion Planning", Springer Science &amp; Business Media, 2012</li> </ol>	<ol style="list-style-type: none"> <li><a href="http://robotics.stanford.edu/~latombe/cs326/2009/schedule.htm">http://robotics.stanford.edu/~latombe/cs326/2009/schedule.htm</a></li> </ol>
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Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#		Theory	Practice
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice		
Level 1	Remember	40 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Understand										
Level 2	Apply	40 %	-	40 %	-	40 %	-	40 %	-	40%	-
	Analyze										
Level 3	Evaluate	20 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

# CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
		Dr.R.Annie Uthra
		Dr.P. Supraja

Course Code	18CSE486T	Course Name	ADVANCED ALGORITHMS	Course Category	E	Professional Elective	L	T	P	C
							3	0	0	3

Pre-requisite Courses	18CS201J	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Computer Science and Engineering		Data Book / Codes/Standards	Nil	

Course Learning Rationale (CLR):		The purpose of learning this course is to:			Learning			Program Learning Outcomes (PLO)																			
CLR-1 :	Understand different asymptotic notations to analyze an algorithms	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15					
CLR-2 :	Utilize various data structures in developing applications				Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3								
CLR-3 :	Utilize stack and queues in processing data for real-time applications				L	H	-	H	L	-	-	-	L	L	-	H	-	-	-	-							
CLR-4 :	Understand various data structures to handle graph theory related real-time applications				M	H	L	M	L	-	-	-	M	L	-	H	-	-	-	-							
CLR-5 :	Understand various probabilistic algorithms and randomized algorithms for real-time programming applications				M	H	M	H	L	-	-	-	M	L	-	H	-	-	-	-							
CLR-6 :	Understand various Complexity classes like P-Type, NP-Type, NP-Complete, NP-Hard problems				M	H	M	H	L	-	-	-	M	L	-	H	-	-	-	-							
Course Learning Outcomes (CLO):		At the end of this course, learners will be able to:																									
CLO-1 :	Understand complexity of various algorithms	3	80	70																							
CLO-2 :	How efficiently a problem can be solved with respect to time and space	3	85	75																							
CLO-3 :	To find the appropriateness of Data structure for real time applications	3	75	70																							
CLO-4 :	Representation and Solving Graph algorithms	3	85	80																							
CLO-5 :	Understand approximation methods to solve very difficult problems	3	85	75																							

Duration (hour)	9		9		9		9		9	
S-1	SLO-1	Introduction-Basic Terminology	Elementary data structures-Array	Graph algorithms-Representation of graphs	Approximation algorithms	Complexity classes-Introduction				
	SLO-2	Complexity of algorithms- Space and time complexity issues- Growth of functions	Operations on Arrays – Insertion and Deletion	BFS-DFS	The vertex-cover problem	Various definitions				
S-2	SLO-1	Introduction of various asymptotic notations like $\theta, \omega, O, \Omega$	Stack-Variou ADT operations- Uses of stack-Variou examples	Strongly connected components	The traveling-salesman problem	NP-Completeness and the classes of P and NP				
	SLO-2	Designing algorithm-Analysis of Insertion sort-Best case, worst case, average case analysis	Queue ADT- Insertion-deletion and various operations on Queue	Minimum Spanning tree-Introduction Prim's algorithm	Example	Continued				
S-3	SLO-1	Various Problem solving techniques	Linked List- Deletion and Search-Doubly linked list-Variou operations on linked list	Kruskal algorithm	The set-covering problem –With an example	A Formal language framework- Polynomial time verification				
	SLO-2	Divide and Conquer paradigm	Polynomial Arithmetic	Single source Shortest path problem	The subset-sum problem	Continued				
S 4-5	SLO-1	Recurrence relations-Construction of recurrence relation for various examples- Towers of Hanoi Problem, Fibonacci series	Hashing-Hash functions Open addressing- Perfect Hashing	The Bellman-Ford algorithm - Single-source shortest paths in directed acyclic graphs -Dijkstra's algorithm	String Matching- The naive string-matching algorithm	p-type and NP-type problems NP-Completeness-Variou examples				
	SLO-2	Solution by Substitution method	Variou hashing methods	Shortest paths and matrix multiplication	Example	NP-Completeness-reducibility				
S-6	SLO-2	Recursion Tree Method	Collision in hashing-Avoiding Collision –	The Floyd-Warshall algorithm	The Rabin-Karp algorithm	Continued				

			Various methods			
S-7	SLO-1	Mater Theorem-Proof	Binary search tree	An example	Continued	NP-Completeness-reducibility
	SLO-2	Simple examples	Insertion-Deletion-Finding max,min	Johnson's algorithm for sparse graphs	The Knuth-Morris-Pratt algorithm	Continued
S-8	SLO-1	Probabilistic analysis of an algorithm	Red Black tree	Example	An example	NP-completeness proofs Continued-Satisfiability of boolean formulas is NP-complete.
	SLO-2	Hiring assistant problem	Insertion-Deletion	Flow network-example	Computational Geometry- Finding Convex hull- Finding the closest pair of points	3-CNF satisfiability problem-NP Complete
S-9	SLO-1	Probabilistic analysis Quick sort with illustration	Properties of RBT	Continued	Continued	NP-Hard problem-Definition and various examples-continued
	SLO-2					

Learning Resources	<ol style="list-style-type: none"> <li>1. Cormen, Thomas H.; Leiserson, Charles E.; Rivest, Ronald L.; Stein, Clifford (2009) Introduction to Algorithms (3rd ed.). MIT Press and McGraw-Hill</li> <li>2. Ananyeviton, Introduction to the Design and Analysis of Algorithms, Kindle edition 2017.</li> <li>3. Harowitz, Sahani and Sangudevar Rajasekaran, Fundamentals of computer algorithm, Universities Press; Second edition 2008</li> <li>4. Mark Allen Weiz, Data structures and algorithm analysis, Pearson Education India 2012</li> </ol>
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Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#		Theory	Practice
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	40 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Understand										
Level 2	Apply	40 %	-	40 %	-	40 %	-	40 %	-	40%	-
	Analyze										
Level 3	Evaluate	20 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

# CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
	1. Dr.Masila Mani.V IIITDM, Kancheepuram, noor@iiitdm.ac.in	1. K.Senthil Kumar, SRMIST
		2. Dr.Thenmozhi, SRMIST

Course Code	18CSE355T	Course Name	DATA MINING AND ANALYTICS	Course Category	E	Professional Elective	L	T	P	C
							3	0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	CSE	Data Book / Codes/Standards	Nil		

Course Learning Rationale (CLR):	The purpose of learning this course is to:			Program Learning Outcomes (PLO)																																						
CLR-1 :	Understand the concepts of Data Mining			Learning			1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15																		
CLR-2 :	Familiarize with Association rule mining			Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3																					
CLR-3 :	Familiarize with various Classification algorithms																																									
CLR-4 :	Understand the concepts of Cluster Analysis																																									
CLR-5 :	Familiarize with Outlier analysis techniques																																									
CLR-6 :	Familiarize with applications of Data mining in different domains																																									
Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:																																									
CLO-1 :	Gain knowledge about the concepts of Data Mining			2	80	85																																				
CLO-2 :	Understand and Apply Association rule mining techniques			2	75	80																																				
CLO-3 :	Understand and Apply various Classification algorithms			2	85	80																																				
CLO-4 :	Gain knowledge on the concepts of Cluster Analysis			2	80	75																																				
CLO-5 :	Gain knowledge on Outlier analysis techniques			2	75	85																																				
CLO-6 :	Understand the importance of applying Data mining concepts in different domains			2	80	85																																				

Duration (hour)	9		9		9		9		9	
S-1	SLO-1	Why Data mining? What is Data mining ?	Mining frequent patterns: Basic concepts	Classification: Basic concepts	Cluster Analysis: Introduction	Outliers: Introduction				
	SLO-2	Kinds of data meant for mining	Market Basket Analysis	General approach to Classification	Requirements and overview of different categories	Challenges of outlier detection				
S-2	SLO-1	Kinds of patterns that can be mined	Frequent itemsets, Closed itemsets	Decision tree induction	Partitioning method: Introduction	Outlier detection methods: Introduction				
	SLO-2	Applications suitable for data mining	Association rules-Introduction	Algorithm for Decision tree induction	k-means	Supervised and Semi-supervised methods				
S-3	SLO-1	Issues in Data mining	Apriori algorithm-theoretical approach	Numerical example for Decision tree induction	k-medoids	Unsupervised methods				
	SLO-2	Data objects and Attribute types	Apply Apriori algorithm on dataset-1	Attribute selection measure	Hierarchical method: Introduction					
S-4	SLO-1	Statistical descriptions of data	Apply Apriori algorithm on dataset-2	Tree pruning	Agglomerative vs. Divisive method	Statistical and Proximity based methods				
	SLO-2		Generating Association rules from frequent itemsets	Scalability and Decision tree induction	Distance measures in algorithmic methods					
S-5	SLO-1	Need for data preprocessing and data quality	Improving efficiency of Apriori	Bayes' Theorem	BIRCH technique	Statistical approaches				
	SLO-2			Naïve Bayesian Classification						
S-6	SLO-1	Data cleaning	Pattern growth approach	IF-THEN rules for classification	DBSCAN technique	Statistical data mining				
	SLO-2	Data integration		Rule extraction from a decision tree						
S-7	SLO-1	Data reduction	Mining frequent itemsets using Vertical data format	Metrics for evaluating classifier performance	STING technique	Data mining and recommender systems				
	SLO-2		Strong rules vs. weak rules	Cross validation						



S-8	SLO-1	Data transformation	Association analysis to Correlation analysis	Bootstrap	CLIQUE technique	Data mining for financial data analysis
	SLO-2			Ensemble methods-Introduction		
S-9	SLO-1	Data cube and its usage	Comparison of pattern evaluation measures	Bagging and Boosting	Evaluation of clustering techniques	Data mining for Intrusion detection
	SLO-2			Random Forests: Introduction		

Learning Resources	1. Jiawei Han and Micheline Kamber, "Data Mining: Concepts and Techniques", 3 <sup>rd</sup> Edition, Morgan Kauffman Publishers, 2011.
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Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#		Theory	Practice
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice		
Level 1	Remember	40 %	-	30 %	-	30 %	-	30 %	-	30%	-
Level 2	Understand	40 %	-	40 %	-	40 %	-	40 %	-	40%	-
	Apply										
Level 3	Analyze	20 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Evaluate										
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

# CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Mr.V.Selvakumar, Hexaware Technologies, selvakumarv@hexaware.com	1. Dr.Latha Parthiba, Pondicherry University, lathaparthiban@yahoo.com	1. Mr.L.N.B.Srinivas, SRMIST
2.	2.	2. Mr.S.Karthick, SRMIST
		3. Dr.V.V.Ramalingam, SRMIST

Course Code	18CSE391T	Course Name	BIG DATA TOOLS AND TECHNIQUES	Course Category	E	Professional Elective	L	T	P	C
							3	0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Computer Science and Engineering		Data Book / Codes/Standards	Nil	

Course Learning Rationale (CLR):	The purpose of learning this course is to:			Learning			Program Learning Outcomes (PLO)														
CLR-1 :	Gain knowledge about the various tools and techniques used in big data analytics			1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CLR-2 :	Learn the fundamentals of Hadoop and the related technologies			Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3
CLR-3 :	Understand the basics of development of applications using MapReduce, HDFS, YARN																				
CLR-4 :	Learn the basics of Pig, Hive and Sqoop																				
CLR-5 :	Learn the basics of Apache Spark, Flink and understand the importance of NoSQL databases																				
CLR-6 :	Learn about Enterprise Data Science and data visualization tools																				
Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:																				
CLO-1 :	Use the various tools and techniques in big data analytics			2	80	85	L	-	H	-	H	-	-	-	-	-	-	-	-	-	-
CLO-2 :	Apply Hadoop and related technologies to big data analytics			2	75	80	L	H	H	M	H	-	-	-	-	-	-	-	-	-	-
CLO-3 :	Apply MapReduce, HDFS and YARN develop big data applications			2	85	80	L	-	H	-	H	-	-	-	-	-	-	-	-	-	-
CLO-4 :	Develop applications using Pig, Hive and Sqoop			2	80	75	L	H	H	-	H	-	-	-	-	-	-	-	-	-	-
CLO-5 :	Apply Apache Spark and Flink to applications and understand the importance of NoSQL databases			2	75	85	L	-	H	M	H	-	-	-	-	-	-	-	-	-	-
CLO-6 :	Understand the applications of Enterprise Data Science and data visualization tools			2	80	85	L	-	H	-	H	-	-	-	-	-	-	-	-	-	-

Duration (hour)	9		9		9		9		9	
S-1	SLO-1	Overview of Big Data Analytics	MapReduce	Setting up a Hadoop cluster	Introducing Oozie	Enterprise Data Science Overview				
	SLO-2	Introduction to data analytics and big data	Analyzing data with Unix tools and Hadoop	Cluster specification and setup						
S-2	SLO-1	Big data mining	Scaling Out – Data Flow, Combiner Functions	Hadoop configuration	Apache Spark	Data Science Solutions in the enterprise				
	SLO-2	Technical elements of the Big Data platform	Hadoop Streaming	YARN configuration						
S-3	SLO-1	Analytics Toolkit, Components of the analytics toolkit	HDFS	Introduction to Pig	Limitations of Hadoop and overcoming the limitations	Enterprise data science – Machine Learning and AI				
	SLO-2	Distributed and Parallel Computing for Big Data		Installing and running pig	Core components and architecture of Spark	Enterprise Infrastructure solutions				
S-4	SLO-1	Cloud computing and Big Data	Hadoop filesystems	Basics of Pig Latin	Introduction to Apache Flink	Visualizing Big Data				
	SLO-2		Java Interface to Hadoop		Installing Flink					
S-5	SLO-1	In-Memory Computing Technology for Big Data	YARN	Introduction to Hive	Batch analytics using Flink	Using Python and R for visualization				
	SLO-2		Job Scheduling	Installing and running Hive			Big Data Visualization Tools			
S-6	SLO-1	Fundamentals of Hadoop	Hadoop I/O	Introduction to HiveQL	Big Data Mining with NoSQL	Data Visualization with Tableau				
	SLO-2	Hadoop Ecosystem								
S-7	SLO-1	The core modules of Hadoop	Data Integrity	Introduction to Zookeeper	Why NoSQL?	Case Studies: Hadoop				

	SLO-2		Compression	Installing and running Zookeeper	NoSQL databases	
S-8	SLO-1	Introduction to Hadoop MapReduce	Serialization	The Zookeeper Service	Introduction to HBase	Case Studies: Spark
	SLO-2		File based Data Structures	Flume Architecture		
S-9	SLO-1	Introduction to Hadoop YARN	Developing a MapReduce Application	Introduction to Sqoop	Introduction to MongoDB, Cassandra	Case Studies: NoSQL
	SLO-2					

Learning Resources	1. TomWhite, <i>Hadoop: The Definitive Guide, 3rd Edition</i> , O'Reilly, 2012.	3. Nataraj Dasgupta, <i>Practical Big Data Analytics</i> , Packt, 2018.
	2. Sridhar Alla, <i>Big Data Analytics with Hadoop 3</i> , Packt, 2018.	4. DTEditorialServices, <i>Big Data: Black Book</i> , 2016.

Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	40 %	-	30 %	-	30 %	-	30 %	-	30%	-
Level 2	Understand	40 %	-	40 %	-	40 %	-	40 %	-	40%	-
	Apply	40 %	-	40 %	-	40 %	-	40 %	-	40%	-
Level 3	Analyze	20 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Evaluate	20 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Create	20 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Total	100 %		100 %		100 %		100 %		100 %	

# CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts

Course Code	18CSE392T	Course Name	MACHINE LEARNING - I	Course Category	E	Professional Elective	L	T	P	C
							3	0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	CSE	Data Book / Codes/Standards	Nil		

Course Learning Rationale (CLR):	The purpose of learning this course is to:			Program Learning Outcomes (PLO)																				
CLR-1 :	To provide basic concepts of machine learning			1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15			
CLR-2 :	To provide deeper understanding of various tools and techniques for Machine learning Algorithms and outputs			Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3			
CLR-3 :	Understand and Implement the major classification techniques						H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLR-4 :	Understand and Implement the various Clustering Methods						H	H	H	-	H	-	-	-	-	-	-	-	-	-	-	-	-	-
CLR-5 :	Learn and Understand the Tree based machine Learning Algorithms						H	H	-	-	H	-	-	-	-	-	-	-	-	-	-	-	-	-
Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:																							
CLO-1 :	Understand the concepts of machine learning			2	80	85	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-			
CLO-2 :	Learn and understand machine tools and libraries of machine learning			2	75	80	H	H	H	-	H	-	-	-	-	-	-	-	-	-	-			
CLO-3 :	Learn and understand the linear learning models and classification in machine learning			2	85	80	H	H	-	-	H	-	-	-	-	-	-	-	-	-	-			
CLO-4 :	Understand the clustering techniques and their utilization in machine learning			2	80	75	H	H	-	-	H	-	-	-	-	-	-	-	-	-	-			
CLO-5 :	Study the tree based machine learning techniques and to appreciate their capability			2	75	85	H	H	-	H	H	-	-	-	-	-	-	-	-	-	-			

Duration (hour)	9		9		9		9		9	
S-1	SLO-1	Machine Learning: What and Why?	Platform for machine learning	Ridge Regression	Measuring (dis)similarity	Decision tree representation	SLO-2	Types of Machine Learning	Machine learning python libraries	Evaluating output of clustering methods
S-2	SLO-1	Supervised Learning	Scikit-learn	Maximum likelihood estimation (least squares)	Spectral clustering	Basic decision tree learning algorithm	SLO-2	Unsupervised Learning	training data – testing data – validation data	Hierarchical clustering
S-3	SLO-1	Reinforcement learning	k-fold cross validation	principal component analysis	Agglomerative clustering	Inductive bias in decision tree	SLO-2	The Curse of dimensionality	Features	Divisive clustering
S-4	SLO-1	Over fitting and under fitting	Performance metrics	Bayesian classifier	Choosing the number of clusters	Decision tree construction	SLO-2	linear regression	MSE, accuracy, confusion matrix, precision	Clustering datapoints and features
S-5	SLO-1	Bias and Variance tradeoff	recall, F- score	Support vector machine	Bi-clustering	Issues in decision tree	SLO-2	Testing – cross validation		
S-6	SLO-1	Regularization	Linear Regression with multiple variables	Support vector machine + kernels	Multi-view clustering	Classification and regression trees (CART)	SLO-2	Learning Curve		
S-7	SLO-1	Classification	Logistic Regression	Multi class classification	K-Means clustering	Random Forest	SLO-2	Error and noise		
S-8	SLO-1	Parametric vs. non-parametric models	spam filtering with logistic regression	K nearest neighbour classification	K-meloids clustering	Multivariate adaptive regression trees (MART)	SLO-2			
S-9	SLO-1	Linear Algebra for machine learning	Naive Bayes with scikit-learn	Application: face recognition with PCA	Application: image segmentation using K-means clustering	Perceptron learning	SLO-2			

Learning Resources	1. Kevin P. Murphy, "Machine Learning: A Probabilistic Perspective", MIT Press, 2012.	4. Sebastian Raschka, Vahid Mirjalili, "Python Machine Learning and deep learning", 2 <sup>nd</sup> edition, kindle book, 2018
	2. Ethem Alpaydin, "Introduction to Machine Learning", Prentice Hall of India, 2005	5. Carol Quadros, "Machine Learning with python, scikit-learn and Tensorflow", Packet Publishing, 2018.
	3. Tom Mitchell, "Machine Learning", McGraw-Hill, 1997.	6. Gavin Hackeling, "Machine Learning with scikit-learn", Packet publishing, O'Reilly, 2018.

Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	40 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Understand										
Level 2	Apply	40 %	-	40 %	-	40 %	-	40 %	-	40%	-
	Analyze										
Level 3	Evaluate	20 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

# CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
		Dr.G.Vadivu Dr. UshaKiruthika Mr.S.Joseph James

Course Code	18CSE393T	Course Name	TEXT MINING	Course Category	Professional Elective	L	T	P	C
						3	0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	CSE	Data Book / Codes/Standards	Nil		

Course Learning Rationale (CLR):		The purpose of learning this course is to:			Learning			Program Learning Outcomes (PLO)															
CLR-1 :	Understand the fundamentals of text mining	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
CLR-2 :	Utilize text for prediction techniques							Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3	
CLR-3 :	Understand the relevance between information retrieval and text mining							H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLR-4 :	Understand the goals of information extraction							H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLR-5 :	Analyze different case studies related to text mining							H	M	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Course Learning Outcomes (CLO):		At the end of this course, learners will be able to:							H	-	M	-	M	-	-	-	-	-	-	-	-	-	-
CLO-1 :	Acquire knowledge on fundamentals of text mining				2	80	85	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-2 :	Perform prediction from text and evaluate it				2	80	80	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-3 :	Perform document matching				2	80	75	H	M	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-4 :	Identify patterns and entities from text				2	75	85	H	-	M	-	M	-	-	-	-	-	-	-	-	-	-	-
CLO-5 :	Understand how text mining is implemented				2	80	85	H	-	-	-	-	-	-	-	-	-	-	L	-	-	-	-

Duration (hour)	9		9		9		9		9	
S-1	SLO-1	Overview of text mining	Labels for the Right Answers	Linear scoring Methods	Clustering Documents by similarity	Ideal Model of Data				
	SLO-2	Special about Text Mining	Feature selection by attribute ranking	Evaluation of Performance	Similarity of composite documents	Practical Data Sourcing				
S-2	SLO-1	Structured Data	Sentence Boundary Determination	Estimating current and future performance	K-means Clustering	Prototypical Examples				
	SLO-2	Unstructured Data	Part of speech Tagging	Getting the most from a Learning Method	Hierarchical Clustering	Hybrid Example				
S-3	SLO-1	Is text different from numbers	Word Sense Disambiguation	Errors and Pitfalls in Big data Evaluation	The EM Algorithm	Mixed Data in Standard Table Format				
	SLO-2	Types of Problem can be solved.	Phrase Recognition	Graph models for social Networks	Goals for Information Extraction	Case study: Market Intelligence from the web				
S-4	SLO-1	Document Classification	Named Entity Recognition	Information Retrieval and Text Mining	Finding Patterns and Entities from Text	Case Study: Lightweight Document Matching for Digital Libraries				
	SLO-2	Informational Retrieval	Parsing	Keyword search	Entity Extraction as Sequential Tagging	Generating Model cases for Help desk Application: case study				
S-5	SLO-1	Prediction and Evaluation	Feature Generation	Nearest- Neighbor Methods	Tag Prediction as Classification	Assigning topics to news articles: Case study				
	SLO-2	From Textual Information to Numerical Vectors	Using text for prediction	Measuring Similarity	The maximum Entropy method	E-mail Filtering: Case study				
S-6	SLO-1	Collecting Documents	Recognizing that document Fit a pattern	Shared Word Count	Linguistic Features and Encoding	SearchEngines : case study				
	SLO-2	Document Standardization	Document Classification	Word count and Bonus	Local Sequence Prediction Models	Extracting Named Entities from Documents				
S-7	SLO-1	Tokenization	Learning to Predict from Text	Cosine Similarity	Global sequence Prediction Models	Mining Social Media				

	SLO-2	Lemmatization	Similarity and Nearest-Neighbor Method	Web based Document Search	Coreference and relationship Extraction	Customized Newspapers
S-8	SLO-1	Inflectional Stemming	Document Similarity	Link Analysis	Template Filling And Database Construction	Emerging Directions
	SLO-2	Stemming to a Root	Decision Rules	Document Matching	Commercial Extraction System: Application	Different ways of collecting samples
S-9	SLO-1	Vector Generation for Prediction	Decision trees	Inverted List	Criminal Justice : Application	Learning to Unlabeled data
	SLO-2	Multiword Features	Scoring by Probabilities	Evaluation of Performance	Intelligence Applicaton	Distributed Text Mining

Learning Resources	1. By Sholom M. Weiss, Nitin Indurkha, Tong Zhang., Fundamentals of Predictive Text Mining
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Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember Understand	40 %	-	30 %	-	30 %	-	30 %	-	30%	-
Level 2	Apply Analyze	40 %	-	40 %	-	40 %	-	40 %	-	40%	-
Level 3	Evaluate Create	20 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Total	100 %		100 %		100 %		100 %		100 %	

# CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
		Dr.E.Poovammal, SRMIST
		Mr.L.N.B.Srinivas, SRMIST
		Mr.D.Vivek, SRMIST

Course Code	18CSE394T	Course Name	BUSINESS INTELLIGENCE AND ANALYTICS	Course Category	E	Professional Elective	L	T	P	C
							3	0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	CSE	Data Book / Codes/Standards	Nil		

Course Learning Rationale (CLR):	The purpose of learning this course is to:			Learning			Program Learning Outcomes (PLO)																
CLR-1 :	Familiarize with Business Intelligence, Analytics and Decision Support			1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15		
CLR-2 :	Understand the technologies for Decision making			Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3		
CLR-3 :	Familiarize with predictive modeling techniques																						
CLR-4 :	Familiarize with sentiment analysis techniques																						
CLR-5 :	Understand about Multi-criterai Decision making systems																						
CLR-6 :	Familiarize with Automated decision systems																						
Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:																						
CLO-1 :	Gain knowledge on Business Intelligence, Analytics and Decision Support			2	80	85																	
CLO-2 :	Understand the technologies for Decision making			2	75	80																	
CLO-3 :	Apply predictive modeling techniques			2	85	80																	
CLO-4 :	Apply sentiment analysis techniques			2	80	75																	
CLO-5 :	Gain knowledge on Multi-criterai Decision making systems			2	75	85																	
CLO-6 :	Gain knowledge on Automated decision systems			2	80	85																	

Duration (hour)	9		9		9		9		9	
S-1	SLO-1	Information Systems Support for Decision Making	Decision Making:	Basic Concepts of Neural Networks	Decision Support Systems modeling	Automated Decision Systems				
	SLO-2		Introduction and Definitions	Developing Neural Network	Structure of mathematical models for decision support	The Artificial Intelligence field				
S-2	SLO-1	An Early Framework for Computerized Decision Support	Phases of the Decision	Based Systems	Decision making under certainty	Basic concepts of Expert Sysytems				
	SLO-2		Making Process	Illuminating the Black Box of ANN with Sensitivity	Uncertainty and Risk					
S-3	SLO-1	The Concept of Decision Support Systems	The Intelligence Phase	Support Vector Machines	Decision modeling with spreadsheets	Applications of Expert Sysytems				
	SLO-2			A Process						
S-4	SLO-1	A Framework for Business Intelligence	Design Phase	Based Approach to the Use of SVM	Mathematical programming optimization	Structure of Expert Sysytems				
	SLO-2			Nearest Neighbor Method for Prediction						
S-5	SLO-1	Business Analytics Overview	Choice Phase	Sentiment Analysis Overview	Decision analysis-introduction	Knowledge Engineering				
	SLO-2									
S-6	SLO-1	Brief Introduction to Big Data Analytics	Implementation Phase	Sentiment Analysis Applications	Decision tables	Development of Expert Sysytems				
	SLO-2									
S-7	SLO-1	Clickstream Analysis	Decision Support SystemsCapabilities	Sentiment Analysis Process	Decision Trees	Location based Analytics				
	SLO-2	Metrics								



S-8	SLO-1	Clickstream Analysis	Decision Support SystemsClassification	Sentiment Analysis	Multi-criteria decision making	Cloud Computing
	SLO-2	Practical Solutions				
S-9	SLO-1	Competitive Intelligence Analysis	Decision Support SystemsComponents	Speech Analytics	Pairwise comparisons	Business Intelligence
	SLO-2					

Learning Resources	1. Ramesh Sharda, Dursun Delen, EfraimTurban, J.E.Aronson, Ting-Peng Liang, David King, "Business Intelligence and Analytics: System for Decision Support", 10 <sup>th</sup> Edition, Pearson Global Edition, 2013.
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Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#		Theory	Practice
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice		
Level 1	Remember	40 %	-	30 %	-	30 %	-	30 %	-	30%	-
Level 2	Understand	40 %	-	40 %	-	40 %	-	40 %	-	40%	-
	Apply										
Level 3	Analyze	20 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Evaluate										
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

# CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Mr.V.Selvakumar,Hexaware Technologies, selvakumarv@hexaware.com	1.	1. Mr.L.N.B.Srinivas, SRMIST
2.	2.	2. Ms.S.Nagadevi, SRMIST

Course Code	18CSE395T	Course Name	WEB INTELLIGENCE	Course Category	E	Professional Elective	L	T	P	C
							3	0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	CSE	Data Book / Codes/Standards	Nil		

Course Learning Rationale (CLR):	The purpose of learning this course is to:			Learning			Program Learning Outcomes (PLO)															
CLR-1 :	Understand the topics of Web Intelligence			1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
CLR-2 :	Study models of information retrieval, semantic webs, search engines, and web mining.			Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3	
CLR-3 :	Gain knowledge on the algorithmic aspect of Web Intelligent systems			2	80	85	H	-	-	-	-	-	-	-	-	-	-	-	H	H	H	-
CLR-4 :	Acquire knowledge on Data mining techniques			2	75	80	H	H	H	-	H	-	-	-	-	-	-	-	H	H	H	M
CLR-5 :	Understand the impact of Social Network Design for Web Intelligence			2	85	80	H	-	-	-	-	H	-	-	-	-	-	-	H	H	H	H
CLR-6 :	Gain Knowledge on different approaches required for studying the impact of social network for Web Intelligence			2	80	75	H	H	H	M	M	-	-	-	-	-	-	-	H	H	H	H
CLR-5 :	Understand the impact of Social Network Design for Web Intelligence			2	75	85	H	-	-	H	H	-	-	-	-	-	-	-	H	H	H	H
CLR-6 :	Gain Knowledge on different approaches required for studying the impact of social network for Web Intelligence			2	80	85	H	-	H	-	-	H	-	-	-	-	-	-	H	H	H	H

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:			2	80	85	H	-	-	-	-	-	-	-	-	-	-	-	H	H	H	-
CLO-1 :	Acquire the knowledge on topics and benefits of Web Intelligence			2	75	80	H	H	H	-	H	-	-	-	-	-	-	-	H	H	H	M
CLO-2 :	Acquire the ability to build models of information retrieval, semantic webs, search engines, and web mining.			2	85	80	H	-	-	-	-	H	-	-	-	-	-	-	H	H	H	H
CLO-3 :	Understand the basic ideas of Multimedia Information Retrieval			2	80	75	H	H	H	M	M	-	-	-	-	-	-	-	H	H	H	H
CLO-4 :	Acquire knowledge to use web crawlers and fetch relevant information			2	75	85	H	-	-	H	H	-	-	-	-	-	-	-	H	H	H	H
CLO-5 :	Acquire knowledge to refine the social network design approached used for developing intelligent web			2	80	85	H	-	H	-	-	H	-	-	-	-	-	-	H	H	H	H
CLO-6 :	Apply the knowledge of different web intelligence based algorithms in practical applications			2	80	85	H	-	H	-	-	H	-	-	-	-	-	-	H	H	H	H

Duration (hour)	9		9		9		9		9	
S-1	SLO-1	Introduction to Web Intelligence What is Web Intelligence? Benefits of Intelligent Web:What applications can benefit from web intelligence	Information Retrieval- Introduction, Document Representation	Data Mining Techniques-Classification	Web Content Mining-Web Crawlers	Social Network Design for Web Intelligence:Introduction: Social Network Design for Web Intelligence				
S-2	SLO-1	Wisdom Web	Retrieval Models	Data Mining Techniques-Clustering and Association	Web Crawlers	Overview of Social Intelligence Design: Groups and Communities, Issues of Social Intelligence Design, Applications of Social Intelligence Design				
S-2	SLO-2									
S-3	SLO-1	Ingredients of Intelligent Web	Retrieval Models	Data Mining Techniques- Association	Search Engines	The Travelling Conversation Model				
S-3	SLO-2									
S-4	SLO-1	Topics of Web Intelligence	Evaluation of Retrieval Performance	Web Usage Mining- Web-Log processing	Personalization of Web Content	A Broadcast-Based Approach				
S-4	SLO-2									
S-5	SLO-1	How can I build intelligence in my own application?	Semantic Web-Introduction, The Layered-Language Model	Web Usage Mining -Analyzing Web Logs	Multimedia Information Retrieval	A Conversational Agent-Based Approach				
S-5	SLO-2									
S-6	SLO-1	Examples of intelligent web applications	Metadata and Ontologies	Applications of Web Usage Mining Clustering of Web Users	Web Structure Mining- Modeling Web Topology	Smart Environment based approach				
S-6	SLO-2									
S-7	SLO-1	Fallacies of Intelligent applications	Ontology Languages for the Web	Applications of Web Usage Mining-Classification Modeling of Web Users	PageRank Algorithm	Psychological Evaluation, Technical Issues				
S-7	SLO-2									
S-8	SLO-1	Related Technologies	Tool Environment for the Ontology RDFferret-	Applications of Web Usage Mining-	Hyperlink-Induced Topic Search	Case Study-Putting it all together : an				

	SLO-2		Full Text Search and RDF Querying,Onto Share-Community support Onto Edit-Ontology Development	Association Mining of Web Usages	(HITS)	intelligent news portal
S-9	SLO-1	Related Technologies	OntoView-Change Management for Ontologies Sesame-Repositories for Ontologies and Data CORPORIUM-Information Extraction	Sequence-Pattern Analysis of Web Logs	Random Walks on the Web	Case Study-Applying Web Intelligence for Business Intelligence
	SLO-2					

Learning Resources	<p>1. Akerkar, R. &amp; Lingras, P. (2008). <i>Building an Intelligent Web: Theory and practice</i>. Jones and Bartlett Publishers, Sudbury, Massachusetts. ISBN-13: 978-0- 7637-4137-2</p> <p>2. Marmanis &amp; Babenko: <i>Algorithms of the Intelligent Web</i>, Manning Publications, 2009, ISBN:978-1933988665</p> <p>3. Witten, Ian H. &amp; Frank, E. (2005). <i>Data Mining: Practical Machine Learning Tools and Techniques</i>. 2<sup>nd</sup> Edition, Morgan Kaufman. ISBN 0120884070, 9780120884070</p>	<p>4. Bing Liu: <i>Web Data Mining</i>, Springer, 2nd ed. 2011 (view online or download from <a href="#">Springerlink</a>)</p> <p>5. Manning, Raghavan and Schuetze: <i>Introduction to Information Retrieval</i>, CambridgeUniversityPress,2008(bookavailableonline)</p> <p>N. Zhong, J.M. Liu, Y.Y. Yao, <i>Web Intelligence</i> (Springer, 2003)</p>
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Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#		Theory	Practice
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice		
Level 1	Remember	40 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Understand										
Level 2	Apply	40 %	-	40 %	-	40 %	-	40 %	-	40%	-
	Analyze										
Level 3	Evaluate	20 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

# CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Dr.B.Sathiya, Data Scientist,SPi Global - Analytics & AI,Adyar, Chennai	1. Dr.S.RenugaDevi, Assistant Professor(SI.Gr.),College of Engineering,Guindy,AnnaUniversity,Chennai	1. Dr.G.Manju
		2.Mr.K.Vijayakumar
		3.Mr.LNB.Srinivas

Course Code	18CSE396T	Course Name	DATA SCIENCE	Course Category	E	Professional Elective	L	T	P	C
							3	0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Computer Science and Engineering		Data Book / Codes/Standards	Nil	

Course Learning Rationale (CLR):		The purpose of learning this course is to:			Learning			Program Learning Outcomes (PLO)														
					1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
					Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3
CLR-1 :	Able to apply fundamental algorithmic ideas to process data			2	85	80	L	M	L	L	H	L	L	L	L	L	M	M	H	M	L	L
CLR-2 :	Understand the Data Analytics lifecycle			2	80	75	M	H	L	M	M	L	L	M	M	M	M	M	H	M	M	M
CLR-3 :	Able to construct predictive models to classify new data set			3	85	80	H	M	H	H	H	L	L	M	H	M	H	M	H	M	H	M
CLR-4 :	Learn to apply hypotheses and data into actionable predictions			3	75	70	M	H	H	H	H	L	M	M	H	H	H	H	M	H	M	H
CLR-5 :	Document and communicate the results effectively to different stakeholders			4	80	75	H	H	M	H	M	L	M	M	H	M	H	M	H	M	H	H
CLR-6 :	Effectively communicate the findings using visualization techniques			4	85	80	M	M	M	H	H	M	L	H	H	H	H	H	H	M	M	H
Course Learning Outcomes (CLO):		At the end of this course, learners will be able to:																				
CLO-1 :	Able to comprehend basic methods of processing data from real world problems			2	85	80																
CLO-2 :	Able to convert data into actionable insights			2	80	75																
CLO-3 :	Build clustering and classification models using R environment			3	85	80																
CLO-4 :	Apply statistical techniques for evaluation			3	75	70																
CLO-5 :	Analyze and validate the models using appropriate performance metrics			4	80	75																
CLO-6 :	Present the results using effective visualization techniques			4	85	80																

Duration (hour)	9	9	9	9	9	
S-1	SLO-1	Data science process	Approaching Analytics Problems	Introduction to R	Choosing and evaluating models	Documentation
	SLO-2	The roles in a data science project	Key roles for successful Analytics project	R Graphical user interfaces	Schematic model construction and evaluation	Knitr package
S-2	SLO-1	Stages in data science project	Discovery	Data Import and Export	Mapping problems to machine learning	Deploying models
	SLO-2	Define, Collect, Build, Evaluate, Present and Deploy	Business domain, Resources, Problem framing, Key stakeholders, Analytics sponsors, Initial hypotheses, Data sources	Attributes and Data Types	Solving classification problems, working without known targets	Deploying R HTTP services and exporting
S-3	SLO-1	Working with data from files	Data Preparation	Vectors	Evaluating classification models	Presenting your results to the project sponsor
	SLO-2	Structured data, other data formats and Transforming data in R	Learning about the data, conditioning	Arrays and Matrices	Accuracy, precision, Recall, sensitivity and specificity	Summarizing the project goals and stating the results
S-4	SLO-1	Working with relational databases and NoSQL databases	Model Planning	Data Frames	Evaluating clustering models	Presenting your model to end user
	SLO-2	Staging and Curating the data	Data exploration, Model selection	Lists	Intracluster distance, cross cluster distance	Presenting your work to other data scientist
S-5	SLO-1	Exploring data	Model Building	Factors	Validating models	Introduction to data analysis
	SLO-2	Using summary statistics to spot	Common tools for model building	Contingency Tables	Overfitting, Quantifying model	Visualization before Analysis

		problems			soundness, Ensuring model quality	
S-6	SLO-1	Managing data	Communicate Results	Descriptive statistics	Memorization methods	Dirty data
	SLO-2	Cleaning data	Analysis over the different models	Model building, Evaluation and Deployment	Using single variable and multi variable	Visualizing a single variable
S-7	SLO-1	Sampling for modeling and validation	Operationalize	Hypotheses Testing	Linear regression	Examining multiple variables
	SLO-2	Training and test set split, Sample group column, Record grouping, Data provenance	Moving the model to deployment environment	Null hypotheses and Alternative hypotheses	Building a linear regression model and predicting	Dotchart and Barplot
S-8	SLO-1	Data Structures	Analytics Plan	Difference of means	Logistic regression	Box and Whisker plot
	SLO-2	Structured, Semi-structured, Quasi-structured and Unstructured data		Student t-test, Welch's t-test	Building a logistic regression model and predicting	Hexbinplot for large datasets
S-9	SLO-1	Drivers of big data	Key deliverables of analytics project	Wilcoxon Rank-Sum test	Unsupervised methods	Scatterplot matrix
	SLO-2	Devices – Mobile, smart devices	Presentation: Project sponsors, Analysts, Code, Technical specifications	Type I and II errors	Cluster analysis	Analyzing a variable over time

Learning Resources	<ol style="list-style-type: none"> <li>David Dietrich, Barry Heller, Beibei Yang, "Data Science and Big Data Analytics", EMC Education Services, 2015</li> <li>Nina Zumel, John Mount, "Practical Data Science with R", Manning Publications, 2014</li> <li>Jure Leskovec, Anand Rajaraman, Jeffrey D. Ullman, "Mining of Massive Datasets", Cambridge University Press, 2014</li> </ol>	<ol style="list-style-type: none"> <li>Mark Gardener, "Beginning R: The Statistical Programming Language", John Wiley &amp; Sons, Inc, 2012</li> <li>W.N. Venables, D.M. Smith and the R Core Team, "An Introduction to R", 2013</li> <li>Tony Ojeda, Sean Patrick Murphy, Benjamin Bengfort, Abhijit Dasgupta, "Practical Data Science Cookbook", Packt Publishing Ltd., 2014</li> </ol>
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Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	40 %	-	30 %	-	30 %	-	30 %	-	30%	-
Level 2	Understand	30 %	-	40 %	-	30 %	-	40 %	-	40%	-
Level 3	Apply	30 %	-	30 %	-	40 %	-	30 %	-	30%	-
	Analyze										
	Evaluate										
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

# CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Dr. Pethuru Raj, Reliance Jio Infocomm Ltd, peterindia@gmail.com	1. Prof. P. Marikkannu, IT HOD, Anna University Regional centre, Coimbatore, pmarikkannu@gmail.com	1. Dr. G. Vadivu, SRMIST
	2. Prof. E. Ilavarasan, Pondicherry University, eilavarasan@pec.edu	2. Dr. B. Baranidharan, SRMIST
		3. Mr. D. Vivek, SRMIST

Course Code	18CSE487T	Course Name	DATA WAREHOUSING AND ITS APPLICATIONS			Course Category	E	Professional Elective					L	T	P	C								
		Pre-requisite Courses		Nil	Co-requisite Courses		Nil	Progressive Courses		Nil														
Course Offering Department		Computer Science and Engineering			Data Book / Codes/Standards		Nil																	
Course Learning Rationale (CLR):		The purpose of learning this course is to:					Learning			Program Learning Outcomes (PLO)														
CLR-1 :	Understand the basic idea of data warehouse					1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
CLR-2 :	To learn step by step approach to design a data warehouse					Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3	
CLR-3 :	Understand ETL Process					H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
CLR-4 :	To learn building process of data warehouse and implementation of data mart					H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
CLR-5 :	Identify the Data mining concepts with various domains					H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
CLR-6 :	To learn case studies to bring out practical aspects of data warehouse					H	-	-	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Course Learning Outcomes (CLO):		At the end of this course, learners will be able to:					2	80	85	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-1 :	Acquire the knowledge, Architecture and schema and OLAP Tool concepts.					2	75	80	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-2 :	Acquire knowledge to design a data warehouse.					2	85	80	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-3 :	Implement ETL Process in various data warehouse applications.					2	80	75	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-4 :	Acquire knowledge to implement a data warehouse.					2	75	85	H	-	-	H	-	-	-	-	-	-	-	-	-	-	-	-
CLO-5 :	Implement the various concepts and applications of data mining rules and technology.					2	80	85	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-6 :	To Implement the data warehouse concepts in various organizations.					2	80	85	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Duration (hour)	9		9		9		9		9		9		9		9		9		9		9		9	
S-1	SLO-1	Introduction to data ware housing	Data Warehouse Schema-Introduction	Building a data warehouse - Introduction	DATA MINING-introduction – Data – Types of Data – Data Mining Functionalities	Data Warehouse in Tamil Nadu government																		
	SLO-2	Introduction to data ware housing	Dimensional Modeling	Critical success factor	Integrating Data Mining with Data Warehouse	Data warehouse for ministry of commerce																		
S-2	SLO-1	Data warehousing Components	The Star Schema	Requirement Analysis	Data Mining Task Primitives	Data warehouse for the government of Andhra Pradesh																		
	SLO-2	Need for Data warehousing	The Snowflake Schema	Planning for the data warehouse	Data Preprocessing	Data warehouse for the government of Andhra Pradesh																		
S-3	SLO-1	Benefits and application of data warehouse	Aggregate Tables	Data warehouse design stage	Association rule mining and classification	Data warehouse in Hewlett Packard																		
	SLO-2	Data Warehouse Architecture Goals	DBMS Schemas for Decision Support	Building and implementing data marts	Frequent pattern Mining	Data warehouse in Hewlett Packard																		
S-4	SLO-1	Data Warehouse Architecture and Characteristics	Data Extraction	Building data warehouse	Apriori algorithm	Data warehouse in Levi Strauss																		
	SLO-2	Data Warehouse Architecture and Characteristics	Data transformation: Basic tasks	Backup and Recovery	Frequent pattern Mining without candidate generation	Data warehouse in Levi Strauss																		
S-5	SLO-1	Data Mart	Major transformation types	Establish the data recovery quality framework	Mining Multilevel Association Rules	Data warehouse in World Bank																		
	SLO-2	Data Mart	OLAP definition,	Operating the warehouse	Mining Multidimensional Association Rule, Correlation Analysis Rule	Data warehouse in World Bank																		

S-6	SLO-1	Classification of data mart, Implementation	Dimensional Analysis	Recipe for a successful data warehouse	Classification: Decision Tree	HARBOR-A highly available data warehouse
	SLO-2	Classification of data mart, Implementation	Hypercube	Data warehouse pitfalls	Bayesian Classification-Naïve Bayes Classification	HARBOR-A highly available data warehouse
S-7	SLO-1	Gathering the business requirement	OLAP operations	Meta Data – Introduction	SVM Linear and Non linear data	A Typical Business Data Warehouse for a trading company
	SLO-2	Planning and project management-Project principles	Drill down	Meta Data – Data Management	Text Mining Temporal Data Mining and Spatial Data mining	A Typical Business Data Warehouse for a trading company
S-8	SLO-1	Data ware house readiness assessment, project team	Roll up	Meta Data – Query Generation	Cluster Analysis-Introduction	Customer Data warehouse of world's first and largest online bank in united kingdom
	SLO-2	Selecting the operating system	Slice	Meta Data – Query Generation	K-means– Partitioning Methods	Customer Data warehouse of world's first and largest online bank in united kingdom
S-9	SLO-1	Selecting the database software	OLAP models	Meta Data and Tools	Hierarchical Methods	A German supermarket Edeka's Data warehouse
	SLO-2	Selecting the tools	MOLAP	Meta Data and Tools	Data Mining Applications	A German supermarket Edeka's Data warehouse

Learning Resources	1. PaulrajPonniah, – DataWarehousing:FundamentalsforITProfessionals,WileyIndia.,2001.	4. Prabhu CSR ,Data Warehousing Concepts, Technique, Product and application, PHI Learning private Ltd, Third Edition,2013.
	2. Reema Theraja "Data Warehousing" by Oxford UniversityPress-2011.	
	3. DataMiningandDataWarehousingbyMs.KhushbooSaxena,Mr.Sandeepsaxena,Dr.AkashSaxenafirst edition 2015,BPBpublication,India	

Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#		Theory	Practice
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice		
Level 1	Remember	40 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Understand										
Level 2	Apply	40 %	-	40 %	-	40 %	-	40 %	-	40%	-
	Analyze										
Level 3	Evaluate	20 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

# CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
K Selvanayagam, System Analyst, project Lead, Preludesys, Siruseri, Kancheepuram Dist.	V.Masillamani, Asst Prof,IIITDM, Kancheepuram ,chennai	1.A.M.J Muthu Kumaran
		2. S.A Saranya

Course Code	18CSE488T	Course Name	FUNCTIONAL PROGRAMMING	Course Category	E	Professional Elective	L	T	P	C
							3	0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Computer Science and Engineering		Data Book / Codes/Standards	Nil	

Course Learning Rationale (CLR):		The purpose of learning this course is to:			Program Learning Outcomes (PLO)																			
CLR-1 :	Understand the basic building blocks of stream processing				1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15		
CLR-2 :	Explore the data ingestion options into stream processing engines				Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3		
CLR-3 :	Process streaming data in real time							L	H	H	H	H	-	-	-	L	L	-	H	-	-	-	-	-
CLR-4 :	Utilize NOSQL storage options to store real time data							M	H	L	M	M	-	-	-	-	M	L	-	H	-	-	-	-
CLR-5 :	Deliver stream processing results to end users							M	H	M	H	H	-	-	-	M	L	-	H	-	-	-	-	-
								H	H	M	H	M	-	-	-	M	L	-	H	-	-	-	-	
Course Learning Outcomes (CLO):		At the end of this course, learners will be able to:																						
CLO-1 :	Comprehend the usage of basic constructs of a functional programming language				3	80	70																	
CLO-2 :	Create the different types of functions and evaluate its operations				3	85	75																	
CLO-3 :	Create patterns and match the same with traits and case classes				3	75	70																	
CLO-4 :	Create lists and collections, evaluate its operations				3	85	80																	
CLO-5 :	Construct functional design for real world applications using common structures				3	85	75																	

Duration (hour)	9		9		9		9		9	
S-1	SLO-1	Programming Paradigms	Modules, Objects and Namespaces	Traits – Purpose and Syntax	Lists – Java vs Scala Lists	Functors - Purpose and Use				
	SLO-2	Different types of programming paradigms, Functional vs OOP	Demo - Modules, Objects and Namespaces	Define a trait	Lists definitions and usage demo	Writing a simple functor				
S-2	SLO-1	Scala Language Basics - Variables,	Anonymous Functions	Interface types	Working with Lists	Functor Laws				
	SLO-2	Expressions	Polymorphic Functions, Nested Functions	Interface types examples	Constructing Lists	Applicatives – Concepts and use				
S-3	SLO-1	Functions	Demo – Anonymous , Polymorphic and Nested Functions	Thick Interfaces	Basic operations on lists	Defining an applicative				
	SLO-2	Recursion	Closures	Thin Interfaces	head, tail, isEmpty demo, List Patterns	Demo of Applicatives				
S-4	SLO-1	Call By Name	Demo - Closures	Comparison - Thick vs Thin Interfaces	Lists - First Order methods	Traversable functors				
	SLO-2	Call By Value	Repeated Parameters	Ordered trait	Examples of First Order Methods	Example – Traversable Functors				
S-5	SLO-1	Conditionals	Tail Recursion	Demo – Ordered trait, Trait Comparisons	Lists - Higher Order methods	Monads				
	SLO-2	Looping – for each and for	Demo – Tail Recursion	Traits for modifying interfaces	Examples of Higher Order Methods	Defining Monads				
S-6	SLO-1	Significance of vals	Define a tail recursive function	Stacking modifications	Sequences – Overview and operations	Monad Laws				
	SLO-2	Classes	Tracing tail-recursive functions	Recap – Traits and operations	Demo - Sequences	Demo – Monads and Monad Laws				
S-7	SLO-1	Types	Demo – Tracing tail-recursive functions	Mixin – Purpose & Composition	Tuples - Overview and operations	Monoid – Concept, Purpose and Use				
	SLO-2	Fields	Limits of tail-recursive functions	Mixin Example	Demo - Tuples	Examples of Monoid				
S-8	SLO-1	Methods	Curried Functions	Case Classes – Use, Definition	Sets and Maps – Overview and operations	Recap with more examples -Monads and Functors				
	SLO-2	Variable scope	Demo - Curried Functions	Pattern Matching, Example	Demo – Sets and Maps	Recap with more examples -Applicatives				
S-9	SLO-1	Objects	Higher Order Functions - Definition and Uses	Sealed Classes, Option Type	Recap – Lists and Collections	Applications – Functors, Monads				



SLO-2	Singleton object, Variables of objects	Higher Order Functions Example	Applications – Sealed Classes and Option Type	Examples – Lists and Collections	Applications - Monads
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Learning Resources	1. Chiusano.P,BjarnasonR,FunctionalProgramminginScala,ManningPublications,2015	3. Hortsman, C., Scala for the Impatient, 2 <sup>nd</sup> ed., Addison-Wesley,2016.
	2. OderskeyM,SpoonL,VennersB,“ProgramminginScala”,Thirdedition.	4. Raychaudhuri R, Scala in Action, 1 <sup>st</sup> ed. Manning Publications,2013.

Learning Assessment		Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
Bloom's Level of Thinking		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#		Theory	Practice
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice		
Level 1	Remember	40 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Understand										
Level 2	Apply	40 %	-	40 %	-	40 %	-	40 %	-	40%	-
	Analyze										
Level 3	Evaluate	20 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

# CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
		Ms. K.Sornalakshmi
		Mr.R.Rajkumar

Course Code	18CSE489T	Course Name	STREAMING ANALYTICS	Course Category	E	Professional Elective	L	T	P	C
							3	0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	
Course Offering Department	Computer Science and Engineering		Data Book / Codes/Standards	Nil	

Course Learning Rationale (CLR):		The purpose of learning this course is to:			Program Learning Outcomes (PLO)															
CLR-1 :	Understand the basic building blocks of stream processing	Learning	1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CLR-2 :	Explore the data ingestion options into stream processing engines		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3
CLR-3 :	Process streaming data in real time		3	80	70	L	H	H	H	M	-	-	-	L	L	-	H	-	-	-
CLR-4 :	Utilize NOSQL storage options to store real time data		3	85	75	M	H	L	M	M	-	-	-	M	L	-	H	-	-	-
CLR-5 :	Deliver stream processing results to end users		3	75	70	M	H	M	H	H	-	-	-	M	L	-	H	-	-	-
Course Learning Outcomes (CLO):		At the end of this course, learners will be able to:			3	85	80	M	H	M	H	H	-	-	M	L	-	H	-	-
CLO-1 :	Comprehend the concepts and terminologies in stream processing	3	80	70	H	H	M	H	M	-	-	-	M	L	-	H	-	-	-	
CLO-2 :	Create the data ingestion pipeline for a stream processing application	3	85	75	L	H	H	H	H	-	-	-	L	L	-	H	-	-	-	
CLO-3 :	Create stream processing applications using Apache Storm and Spark Streaming	3	75	70	M	H	M	H	H	-	-	-	M	L	-	H	-	-	-	
CLO-4 :	Store real time data using NoSQL databases	3	85	80	M	H	M	H	H	-	-	-	M	L	-	H	-	-	-	
CLO-5 :	Construct stream data visualizations for users	3	85	75	H	H	M	H	M	-	-	-	M	L	-	H	-	-	-	
		3	80	70	L	H	H	H	H	-	-	-	L	L	-	H	-	-	-	

Duration (hour)	9		9		9		9		9	
S-1	SLO-1	Introduction to Stream Processing	Getting Started with Kafka	Apache Storm – Introduction	Apache Spark Streaming Introduction	NoSQL Data Bases				
	SLO-2	Batch vs Stream Processing, Examples of stream processing	Why Kafka ? Publish Subscribe messaging model	Features of Storm	Spark's Memory Usage	Introduction to MongoDB				
S-2	SLO-1	Map Reduce, Scalability and Fault Tolerance	Kafka Architecture	Storm Components	Understanding Resilience and Fault Tolerance in a Distributed System	MongoDB's Key Feature				
	SLO-2	Applications of stream processing	Messages and Batches, Schemas	Nimbus, Supervisor Nodes	Spark's cluster manager	Data Model, Adhoc queries				
S-3	SLO-1	Stateful Stream Processing	Topics and Partitions,	Zookeeper cluster	Data Delivery Semantics in Spark	Indexes, Querying				
	SLO-2	Stream Processing Model	Producers and consumers	Storm Data Model	Data Delivery Semantics in Spark Applications	Replication, Speed and Durability				
S-4	SLO-1	Data Sources, Stream processing pipelines, Sinks	Brokers and Clusters	Definition of a Storm topology, Operation modes in Storm	Microbatching	Scaling, MongoDB Change Streams				
	SLO-2	Transformations and Aggregation	Multiple Clusters, Data Ecosystem	Storm – Prerequisites and Setting up a storm cluster, Developing a hello world example	Dynamic Batch Interval	Real-time data changes with Change Streams				
S-5	SLO-1	Window Aggregations	Sending messages with producers	Storm topology options, Demo of Hello world in Storm	Structured Stream processing model	Visualizing Streaming data – Events, Logs, Records				
	SLO-2	Stateless and stateful processing	Steps & Example - Sending messages with producers	Introduction to Storm UI	Spark Streaming Resilience Model	Dashboards				

S-6	SLO-1	Effect of time in stream processing	Receiving messages with consumers	Cluster, Nimbus, Supervisor, Topology Summary. Nimbus Configuration	Data Structures in Spark – RDDs and DStreams	Visual Elements and Properties
	SLO-2	Lambda Architecture	Steps & Example - Receiving messages with consumers	Storm Scheduler	Spark Fault Tolerance Guarantees	Data Density
S-7	SLO-1	Kappa Architecture	Developing Kafka Streams Application	Types of schedulers	First Steps in Structured Streaming	Dividing time, Time to Live, Context
	SLO-2	Examples – Lambda & Kappa Architectures	Phases in a Kafka Streams Application Development	Applications of schedulers	Streaming Analytics Phases	Examples of Streaming Data Visualization
S-8	SLO-1	Streaming vs Batch Algorithms	Constructing a topology	Storm Cluster Monitoring	Acquiring streaming data	Visual Distractions and Visual Deception
	SLO-2	Applications – Streaming and Batch Algorithms	Streams and State – Applying stateful operations	Integration of Storm with Kafka	Transforming streaming data	Example – Stream processing visualization dashboards
S-9	SLO-1	Use of a Batch-Processing Component in a Streaming Application	Example application development with Kafka Streams	Integration of Storm with Kafka example	Output the resulting data	Streaming Visualization Techniques
	SLO-2	Recap – Stream Processing Fundamentals	Demo – Kafka Streams	Recap – Storm in Stream Processing	Demo – Stream Processing with Spark Streaming	Demo – Stream Processing visualization

Learning Resources	<ol style="list-style-type: none"> <li>1. Ellis B, <i>Real-Time Analytics – Techniques to analyze and visualize streaming data</i>, 1<sup>st</sup> ed., John Wiley &amp; Sons Inc, 2014</li> <li>2. Andrade.H.C, Gedik B, Turaga D.S, “<i>Fundamentals of Stream Processing: Application Design, Systems, and Analytics</i>”, 1<sup>st</sup> ed., Cambridge University Press, 2014.</li> <li>3. Narkhede N, Shapira .G, and Palino T., <i>Kafka: The Definitive Guide - Real-Time Data and Stream Processing at Scale</i>, 1<sup>st</sup> ed., O'Reilly Media, Inc., 2017.</li> </ol>	<ol style="list-style-type: none"> <li>4. Jain.A, <i>Mastering Apache Storm</i>, 1<sup>st</sup> ed., Packt Publishing, 2017.</li> <li>5. Garillot F and Mass. G., <i>Stream Processing with Apache Spark</i>, 1<sup>st</sup> ed., O'Reilly Media, Inc., 2019.</li> <li>6. <a href="https://docs.mongodb.com/manual/changeStreams/">https://docs.mongodb.com/manual/changeStreams/</a></li> <li>7. Banker K., Bakkum P., Verch S., Garret D., Hawkins T., <i>MongoDb in Action</i>, ”, 1<sup>st</sup> ed., Manning Publications, 2016</li> <li>8. Arageus A, <i>Visualizing Streaming Data</i>, 1<sup>st</sup> ed., O'Reilly Media, Inc., 2018.</li> </ol>
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Learning Assessment											
Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)									Final Examination (50% weightage)	
	CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#		Theory	Practice	
	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice			
Level 1	Remember	40 %	-	30 %	-	30 %	-	30 %	-	30%	-
Level 2	Understand	40 %	-	40 %	-	40 %	-	40 %	-	40%	-
Level 3	Apply	20 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Analyze										
	Evaluate										
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

# CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
		Ms.K.Sornalakshmi
		Ms.A.Saranya, Dr.Manju

Course Code	18CSE490T	Course Name	BIG DATA VISUALIZATION	Course Category	E	Professional Elective	L	T	P	C
							3	0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Computer Science and Engineering		Data Book / Codes/Standards	Nil	

Course Learning Rationale (CLR):	The purpose of learning this course is to:			Learning			Program Learning Outcomes (PLO)														
CLR-1 :	Understand the key techniques used in visualization which includes data models, graphical perception and techniques specifically for visual encoding and interaction			1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CLR-2 :	Obtain an exposure to common data domains and the corresponding analysis tasks which includes multivariate data and text			Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3
CLR-3 :	Get hands-on experience in building and evaluating visualization systems																				
CLR-4 :	Gain knowledge in data visualization aides																				
CLR-5 :	Understand the significance of data by placing it in a visual context																				
CLR-6 :	Utilize the knowledge by reading and discussing research papers from the visualization literature																				
Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:																				
CLO-1 :	Design and exploring the result with data visualizations			3	75	70	L	M	M	M	L	-	-	-	M	L	M	M			
CLO-2 :	Conducting exploratory data analysis using visualization techniques and tools.			3	75	70	M	H	M	M	M	-	-	-	M	L	M	M			
CLO-3 :	Visual presentations of data for effective Communication.			3	80	75	M	M	H	H	M	M	-	-	M	M	H	H			
CLO-4 :	Designing and evaluating color palettes for visualization based on principles of perception.			3	85	80	M	M	M	H	H	-	-	-	M	M	H	H			
CLO-5 :	Using the knowledge of perception and cognition to evaluate visualization design alternatives			3	85	80	M	H	M	H	H	-	-	-	M	M	H	H			
CLO-6 :	Identifying opportunities for the application of data visualization in various domains.			3	85	80	M	H	H	H	H	-	-	-	M	M	H	H			

Duration (hour)	9		9		9		9		9	
S-1	SLO-1	Introduction to Big Data Visualization	Definitions and explanations of visualization categories	An Introduction to Visualization tools		Introduction to D3		Case Studies: 1: Color considerations with a dark background		
	SLO-2	Challenges of Big Data Visualization	Exploring R In big data	Visualization tools and big data		D3 and big data				
S-2	SLO-1	Categorization	Example with Patient Medical History	Example 1 – Sales transactions		Basic Examples		2: Leveraging animation in the visuals you present		
	SLO-2	Visualization Philosophies	Digging in with R	Adding more context		Getting started with D3				
S-3	SLO-1	Approaches to Big Data Visualization	No looping	Wrangling the data		D3 visualization sample templates		3: Logic in order		
	SLO-2	Quality of Visualization	Comparisons and Contrasts	Trifacta Script panel		Big data visualization using D3				
S-4	SLO-1	Infographics versus Data Visualization	Tendencies	A visualization dashboard		Displaying Results Using D3		4: Strategies for avoiding the spaghetti graph		
	SLO-2	Exploration versus Explanation	Dispersion	Experimenting with the data and build the visualization		Create a summary file for visualization				
S-5	SLO-1	Informative versus Persuasive versus Visual Art	Data quality categorized	Data pane_core details		Visualization using HTML document		5: Alternatives to pies		
	SLO-2	Ingredients of Successful Visualizations	Data Manager	Constructing Dashboards		Data visualization showing the stacked view				
S-6	SLO-1	Choose Appropriate Visual Encodings- Natural Ordering, Distinct Values	Data Manager and big data	Saving and Presenting the work		Visual transitions		Final Thought		
	SLO-2	Redundant Encoding ,Defaults versus	Example-Reformatting-A little Setup	Visualization re-coloring, resizing, adding or						

		<i>Innovative Formats ,Readers' Context</i>		<i>changing labels</i>		
S-7	SLO-1	<i>Compatibility with Reality ,Patterns and Consistency</i>	<i>Adding Script Code</i>	<i>Filters and Measure Names</i>	<i>Multiple donuts</i>	<i>Where to go from here</i>
	SLO-2	<i>Selecting Structure</i>	<i>Executing the scene</i>	<i>Example-Promotion Spend Effect on Sales</i>	<i>Another twist on bar chart visualizations with examples</i>	
S-8	SLO-1	<i>Position: Layout and Axes</i>	<i>Status and relevance</i>	<i>Sales and spend</i>		<i>Building storytelling with data competency in your team or organization</i>
	SLO-2	<i>The Meaning of Placement and Proximity</i>	<i>Naming the nodes</i>	<i>Sales v Spend and Spend as % of Sales Trend</i>	<i>D3 Stacked Area via Nest template</i>	
S-9	SLO-1	<i>Patterns of Organization-Specific Graphs, Layouts, and Axis Styles</i>	<i>Consistency ,Reliability ,Appropriateness</i>	<i>ables and indicators</i>	<i>Adopting the sample</i>	
	SLO-2	<i>Appropriate Use of Circles and Circular Layouts</i>	<i>Accessibility and Other Output nodes</i>		<i>Visualization changes format</i>	

Learning Resources	1. <i>Big Data Visualization, James D. Miller, Copyright © 2017 Packt Publishing</i>	3. <i>Storytelling with data - a data visualization guide for business professionals by cole nussbaumer knaflic, Wiley publications</i>
	2. <i>Designing Data Visualizations, by Noah Iliinsky and Julie Steele, Copyright © 2011 Julie Steele and Noah Iliinsky. All rights reserved. Printed in the United States of America</i>	

**Learning Assessment**

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#		Theory	Practice
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice		
Level 1	Remember Understand	40%	-	30%	-	30%	-	30%	-	30%	-
Level 2	Apply Analyze	40%	-	40%	-	40%	-	40%	-	40%	-
Level 3	Evaluate Create	20%	-	30%	-	30%	-	30%	-	30%	-
	Total	100 %		100 %		100 %		100 %		100 %	

# CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

**Course Designers**

Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
<i>Valiyullasha, Bugtreat Technologies, UK, ceo@bugtreat.com</i>	<i>Prof. Shiv ram Dubey, IIT Sricity, srdubey@iits.in</i>	<i>Dr. Mangalraj, SRMIST,</i>
<i>Saravanakarthick, Hewlett-Packard, India, saravanakarthick.chinniah@dx.com</i>	<i>Prof. Bhawana Rudra, NITK suratkal, bhawanarudra@nitk.edu.in</i>	<i>Dr. K.P. Vijayakumar, SRMIST</i>

Course Code	18CSE491T	Course Name	MACHINE LEARNING - II	Course Category	E	Professional Elective	L	T	P	C
							3	0	0	3

Pre-requisite Courses	18CSE392T	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	CSE	Data Book / Codes/Standards	Nil		

Course Learning Rationale (CLR):	The purpose of learning this course is to:			Program Learning Outcomes (PLO)																					
CLR-1 :	Understand the Fundamentals of machine Learning Experiments			Learning	1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15			
CLR-2 :	Design and implement Ensemble learning methods			Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3				
CLR-3 :	To provide deeper understanding of Reinforcement Learning and its Elements						H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
CLR-4 :	Understand and Implement Neural Network Algorithms						H	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLR-5 :	Understand the concepts of Deep Learning Algorithms						H	H	-	-	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-
							H	H	-	H	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:																								
CLO-1 :	Design and Analyze Machine Learning Experiments			2	80	85																			
CLO-2 :	Learn and Understand Graphical Model Learning and ensemble learning			2	75	80																			
CLO-3 :	Understand the concept of Reinforcement learning			2	85	80																			
CLO-4 :	Study the neural network systems for machine learning			2	80	75																			
CLO-5 :	Learn and Implement Deep Learning algorithms			2	75	85																			

Duration (hour)	9		9		9		9		9	
S-1	SLO-1	Introduction to machine learning	Graphical Models	Reinforcement Learning	Neural Networks representations	Feature selection				
	SLO-2	Basic probability theory	Bayesian belief networks	K-Armed Bandit	McCulloch-Pitts units	Feature extraction				
S-2	SLO-1	linear algebra	Markov random fields	Elements of reinforcement learning	Thresholding logic	Deep Learning				
	SLO-2			Model based learning	Perceptron	Deep learning python libraries				
S-3	SLO-1	Factors		Value iteration	Feed forward networks	Simple DNN				
	SLO-2	Response and strategy of Experimentation	Naïve Bayes classifiers	policy iteration	Multi-layer perceptron	Activation functions				
S-4	SLO-1	Randomization, Replication and Blocking	Markov models	Temporal difference learning						
	SLO-2	Guidelines for machine learning Experiments	Hidden Markov models	Exploration strategies	Back propagation algorithms	Regularization methods				
S-5	SLO-1	Cross validation and resampling methods	Ensemble learning methods	Deterministic and Non-deterministic rewards and actions	Convergence and Hidden layer representation in back propagation	Convolutional Neural Networks				
	SLO-2	Measuring classifier performance	Voting, Boosting, Adaboost		Optimization Algorithms					
S-6	SLO-1	Interval estimation	Gradient Boosting	Semi-supervised learning	Gradient Decent	Recurrent Neural Networks				
	SLO-2	Hypothesis testing	Bagging		Stochastic gradient					
S-7	SLO-1	Assessing a Classification Algorithm's performance	Random Forest	Computational learning theory	Adam, Adagrad	LSTM				
	SLO-2	Comparing two classification Algorithms			RMSProp	Sentiment analysis with LSTM keras code				

S-8	SLO-1	Comparing multiple Algorithms	Fine Tuning Ensemble	VC dimension	Drop out	Auto encoders
	SLO-2		Cascading		Batch Normalization	
S-9	SLO-1	Comparison over multiple Datasets	Application Face recognition using Ensemble techniques	PAC learning	Application Face recognition using Neural Networks	Dimensionality reduction using Auto Encoders
	SLO-2					

Learning Resources	<ol style="list-style-type: none"> <li>Kevin P. Murphy, "Machine Learning: A Probabilistic Perspective", MIT Press, 2012.</li> <li>Ethem Alpaydin, "Introduction to Machine Learning", Prentice Hall of India, 2005</li> <li>Tom Mitchell, "Machine Learning", McGraw-Hill, 1997.</li> </ol>	<ol style="list-style-type: none"> <li>Sebastian Raschka, Vahid Mirjalili, "Python Machine Learning and deep learning", 2<sup>nd</sup> edition, kindle book, 2018</li> <li>Ian Goodfellow, Yoshua Bengio, Aaron Courville, "Deep Learning", MIT Press, 2016.</li> <li>Jason Brownlee, "Deep Learning with Python", ebook, 2016.</li> </ol>
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Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#		Theory	Practice
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice		
Level 1	Remember	40 %	-	30 %	-	30 %	-	30 %	-	30%	-
Level 2	Understand	40 %	-	40 %	-	40 %	-	40 %	-	40%	-
	Apply	40 %	-	40 %	-	40 %	-	40 %	-	40%	-
Level 3	Analyze	20 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Evaluate	20 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Create	20 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Total	100 %		100 %		100 %		100 %		100 %	

# CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
		1. Dr. G. Vadivu
		2. Dr. Usha Krithika
		3. Mr. S. Joseph James

Course Code	18CSE341T	Course Name	COMMUNICATION SYSTEMS ENGINEERING	Course Category	E	Professional Elective	L	T	P	C
							3	0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Computer Science and Engineering		Data Book / Codes/Standards	Nil	

Course Learning Rationale (CLR):	The purpose of learning this course is to:			Learning			Program Learning Outcomes (PLO)																	
CLR-1 :	Understand the principles of Communication systems engineering			1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15			
CLR-2 :	Gain knowledge on the basics of Communication system components			Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3			
CLR-3 :	Acquire knowledge on encoding, decoding techniques						H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLR-4 :	Understand the fundamentals of Fiber Optic Communication						H	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLR-5 :	Understand the basics of Satellite Communication						H	-	-	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLR-6 :							H	-	-	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:																							
CLO-1 :	Understand the basic ideas about Communication and its types			1	80	85																		
CLO-2 :	Acquire the knowledge on applications of Communication systems			2	75	80																		
CLO-3 :	Gain knowledge on information sources and source coding algorithms			2	85	80																		
CLO-4 :	Understand the concepts of coding for reliable Communication			2	80	75																		
CLO-5 :	Ability to apply/appreciate the skills learnt during the design and integration of the fibre optic mode of Communication in any system under development			2	75	85																		
CLO-6 :	Ability to apply/appreciate the skills learnt during the design and integration of the satellite mode of Communication in any system under development			2	80	85																		

Duration (hour)	9		6		9		9		9		
S-1	SLO-1	Significance of human Communication, Communication systems, transmitter	Introduction to information sources and source coding	Coding for reliable Communication	Fibre Optic Communication: Introduction Through Optical Fiber		Satellite Communication: Introduction				
	SLO-2	Communication channel, Receivers, Transceivers	Modeling of information sources	Tight bound on error probability of orthogonal signals	Electromagnetic Spectrum		Basic Satellite Transponder Kepler's Laws Kepler's First Law Kepler's Second Law Kepler's Third Law				
S-2	SLO-1	Attenuation, Noise	Measure of Information	The promise of coding	Types of Optical Fibres		Satellite Orbits: Low Earth Orbit Satellite Medium Earth Orbit Satellite				
	SLO-2	Types of electronic Communication, simplex	Joint and Conditional Entropy	Linear block codes	Propagation of Light		Satellite Orbital Patterns Inclined Orbits Equatorial Orbit, Polar Orbits				
S-3	SLO-1	Full duplex, half duplex	Source coding theorem	Theorem on Linear code	Single Mode Fibre		Geostationary Satellites				
	SLO-2	Analog signals, Digital signals	Source coding algorithms	Hamming Codes	Multimode Fibre		Geosynchronous Satellite—Advantages and Disadvantages				
S-4	SLO-1	Modulation and multiplexing, Baseband transmission	The Huffman source coding algorithm	Decoding and performance of linear block codes	Losses Within an Optical Fibre: Attenuation Loss		Power Systems				
	SLO-2	Broadband transmission	Huffman Encoding Algorithm	Soft decision decoding	Absorption Loss		Altitude Control: Spin Stabilized				



S-5	SLO-1	Multiplexing	Examples on Huffman Encoding Algorithm	Hard decision decoding	Radiation Loss	Spun/de-spun Stabilization Method
	SLO-2	Electromagnetic spectrum	The Lempel-Ziv source coding algorithm	Error detection and Error correction	Dispersion Loss	Three-axis Stabilized Method
S-6	SLO-1	Frequency and wavelength	Rate distortion theory	Burst error correcting codes	Rayleigh Scattering Loss	Altitude Control Components: Sensors, Actuators
	SLO-2	Optical spectrum	Mutual information	Cyclic codes, The structure of cyclic codes	Modal Dispersion Loss	Satellite System Parameters
S-7	SLO-1	Bandwidth	Differential Entropy	The generator matrix, Encoding of cyclic codes	Coupling Losses	Equivalent Noise
	SLO-2	Channel bandwidth	Rate distortion function	BCH Codes, Reed-Solomon Codes	Fibre Optic Transmission System: Fibre Optic Cable Light Sources	Temperature Carrier-to-Noise Density Ratio
S-8	SLO-1	Spectrum management	Examples on Rate distortion function	Convolutional Codes	Types of Fibre Optic Transmitters, Optical Detectors, Optical Repeater	Energy of Bit-to-Noise Density Ratio
	SLO-2	Standards	Digital audio transmission and digital audio recording	Basic properties of convolutional codes, Encoding, The transfer function	Optical Point-to-point Communication System:	Satellite System Link Models
S-9	SLO-1	Communication applications survey - Simplex	Digital audio in telephone transmission systems	Catastrophic codes	Single Channel System Amplified Single Channel System	Satellite System Link Equation 636 Uplink Power Budget Calculation
	SLO-2	Communication applications survey - Duplex	Digital audio recording	Optimum decoding of convolutional codes - The Viterbi algorithm	Wavelength Division Multiplexing (WDM) Systems	Satellite Radio Navigation

Learning Resources	1. Louis E. Frenzel, Principles of Electronic Communication Systems, 4 <sup>th</sup> Edition, Tata McGraw Hill Education, 2019. (Unit -I)	3. Communication Systems , V. Chandra Sekar, Oxford University Press, 2015(Unit - IV &Unit-V)
	2. John G. Proakis, Masoud Salehi , Communication Systems Engineering, 2 <sup>nd</sup> edition, Pearson Education International, 2015. (Unit - II & Unit -III)	

Learning Assessment											
Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)		
	CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#		Theory	Practice	
	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice			
Level 1	Remember	40 %	-	30 %	-	30 %	-	30 %	-	30%	-
Level 2	Understand	40 %	-	40 %	-	40 %	-	40 %	-	40%	-
Level 3	Apply	20 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Analyze										
	Evaluate										
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

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Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
Mr. Ramesh Somasundaram, Director & Head, IT Sourcing Management & Supplier Governance, Energica, Chennai	Dr.M.P Chitra, HOD/ECE, Panimalar Institute of Science and Technology	Dr.Annapurani.K, Dr.M.Prakash
Mr. Umakanthan Velayutham, Senior Partner & Head, Transform Advisory Services, Energica, Chennai	Dr.Dhalia Sweetlin, Asst.Prof(Sr.G), IT Dept, MIT, Chennai	Mrs.Kayalvizhi Jeyavel

Course Code	18CSE342T	Course Name	DIGITAL COMMUNICATION SYSTEMS	Course Category	E	Professional Elective	L	T	P	C
							3	0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Computer Science and Engineering		Data Book / Codes/Standards	Nil	

Course Learning Rationale (CLR):	The purpose of learning this course is to:			Learning			Program Learning Outcomes (PLO)																		
CLR-1 :	Understand the model of digital Communication system.			1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15				
CLR-2 :	Gain the knowledge about digital coding, signal compression and its application			Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3				
CLR-3 :	Gain knowledge on digital modulation , baseband and band-pass modulation						H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLR-4 :	To know the fundamentals of error control coding						H	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLR-5 :	To learn the importance of Multiplexing and Multiple Access						H	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:						H	-	-	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-1 :	Acquire the knowledge on digital Communication, signals and systems			2	85	80	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			
CLO-2 :	Acquire the knowledge on sampling, Quantization, encoding and Signal Compression			2	80	75	H	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-			
CLO-3 :	Understand the various digital modulation techniques			2	85	80	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			
CLO-4 :	To understand the error Detection and Correction codes			2	80	75	H	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-			
CLO-5 :	Understand the behavior of various multiplexing techniques			2	75	85	H	-	-	H	-	-	-	-	-	-	-	-	-	-	-	-			
CLO-6 :				2	80	85	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			

Duration (hour)	9		9		9		9		9	
S-1	SLO-1	Introduction Digital Communication System, advantages of Digital Communication	Introduction to digital coding	Introduction to Digital Modulation	Introduction-Types and Measure of Error- Shannon-Hartley Capacity Theorem	Introduction to Multiplexing-Types				
	SLO-2	Regeneration of Digital Signals, Power Efficiency of Digital Modulators	Digitizing Analog Signals	Baseband Modulation	Methods of Error Control-Classification of Error Correcting Codes	Frequency Division Multiplexing				
S-2	SLO-1	Bandwidth Compression, Multimedia: Unification of Signals	Sampling	Pulse Modulation Systems	Linear Block Codes-Hamming Distance, Weight, Error Detection, Correction	Time Division Multiplexing				
	SLO-2	Performance, Technology	Quantization	Baseband Signaling	Linear Block Codes-Generator Matrix, Systematic codes, Parity Check Matrix	Frame Synchronization				
S-3	SLO-1	Time and Frequency Representation	Encoding	Correlative Coding: Duo-Binary Coding	Standard Array - Implementing the decoder	Primary Multiplexing in Digital Telephony				
	SLO-2	Fourier Series, Fourier Transform	Signal Compression,	Modified Duo-Binary Coding	Cyclic Codes-Generator Polynomial for cyclic code	Higher Order Multiplexing				
S-4	SLO-1	Discrete-time Fourier Transform	Signal Statistics and Redundancy	Digital Phase Modulation(Phase Shift Keying): Bi-phase shift keying modulation	Systematic Cyclic code	Multiple Access-Frequency Division Multiple Access				
	SLO-2	Discrete Fourier Transform	Companded PCM	Differential coding in Bi-phase shift keying	Polynomial Multiplication and division	Time Division Multiple Access				
S-5	SLO-1	Convolution	Predictive Coding	Scrambling	Importance of Block Codes-Hamming Codes	Code Division Multiple Access				
	SLO-2	Correlation	Transform Coding	Bi-phase shift keying modulator, Quadrature	Problem solving session	Random Access				

				and Offset Quadrature phase shift keying		
S-6	SLO-1	Hilbert Transform	Parametric Coding	Digital Frequency Modulation(Frequency Shift Keying)	Golay-Reed Solomon Codes	Carrier Sense Multiple access/Collision Detection
	SLO-2	Problem solving session	Perceptual Coding	Minimum Shift Keying	Convolutional codes, Convolutional Encoder	Fixed Assignment Multiple Access
S-7	SLO-1	Low-pass and Band-pass Representations,	Application of Digital Coding-Digital	Minimum Shift Keying Modulator, Gaussian	Convolutional Decoding, Maximum	Demand Assignment Multiple Access
		Band-pass Signals and Systems	Speech	Minimum Shift Keying, Continuous Phase Modulation	like hood Decoding	
	SLO-2	Analytic Signals	Adaptive Delta Modulation Codec	Power Spectral Density of Baseband Signals	Viterbi algorithm	Introduction to Pseudo-Noise Sequence
S-8	SLO-1	Low-pass Equivalent Signals	Pulse Code modulation Codec	Power Spectral Density of Band-pass Signals	Sequential Decoding and Fano Algorithm	Properties of PN Sequences
	SLO-2	Problem solving session	Digital Audio: MP3 Coding	Problem solving session	Practical Applications of Error Correcting codes	Direct Sequence Spread Spectrum Transmitter and Receiver, Interface Rejection
S-9	SLO-1	Signal Space Representations: Vector Space	Digital Video: Run Length Coding, variable Length Coding	Comparison of Basic Modulations	Deep Space Communication	Frequency hopping Spread Spectrum, Frequency hopping Spread Spectrum Transmitter and receiver
	SLO-2	Problem solving session	MPEG1	Orthogonal Frequency Division Multiplexing	Satellite Communication	Spread Spectrum Applications

Learning Resources	1. R.N. Mutagi, Digital Communication – Theory, Techniques and Applications, 2 <sup>nd</sup> Edition, Oxford University Press, 2014.	3. JohnG.Proakis, MasoudSalehi, Digital Communications, 5 <sup>th</sup> Edition, McGrawHill Education, 2015
	2. John R. Barry, Edward A. Lee, David G. Messerschmitt, Digital Communication, 3 <sup>rd</sup> Edition, Springer International Edition, Springer, 2011	

Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#		Theory	Practice
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice		
Level 1	Remember	40 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Understand										
Level 2	Apply	40 %	-	40 %	-	40 %	-	40 %	-	40%	-
	Analyze										
Level 3	Evaluate	20 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

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Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
Mr. Ramesh Somasundaram, Director & Head, IT Sourcing Management & Supplier Governance, Energica, Chennai	Dr.M.P Chitra, HOD/ECE, Panimalar Institute of Science and Technology	Dr. Annapurani.K, Dr.M.Prakash
Mr. Umakanthan Velayutham, Senior Partner & Head, Transform Advisory Services, Energica, Chennai	Dr.Dhalia Sweetlin, Asst.Prof(Sr.G), IT Dept, MIT, Chennai	Mrs. M. Safa, Mrs. D. Anitha

Course Code	18CSE378T	Course Name	PRINCIPLES OF CLOUD COMPUTING	Course Category	E	Professional Elective			
						L	T	P	C
						3	0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Computer Science and Engineering		Data Book / Codes/Standards	Nil	

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning			Program Learning Outcomes (PLO)																	
CLR-1 :	Understand the fundamental ideas behind Cloud Computing, the evolution of the paradigm, its applicability; benefits, as well as current and future challenges	1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15			
CLR-2 :	Learn cloud enabling technologies and get exposure to advanced clouds	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3			
CLR-3 :	Explore cloud storage technologies and relevant distributed file systems, NoSQL databases and object storage;				H	H	H	H	H	-	-	-	L	L	-	H	-	-	-	-	-	-
CLR-4 :	Understand the cloud security threats and protective mechanism for cloud computing				M	H	L	M	H	M	-	-	M	L	-	H	-	-	-	-	-	-
CLR-5 :	Participate in team-based peer reviews to analyze the security development life cycle and mitigate risks and vulnerabilities				M	H	M	M	H	-	-	-	M	L	-	H	-	-	-	-	-	-
					M	H	L	H	M	-	-	-	M	L	-	H	-	-	-	-	-	-

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3
CLO-1 :	Explain terms used in secured software development and life cycle process	3	80	70	H	H	H	H	H	-	-	-	L	L	-	H	-	-	-
CLO-2 :	Apply fundamental concepts in cloud infrastructures to understand the cloud system, network and virtualization and outline their role in enabling the cloud computing system model.	3	85	75	M	H	L	M	H	M	-	-	M	L	-	H	-	-	-
CLO-3 :	Illustrate the fundamental concepts of cloud storage and demonstrate their use in storage systems such as Amazon S3 and HDFS	3	75	70	M	H	M	M	H	-	-	-	M	L	-	H	-	-	-
CLO-4 :	Evaluate the security issues related to cloud computing and handle the security threats and construct different cloud delivery design models.	3	85	80	M	H	L	H	M	-	-	-	M	L	-	H	-	-	-
CLO-5 :	Analyze various cloud programming models and apply them to solve problems on the cloud.	3	85	75	H	H	M	H	H	M	-	-	M	M	-	H	-	-	-

Duration (hour)	9		9		9		9		9	
S-1	SLO-1	Introduction to Cloud Computing Evolution of cloud computing	Cloud enabling technologies- Broadband networks and Internet architecture	Introduction to Cloud Data Storage, The evaluation of storage technology	Fundamental Cloud Security	Cloud Application Development and Architectural Styles				
	SLO-2				Basic Terms and Concepts					
S-2	SLO-1	Network-Centric Computing	Data Center Technology	Storage Models	Threat Agents, Cloud Security Threats	MapReduce Programming Model				
	SLO-2	Network-Centric Content								
S-3	SLO-1	Origin of Cloud Computing, Basic Concepts and Terminology	Web Technology	File Systems and databases	Cloud Security Mechanisms	Case Study: the GrepTheWeb Application				
	SLO-2		Multitenant Technology							
S-4	SLO-1	Goals and Benefits	Service Technology Virtualization	Distributed File Systems Google File System	Encryption Hashing	Hadoop: Yarn and Tez				
	SLO-2	Risks and Challenges, Roles and Boundaries, Cloud Characteristics	Technology							
S-5	SLO-1	Cloud Service Models	Virtual Machines	HDFS	Digital Signature, Public Key Infrastructure	SQL on Hadoop: Pig, Hive, and Impala				
	SLO-2	Cloud Deployment Models		NoSQL Databases						
S-6	SLO-1	Cloud Service Providers and the Cloud Ecosystem	Full Virtualization and Para-virtualization	Cloud Databases (HBase, MongoDB, Cassandra, DynamoDB)	Identity and Access Management, Single Sign-On: Kerberos authentication	Current Cloud Applications and New Opportunities				
	SLO-2									

S-7	SLO-1	Amazon Web Services(AWS), Google Clouds,	Hardware Support for Virtualization	Cloud Object Storage (Amazon S3, OpenStack Swift, Ceph)	One-time password, Basic cloud data security mechanisms	Design approaches with Case Study
	SLO-2	Microsoft Azure Cloud				
S-8	SLO-1	SLA Management in Cloud Computing: A Service	Kernel-Based Virtual Machine, Hypervisors	Data Storage for Online Transaction Processing Systems	Virtual Machine Security, Security of Virtualization, A Trusted Hypervisor	Design methodology for IaaS Service Model
	SLO-2	Providers Perspective				
S-9	SLO-1	Case Study on Open Source & Commercial	Containers; Docker Containers, Kubernetes	Disk Locality versus Data Locality in Computer Clouds	Mobile Devices and Cloud Security	Google API, AWS EC2 Instances.
	SLO-2	Clouds: Eucalyptus, OpenStack, Aneka				

Learning Resources	1. Dan C. Marinescu, "Cloud Computing Theory and Practice", Second Edition Copyright © 2018 Elsevier Inc. All <a href="https://www.sciencedirect.com/book/9780128128107/cloud-computing">https://www.sciencedirect.com/book/9780128128107/cloud-computing</a>	4. K. Chandrasekaran, "Essentials of Cloud Computing", Chapman and Hall/CRC Press, 2014, ISBN 9781482205435
	2. Rajkumar Buyya, James Broberg, Andrzej Goscinski, Cloud Computing Principles and Paradigms, Wiley Publications, 2017.	
	3. Thomas Erl, Zaigham Mahmood, and Richardo Puttini, "Cloud Computing: Concepts, Technology & Architecture", Prentice Hall/Pearson PTR, Fourth Printing, 2014, ISBN: 978013338752.	

Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#		Theory	Practice
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice		
Level 1	Remember	40%	-	30%	-	30%	-	30%	-	30%	-
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	Apply	40%	-	40%	-	40%	-	40%	-	40%	-
Level 3	Analyze	20%	-	30%	-	30%	-	30%	-	30%	-
	Evaluate	20%	-	30%	-	30%	-	30%	-	30%	-
	Create	20%	-	30%	-	30%	-	30%	-	30%	-
	Total	100 %		100 %		100 %		100 %		100%	

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Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
Suriyadeepan Ramamoorthy Research Engineer at Saama Technology Puducherry, Puducherry, India Information Technology and Services	Dr.E. Ilavarasan Professor, CSE Pondicherry Engineering college.	1. Mrs. Krishnaveni, SRMIST, KTR-SWE
		2. Dr. S. Ramamoorthy, SRMIST, KTR-CSE
		3. Mr. K. Venkatesh, SRMIST, KTR-IT
		4. Mr. S. Vidhya Sagar, SRMIST, Vadapalani campus

Course Code	18CSE377T	Course Name	DATA CENTRIC NETWORKS	Course Category	E	Professional Elective	L	T	P	C
							3	0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Computer Science and Engineering		Data Book / Codes/Standards	Nil	

Course Learning Rationale (CLR):	The purpose of learning this course is to:			Program Learning Outcomes (PLO)																				
CLR-1 :	Critically discuss data center networking technologies			1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15			
CLR-2 :	Evaluate key concepts in modern Layer 2 & Layer 3 data center networks			Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3			
CLR-3 :	Concepts related to networking technologies in modern data centers.						L	-	-	M	-	-	-	-	-	-	-	-	-	-	H	L	-	-
CLR-4 :	Design, build and configure complex routed and switched networks						M	M	H	H	H	-	-	-	-	-	-	-	-	-	H	M	H	-
CLR-5 :	Expose to implementing the networking solutions in a virtualized environment						M	H	H	H	H	-	-	-	-	-	-	-	-	-	H	H	H	-
							H	H	H	H	H	-	-	-	-	-	M	-	-	-	H	M	H	H
Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:																							
CLO-1 :	apply networking technologies in data centers			1	90	85																		
CLO-2 :	Design modern data centers which incorporate all dynamic routing protocols.			3	85	80																		
CLO-3 :	Design layer 2 and layer 3 protocols.			3	85	80																		
CLO-4 :	design and configure the data centers			3	80	75																		
CLO-5 :	implement various network solutions for data centers			3	80	75																		

Duration (hour)	9		9		9		9		9	
S-1	SLO-1	Data centric networking from different perspectives	Introduction to data center architectures	Introduction to server Architectures	Introduction to Layer 2 Networks	Introduction to Layer 3 Networks				
S-2	SLO-1 SLO-2	Content-Centric Networking (CCN)	Top of rack (TOR)network connectivity	Clustering in server architectures	IEEE 802.3ba standards	Layer 3 Data Center technologies				
S-3	SLO-1 SLO-2	Content Distribution Networks (CDN)	End of rack(EOR) network connectivity	scaling in server architectures	40 Gbps and 100 Gbps Ethernet	Locator/Identifier Separation Protocol (LISP)				
S 4-5	SLO-1 SLO-2	Requirements for modern data centers	Solutions that reduce cabling in architecture	Optimization in server architectures	IEEE 802.1D Spanning Tree Protocol (STP)	Layer 3 Multicasting				
S-6	SLO-1 SLO-2	Design for flexibility	Solutions that reduce power in architecture	Stand-alone blades	RSTP protocol	Protocols; IPv4, IPv6				
S-7	SLO-1 SLO-2	Design for scalability Design for environmental control	TIA/EIA-942. Structured cabling standards	Redundant Layer 2 and Layer 3 designs	PVST protocol MSTP protocol	Protocols; MPLS, OSPF				
S-8	SLO-1 SLO-2	Design for electrical power Design for Backup	Cable management Bandwidth requirements	Limitation of traditional server deployments	TRILL protocols IEEE 802.1Qbg Edge Virtual Bridging	Protocols; IS-IS, BGP				
S-9	SLO-1 SLO-2	Flooring in data centers	I/O connectivity	Case study	Fiber Channel over Ethernet (FCoE) vs Internet	OTV & VPLS layer 2 extension				

Learning Resources	1. Mouricio Arregoces, "Data Centre Fundamentals", Cisco Press, 2003	5. Nash Darukhanawalla, Patrice Bellagamba, "Interconnecting Data Centers Using VPLS" Cisco Press; 1 edition, [ISBN:9781587059926], 2009.
	2. Silvano Gai, Claudio DeSanti, "I/O Consolidation in the Data Center" Cisco Press; 1 edition [ISBN:9781587058882], 2009.	6. Robert W. Kembel, Roger Cummings (Introduction), "The Fibre Channel Consultant" Northwest Learning Assoc; 3rd edition, [ISBN:0931836840], 1998.
	3. Kevin Corbin, Ron Fuller, David Jansen, "NX-OS and Cisco Nexus Switching: Next-Generation Data Center Architectures" Cisco Press; 1 edition [ISBN:9781587058929], 2010.	7. Robert W. Kembel "Fiber Channel Switched Fabric" Northwest Learning Associates, inc. [ISBN:0931836719], 2009.
	4. Silvano Gai, Tommi Salli, Roger Andersson, "Cisco Unified Computing System" Cisco Press; 1 edition, [ISBN:9781587141935], 2010.	8. John L. Hufferd, "ISCSI", Addison-Wesley Boston [ISBN:978-0201784190], 2003

Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember Understand	40 %	-	30 %	-	30 %	-	30 %	-	30%	-
Level 2	Apply Analyze	40 %	-	40 %	-	40 %	-	40 %	-	40%	-
Level 3	Evaluate Create	20 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Total	100 %		100 %		100 %		100 %		100 %	

# CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
Dr.M.S.Sritharan/Wipro Technologies		Dr. B. Amutha, Professor and Head, Department of CSE, SRM IST Dr. G. Vadivu, Professor and Head, Department of IT, SRM IST

Course Code	18CSE343T	Course Name	WEB APPLICATION DEVELOPMENT	Course Category	E	Professional Elective	L	T	P	C
							3	0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Computer Science		Data Book / Codes/Standards	Nil	

Course Learning Rationale (CLR):	The purpose of learning this course is to:		
CLR-1 :	Generate web pages using HTML,CSS, AJAX, JQUERY		
CLR-2 :	Design and implement dynamic web page with validation using JavaScript objects and by applying different event handling mechanisms.		
CLR-3 :	Understand web site dynamic behavior and server side Programming		
CLR-4 :	Generate dynamic web pages using databases		
CLR-5 :	To understand the different web development frameworks		

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:			
CLO-1 :	Acquire the knowledge of HTML,CSS, AJAX, JQUERY	2	80	85
CLO-2 :	Design the dynamic web page with validation using JavaScript objects and by applying different event handling mechanisms	2	75	80
CLO-3 :	Acquire the knowledge of web site dynamic behavior and server side Programming	2	85	80
CLO-4 :	Develop the dynamic web pages using databases	2	80	75
CLO-5 :	Understand the web development frameworks	2	75	85

Learning	Program Learning Outcomes (PLO)														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Level of Thinking (Bloom)															
Expected Proficiency (%)															
Expected Attainment (%)															
Engineering Knowledge															
Problem Analysis															
Design & Development															
Analysis, Design, Research															
Modern Tool Usage															
Society & Culture															
Environment & Sustainability															
Ethics															
Individual & Team Work															
Communication															
Project Mgt. & Finance															
Life Long Learning															
PSO - 1															
PSO - 2															
PSO - 3															

Duration (hour)	11	9	9	7	9
S-1	SLO-1 SLO-2	Introduction: Rich Internet Applications	Introduction Angular JS	Overview of JSP2	Struts Architecture
S-2	SLO-1 SLO-2	Introduction to HTML HTML5 : Responsive web design	Expression	Overview of SERVLET	Struts classes , Action Forward Action Form
S-3	SLO-1 SLO-2	Introduction about CSS CSS types	Module ,Directive Databinding	Creating dynamic web pages using JSP	Struts Security Architecture
S-4	SLO-1 SLO-2	Introduction to JavaScript	Controllers,Scope-Filter	Standard-Tag Library Java Beans , Custom Tags	Understanding struts config.xml
S-5	SLO-1 SLO-2	Control structure	Introduction to Mongo, DB-Documents	Relational Database Introduction to MYSQL	Understanding Action Mappings, Struts flow with an example application
S-6	SLO-1 SLO-2	Objects	Collection-Database	JBDC-Driver	Struts Tiles Framework
S-7	SLO-1 SLO-2	Events	Datatypes	Understanding JDBC ODBC Connection Management	Struts Validation Framework
S-8	SLO-1 SLO-2	Basic AJAX, History of AJAX AJAX - using XMLHttpRequest object	Creating, Updating	ResultSet, Statements	Integrating Data Accessing data with MongoDB
S-9	SLO-1	XML- and DOM , creating a full scaled web design	Deleting documents-Querying	Prepared statement, Callable Statement.	Creating asynchronous method,



	SLO-2	AJAX- Enabled Application using JSON.					Using WebSocket to build an interactive web application
S10	SLO-1	JQuery basic					
	SLO-2	jQuery core, events, effects,					
S11	SLO-1	plugins- user interface using jQuery.					
	SLO-2						

Learning Resources	1. Deitel ,Deitel and Nieto, "Internet and World Wide Web – How to program",4th Edition, Pearson Education Publishers,2009	7. ThomasApowell,"ThecompletereferenceHTML&CSS",5 <sup>th</sup> Edition.
	2. EricFreeman,Elisabeth Robson,"HTML5Programming",firstedition,O'ReillyPublishers, 2011.	8. CraigWalls,"SpringinAction,4thEditionKindleEdition,ManningPublication,2015.
	3. RobinNixon,"LearningPHP,My SQL, JavaScript, CSS & HTML5 "ThirdEdition, O'REILLY, 2014.	9. JobineshPurushothaman,"RESTfulJavaWebServices"SecondEdition,Packt Publishing,2015
	4. Marty Hall, "Core Servlet &Java Sever Pages " SunMicrosystems,	10. <a href="https://www.w3schools.com/angular/angular_filters.asp">https://www.w3schools.com/angular/angular_filters.asp</a>
	5. JamesHolmes"Struts:The Complete Reference,"2ndEdition2007McGrawHillProfessional.	11. KristinaChodorow,MongoDB:TheDefinitiveGuide,2ndEdition,2013,OReilly.
	6. Patrick Naughton, "COMPLETE REFERENCE: JAVA2", 7th edition,Tata McGraw-Hill, 2010.	

Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#		Theory	Practice
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice		
Level 1	Remember	40 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Understand										
Level 2	Apply	40 %	-	40 %	-	40 %	-	40 %	-	40%	-
	Analyze										
Level 3	Evaluate	20 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

# CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Mr.M.Prakash Team Lead(Associate Consultant) ,Virtusa ,Chennai, prakashpm@virtusa.com	1. Dr.KHANNA NEHEMIAH , Professor, Ramanujan Computing, Anna University	1. Dr. M.UMA, Assistant Professor, SWE
		2. Dr.Madhavan, Associate Professor/CSE
		3.K.Navin AP/IT

Course Code	18CSE344T	Course Name	CLOUD ARCHITECTURE			Course Category	E	Professional Elective				L	T	P	C																										
Pre-requisite Courses	Nil		Co-requisite Courses	Nil		Progressive Courses	Nil																																		
Course Offering Department	Computer Science and Engineering			Data Book / Codes/Standards		Nil																																			
Course Learning Rationale (CLR):		The purpose of learning this course is to:				Learning			Program Learning Outcomes (PLO)																																
CLR-1 :	Observe the fundamentals of cloud architecture				1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15																			
CLR-2 :	Observe the Technologies used in cloud platforms				Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3																			
CLR-3 :	Understand the advanced cloud architecture and storage arrays																						H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
CLR-4 :	Understand the importance of cloud architecture design																						H	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLR-5 :	Gain knowledge in virtualization architecture																						H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLR-6 :	Gain knowledge in future trends and technologies in cloud structures																						H	-	-	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Course Learning Outcomes (CLO):		At the end of this course, learners will be able to:																					2	80	85	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-1 :	To understand the concept of basic cloud computing paradigms				2	80	85	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-																	
CLO-2 :	To interpret the concepts of Cloud service structures				2	75	80	H	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-																	
CLO-3 :	To Analyze the components of cloud computing showing how business agility in an organization can be created				2	85	80	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-																	
CLO-4 :	To be familiar with the market service providers in cloud.				2	80	75	H	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-																	
CLO-5 :	To understand the technologies of data center cloud structures.				2	75	85	H	-	-	H	-	-	-	-	-	-	-	-	-	-	-	-	-																	
CLO-6 :	To work with robust cloud architectural patterns				2	80	85	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-																	
Duration (hour)	9		9		9		9		9			9																													
S-1	SLO-1	Introduction to cloud computing fundamentals	Service Oriented Architecture	Introduction to cloud storage infrastructures	Management Of Cloud Services			Introduction to Cloud Architecture patterns																																	
	SLO-2	Cloud Computing definition	REST	Concept, planning and Design	Reliability, availability and security of services deployed from the cloud			Horizontally Scaling Compute Pattern- Cloud Significance																																	
S-2	SLO-1	Cloud deployment models	Systems of Systems	Business continuity	Performance and scalability of services			Queue-Centric Workflow Pattern																																	
	SLO-2	Private, Public, Hybrid, community cloud	Web Services	Basic concepts of information security	Tools and technologies used to manage cloud services deployment			Auto-Scaling Pattern																																	
S-3	SLO-1	Cloud services:	Publish-Subscribe Model	Managing VDC and cloud environments and infrastructures	Cloud Economics			Eventual Consistency Prime																																	
	SLO-2	IaaS, PaaS, SaaS	Basics of Virtualization	Securing storage in virtualized and cloud environments	Cloud Computing infrastructures available for implementing cloud based services			MapReduce Pattern																																	
S-4	SLO-1	Enabling technologies of cloud computing	Types of Virtualization	Monitoring and management	Economics of choosing a Cloud platform for an organization			Database Sharding Pattern																																	
	SLO-2	Benefits and challenges of cloud computing	Implementation Levels of Virtualization	Security auditing and SIEM	Runtime Support Services			Node Failure Pattern																																	
S-5	SLO-1	Business Agility:	Virtualization Structures	Storage Network Design	Resource Provisioning and Platform Deployment- Provisioning of Compute Resources (VMs)			Network Latency Primer																																	
	SLO-2	Benefits and challenges to Cloud architecture.	Tools and Mechanisms	Architecture of storage, analysis and planning.	Resource Provisioning Methods			CDN Pattern.																																	

S-6	SLO-1	Cloud Applications	Virtualization of CPU Memory	Storage network design considerations	NIST Cloud Computing Reference Architecture	Multisite Deployment Pattern
	SLO-2	Application availability	I/O Devices	NAS and FC SANs	Demand-Driven, Event-Driven Resource Provisioning	Network connectivity optimization evolution: Top of rack (TOR), end of rack (EOR), connectivity.
S-7	SLO-1	Performance	Virtualization Support and Disaster Recovery	Hybrid storage networking technologies	Popularity-Driven Resource Provisioning	Stand-alone, blades, stateless,
	SLO-2	Security and disaster recovery	Server Virtualization	iSCSI, FCIP, FCoE	Dynamic Resource Deployment	clustering
S-8	SLO-1	Next generation of Cloud Applications.	Parallel Processing	Design for storage virtualization in cloud computing	Storage-as-a-Service	scaling
	SLO-2	Virtualization	Vector Processing	host system design considerations	Advantages of Cloud Storage - Global Exchange of Cloud Resources	optimization, virtualization.
S-9	SLO-1	Types of virtualization in cloud computing	Symmetric Multiprocessing Systems	Cloud Applications	Application Development	Limitation of traditional server deployments
	SLO-2	Advantages and Disadvantages	Massively Parallel Processing Systems	Technologies and the processes required when deploying web services	Service creation environments to develop cloud based applications	Case studies

Learning Resources	1. Gautam Shroff, "Enterprise Cloud Computing Technology Architecture Applications", Cambridge University Press; 1 edition, [ISBN: 978-0521137355], 2010.	6. Klaus Schmidt, "High Availability and Disaster Recovery" Springer; edition [ISBN: 978-3540244608], 2006.
	2. Toby Velt, Anthony Velt, Robert Elsenpeter, "Cloud Computing, A Practical Approach" McGraw-Hill Osborne Media; 1 edition [ISBN: 0071626948], 2009	7. Kai Hwang, Geoffrey C. Fox, Jack G. Dongarra, "Distributed and Cloud Computing, From Parallel Processing to the Internet of Things", Morgan Kaufmann Publishers, 2012.
	3. Greg Schulz, "Cloud and Virtual Data Storage Networking", Auerbach Publications [ISBN: 978-1439851739], 2011	8. Rittinghouse, John W., and James F. Ransome, – Cloud Computing: Implementation, Management and Security, CRC Press, 2017.
	4. EMC, "Information Storage and Management" Wiley; 2 edition [ISBN: 978-0470294215], 2012.	9. Silvano Gai, Claudio De Santi, "I/O Consolidation in the Data Center" Cisco Press; 1 edition [ISBN: 9781587058882], 2009.
	5. Volker Herminghaus, Albrecht Scriba, "Storage Management in Data Centers" Springer; edition [ISBN: 978-3540850229], 2009.	10. 2. Bill Wilder, Cloud Architecture patterns, 2012

Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#		Theory	Practice
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice		
Level 1	Remember	40 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Understand										
Level 2	Apply	40 %	-	40 %	-	40 %	-	40 %	-	40%	-
	Analyze										
Level 3	Evaluate	20 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

# CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
Mr. Anil Nayer, JPA solutions	Dr. Kanagachidambaresan, Professor, PSG-Tech	Mr K. Venkatesh, SRMIST
		Dr Ramamoorthy, SRMIST
		Mr Vinoth, SRMIST

Course Code	18CSE441T	Course Name	CLOUD APPLICATION DEVELOPMENT	Course Category	E	Professional Elective	L	T	P	C
							3	0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Computer Science and Engineering		Data Book / Codes/Standards	Nil	

Course Learning Rationale (CLR):	The purpose of learning this course is to:			Program Learning Outcomes (PLO)																	
CLR-1 :	Utilize the different types of cloud services			1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CLR-2 :	Utilize the different storage services			Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3
CLR-3 :	Utilize different algorithms for cloud computing						L	H	-	H	L	-	-	-	L	L	-	H	-	-	-
CLR-4 :	Utilize virtualization techniques						M	H	L	M	L	-	-	-	M	L	-	H	-	-	-
CLR-5 :	Utilize real-time cloud services from different vendors						M	H	M	H	L	-	-	-	M	L	-	H	-	-	-
CLR-6 :	Utilize and understand cloud services with real-time cloud applications						M	H	M	H	L	-	-	-	M	L	-	H	-	-	-
CLR-6 :	Utilize and understand cloud services with real-time cloud applications						H	H	M	H	L	-	-	-	M	L	-	H	-	-	-
Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:			3	80	70	L	H	-	H	L	-	-	-	L	L	-	H	-	-	-
CLO-1 :	Understand different cloud architecture and models			3	85	75	M	H	L	M	L	-	-	-	M	L	-	H	-	-	-
CLO-2 :	Create the different types of cloud applications using different languages			3	75	70	M	H	M	H	L	-	-	-	M	L	-	H	-	-	-
CLO-3 :	Understand the concepts of virtualization			3	85	80	M	H	M	H	L	-	-	-	M	L	-	H	-	-	-
CLO-4 :	Create simple cloud applications and deploy			3	85	75	H	H	M	H	L	-	-	-	M	L	-	H	-	-	-
CLO-5 :	Understanding cloud application paradigms			3	80	70	L	H	-	H	L	-	-	-	L	L	-	H	-	-	-
CLO-6 :	Analyze different cloud technologies and its implementations			3	80	70	L	H	-	H	L	-	-	-	L	L	-	H	-	-	-

Duration (hour)	9		9		9		9		9	
S-1	SLO-1	Introduction to cloud computing	Cloud Computing: Applications	Server virtualization	Amazon Web Services: EC2 Instances	Case studies – IaaS, PaaS, SaaS				
	SLO-2	Cloud deployment models	Challenges for Cloud Computing	Hypervisor- based virtualization	Connecting Clients to Cloud Instances Through Firewalls	IaaS				
S-2	SLO-1	business drivers for Cloud Computing	Existing Cloud Applications and New Application Opportunities	Techniques for Hypervisor	Security Rules for Application Layer Protocols in EC2	Storage as a Service				
	SLO-2	cloud computing Delivery Models	Architectural Styles for Cloud Applications	Hardware support for Virtualization	Security Rules for Transport Layer Protocols in EC2	Storage as a Service – Amazon storage service S3				
S-3	SLO-1	cloud computing Services	Workflows: Coordination of Multiple Activities	VMware virtualization software	How to Launch an EC2 Linux Instance and Connect to it	Compute as a service				
	SLO-2	challenges of cloud computing	Coordination Based on a State Machine Model	XenServer Virtual Machine Monitor	How to Use S3 in Java	Compute as a service – Amazon EC2				
S-4	SLO-1	Cloud Infrastructure : cloud computing at Amazon	The Zookeeper	Storage Virtualization	How to Manage SQS Services in C#	PaaS				
	SLO-2	Cloud computing The Google perspective	Scalable data storage techniques	File virtualization	How to Install the Simple Notification Service on Ubuntu	Microsoft Azure				
S-5	SLO-1	Microsoft Windows Azure	The MapReduce Programming Model	Example	Example	Google App Engine				
S-6	SLO-1	Microsoft Windows Azure services	RIAs, simple Hello world example	Block Virtualization	How to Create an EC2 Placement Group	Apache hadoop				

	SLO-2	Open-Source Software Platforms for Private Clouds	Client-server example , RSS Feed Reader	Examples	How to Use MPI	Yahoo Mashups
S-7	SLO-1	Cloud Storage Diversity, Cloud Storage Vendor lock-in	Advanced platform functionality	Grid Computing	Hadoop Ecosystem	SaaS : CRM as a Service
	SLO-2	Cloud Computing Inter-operability	Clouds for Science and Engineering	Grid Technologies	How to Install Hadoop on Eclipse on a Windows System	Salesforce.com
S-8	SLO-1	The inter cloud , Responsibilities of User	High-Performance Computing on a Cloud , social Computing , Digital Content	comparing Grid and Cloud	Cloud-Based Simulation of a Distributed Trust Algorithm	Social Computing services : What Constitutes Social computing?, Case study - Facebook
	SLO-2					
S-9	SLO-1	Responsibilities of service provider	Cloud computing	Creating sample hello world application in OpenShift	A Cloud Service for Adaptive Data Streaming	Micro Blogger : Twitter
	SLO-2	Responsibility Sharing Between User and Cloud Service Provide	A Case Study: The GrepTheWeb Application	Example	Cloud-Based Optimal FPGA Synthesis	Document services

Learning Resources	<ol style="list-style-type: none"> <li>1. Dinkar Sitaram, Geetha Manjunath, Moving To The Cloud: Developing Apps in the New World of Cloud Computing, Syngress, 2013.</li> <li>2. Dan C. Marinescu, Cloud Computing: Theory and Practice., Morgan Kaufman, 2013</li> </ol>	<ol style="list-style-type: none"> <li>3. A Michael P. McGrath, Understanding PaaS: Unleash the Power of Cloud Computing, O'Reilly Media, 2012.</li> </ol>
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Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#		Theory	Practice
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice		
Level 1	Remember	40 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Understand										
Level 2	Apply	40 %	-	40 %	-	40 %	-	40 %	-	40%	-
	Analyze										
Level 3	Evaluate	20 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

# CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
Mr. Venkatesh Varalu, New York Times, USA	Dr. Balaraman Ravindran, Professor, IITM	Mr. Venkatesh, SRMIST Dr Pradeep Mohan Kumar, SRMIST Mrs Krishnaven, SRMIST

Course Code	18CSE442T	Course Name	CLOUD SECURITY	Course Category	E	Professional Elective	L	T	P	C
							3	0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Computer Science and Engineering		Data Book / Codes/Standards	Nil	

Course Learning Rationale (CLR):	The purpose of learning this course is to:			Learning			Program Learning Outcomes (PLO)																		
CLR-1 :	To understand the concept of cloud security			1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15				
CLR-2 :	The issues related to virtualized infrastructure security			Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3				
CLR-3 :	To have knowledge on the various issue in cloud security						L	H	L	H	L	M	H	L	L	L	L	L	L	H	H	H	H	H	H
CLR-4 :	To Learn the methods to improve virtualization security and technologies in security						H	H	L	M	L	M	H	L	M	L	M	L	H	H	L	L	L	L	L
CLR-5 :	Understand the cloud contracting Model and case study of commercial cloud						H	H	H	H	H	M	L	L	L	M	L	M	M	H	M	M	M	M	M
							H	H	H	H	H	L	L	L	M	L	M	L	M	H	L	L	L	H	H
Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:																								
CLO-1 :	Articulate the main concepts of cloud security			3	80	70	L	H	L	H	L	M	H	L	L	L	L	L	H	H	H	H			
CLO-2 :	Explain the architecture design of cloud storage.			3	85	75	H	H	L	M	L	M	H	L	M	L	H	H	L	L	L	L			
CLO-3 :	Explain the core issues of cloud management and security			3	75	70	H	H	H	H	H	M	L	L	M	L	M	H	M	M	M	M			
CLO-4 :	Be able to install and use current cloud Technologies.			3	85	80	H	H	H	H	H	L	L	L	M	L	M	H	L	L	L	H			
CLO-5 :	Apply secure design for cloud Models			3	85	75	H	H	H	H	L	M	L	L	M	L	M	H	L	M	L	L			

Duration (hour)	9		9		9		9		9	
S-1	SLO-1	Cloud Security Fundamentals- Infrastructure Security	Layered Cloud Architecture Design	Confidentiality, privacy, integrity, authentication,	IBM security virtual server protection	Authentication in cloud computing				
	SLO-2	Network level security								
S-2	SLO-1	Host level security	NIST cloud computing Reference Architecture	non-repudiation, availability,	virtualization-based sandboxing	Client access in cloud				
	SLO-2	Application level security								
S-3	SLO-1	Data security and Storage	Public ,Private and Hybrid Cloud IaaS,PaaS,SaaS	access control, defence in depth, least privilege,	Cloud Storage	Cloud contracting Model				
	SLO-2									
S-4	SLO-1	Data privacy and security Issues,	Architectural design Challenges	How these concepts apply in the cloud, what these concepts mean and their importance in PaaS, IaaS and SaaS.	Security- HIDPS	Commercial and business considerations				
	SLO-2									
S-5	SLO-1	Jurisdictional issues raised by Data location	Cloud Storage	Cryptographic Systems- Symmetric cryptography	log management	Case Study on Open Source & Commercial Clouds				
	SLO-2									
S-6	SLO-1	Identity & Access Management	Storage-as-a-service	stream ciphers, block ciphers, modes of operation	Data Loss Prevention	X.509 certificates, OpenSSL.				
	SLO-2									
S-7	SLO-1	Access Control	Advantages of Cloud storage	Public-key cryptography, hashing	Security Governance	Eucalyptus				
	SLO-2									
S-8	SLO-1	Trust, Reputation	Cloud storage Provider	digital signatures, public-key infrastructures	Cloud security Challenges	Microsoft Azure				
	SLO-2									
S-9	SLO-1	Risk	Storage Provider-S3	key management	Virtual Machine Security	Amazon EC2				
	SLO-2									

Learning Resources	<ol style="list-style-type: none"> <li>1. Tim Mather, SubraKumaraswamy, ShahedLatif, "Cloud Security and Privacy:An Enterprise Perspective on Risks and Compliance" O'Reilly Media; 1edition [ISBN: 0596802765], 2009.</li> <li>2. Rittinghouse, John W., and James F. Ransome, – Cloud Computing: Implementation, Management and Security, CRC Press, 2017.</li> <li>3. Kai Hwang, Geoffrey C Fox, Jack G Dongarra, "Distributed and Cloud Computing, From Parallel Processing to the Internet of Things", Morgan Kaufmann Publishers, 2012.</li> </ol>	<ol style="list-style-type: none"> <li>4. Ronald L. Krutz, Russell Dean Vines, "Cloud Security" [ISBN: 0470589876],2010.</li> <li>5. Toby Velte, Anthony Velte, Robert Eisenpeter, "Cloud Computing – A Practical Approach, Tata Mcgraw Hill, 2009.</li> <li>6. George Reese, "Cloud Application Architectures: Building Applications and Infrastructure in the Cloud: Transactional Systems for EC2 and Beyond (Theory in Practice), O'Reilly, 2009.</li> </ol>
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#### Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#		Theory	Practice
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice		
Level 1	Remember Understand	40%	-	30%	-	30%	-	30%	-	30%	-
Level 2	Apply Analyze	40%	-	40%	-	40%	-	40%	-	40%	-
Level 3	Evaluate Create	20%	-	30%	-	30%	-	30%	-	30%	-
	Total	100 %		100 %		100 %		100 %		100%	

# CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

#### Course Designers

Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
Mr.T.Madhan, Team Leader, Tata Consultancy Services, siruseri Campus, Chennai.	Dr. R.Shyamala, Associate Professor [HOD-IT], Anna University College of Engineering Tindivanam.	1. Dr.R.Naresh
		2. Dr.MB.Mukesh krishnan

Course Code	18CSE443T	Course Name	BIG DATA ESSENTIALS	Course Category	E	Professional Elective	L	T	P	C
							3	0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Computer Science and Engineering		Data Book / Codes/Standards	Nil	

Course Learning Rationale (CLR):	The purpose of learning this course is to:			Learning			Program Learning Outcomes (PLO)														
CLR-1 :	Quick and easy approach to learn the fundamental concept of big data analytics			1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CLR-2 :	Understand the concept of Hadoop and installation			Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3
CLR-3 :	Get to know the concept of key value pair programming																				
CLR-4 :	Learn about Map Reduce and its features																				
CLR-5 :	Understanding and solving of case studies																				
Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:																				
CLO-1 :	The main objective is to provide the students the knowledge of big data analytics			1	90	85	L	-	-	M	-	-	-	-	-	-	-	H	L	-	-
CLO-2 :	The students are trained to have knowledge about the architecture, installation and command execution of Hadoop			3	85	80	M	M	H	H	H	-	-	-	-	-	-	H	M	H	-
CLO-3 :	Able to develop a Map Reduce application			3	85	80	M	H	H	H	H	-	-	-	-	-	-	H	M	H	-
CLO-4 :	Identify knowledge of Map Reduce and develop real world map reduce application			3	80	75	M	H	H	H	H	-	-	-	-	-	-	H	H	H	-
CLO-5 :	Apply knowledge and solve various case study problems			3	80	75	H	H	H	H	H	H	-	M	-	-	-	H	M	H	H

Duration (hour)	9		9		9		9		9	
S-1	SLO-1	Data, Data storage and Analysis	Introduction of Big data programming Hadoop, History of Hadoop	Introduction of Map Reduce		Map Reduce Types		Case studies		
	SLO-2	Comparison with other systems- Distributed computing vs Big data Framework	The eco system and stack	Configuration API		Default Map Reduce map		Healthcare		
S-2	SLO-1	Basis of Distributed computing, Need for Big data framework	The Hadoop Distributed File System (HDFS)	Configuring the Development Environment, Writing a Unit Test, Running Locally on Test Data		Input Formats		Telecom		
	SLO-2			Running on a Cluster		Output formats		Privacy preserving Data analytics: Smart Homes		
S-3	SLO-1	Introduction to Big Data- Big data definition	Hadoop file system	Running on a Cluster		Output formats		Privacy preserving Data analytics: Smart Homes		
	SLO-2	enterprise / structured data, social / unstructured data, unstructured data needs for analytics	Java interfaces to HDFS	Running on a Cluster		Output formats		Privacy preserving Data analytics: Smart Homes		
S 4-5	SLO-1	What is Big Data, Big Deal about Big Data	Architecture overview	Tuning a Job ,Map Reduce Workflows How Map Reduce Works, The Map Reduce Anatomy of a Map Reduce Job run		Map reduce features- counters, built in counters, user defined java and streams counters		Data analytics in Intelligent transport system		
	SLO-2			Failures, Job Scheduling		Sorting		Detection and identification of		
S-6	SLO-1	Big Data Sources, Industries	Hadoop installation	Failures, Job Scheduling		Sorting		Detection and identification of		



	SLO-2	using Big Data, Big Data challenges.					influential spreaders in social media data streams
S-7	SLO-1	Big Data Technology	Hadoop commands execution	Shuffle and Sort	Joins		Predictive analytics in insurance
	SLO-2	Old vs. New Approaches	Hadoop commands execution	The Map Side	Programming Real-World Map Reduce		Predictive analytics in insurance
S-8	SLO-1	Data Discovery	Hadoop I/O	The Reduce Side, Configuration Tuning	Weather dataset		Pricing analytics in consumer products
	SLO-2	Open-Source Technology for Big Data Analytics	Data Integrity	Task Execution	data with Unix		Pricing analytics in consumer products
S-9	SLO-1	The Cloud and Big Data	Compression	Task Execution	data with Hadoop		Analytics in banking sector
	SLO-2						

Learning Resources	<ol style="list-style-type: none"> <li>1. Michael Minelli, Michele Chambers, Ambiga Dhiraj, "Big Data, Big Analytics - Emerging Business Intelligence and Analytic Trends for Today's Businesses", Wiley.</li> <li>2. Tom White, "Hadoop - The Definitive Guide", O'Reilly</li> </ol>	<ol style="list-style-type: none"> <li>3. Frank Ohlhorst, "Big Data Analytics - Turning Big Data into Big Money", Wiley</li> <li>Alan Anderson, David Semmelroth, "Statistics for Big Data for Dummies", John Wiley &amp; Sons</li> </ol>
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Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA - 1 (10%)		CLA - 2 (15%)		CLA - 3 (15%)		CLA - 4 (10%)#		Theory	Practice
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice		
Level 1	Remember Understand	40 %	-	30 %	-	30 %	-	30 %	-	30%	-
Level 2	Apply Analyze	40 %	-	40 %	-	40 %	-	40 %	-	40%	-
Level 3	Evaluate Create	20 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Total	100 %		100 %		100 %		100 %		100 %	

# CLA - 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
		Dr. B. Amutha, Professor and Head, Department of CSE, SRM IST
		Dr. G. Vadivu, Professor and Head, Department of IT, SRM IST

Course Code	18CSE444T	Course Name	CLOUD STRATEGY PLANNING AND MANAGEMENT	Course Category	E	Professional Elective	L	T	P	C
							3	0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Computer Science and Engineering		Data Book / Codes/Standards	Nil	

Course Learning Rationale (CLR):	The purpose of learning this course is to:			Program Learning Outcomes (PLO)																				
CLR-1 :	To learn the concepts and technological advances fueling the rapid adoption of cloud computing today.			1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15			
CLR-2 :	To provide the students with the skills and knowledge required to plan and manage a Cloud Computing strategy within an organization.			Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3			
CLR-3 :	To enable students to evaluate the strategic value of Cloud Computing using IT Governance and Compliance.						H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:			Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3	
CLO-1 :	Strategically assess how cloud computing enables IT Transformation and business value in an organization.			2	80	85	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-2 :	Analyze the role that cloud computing can play in the business process.			2	75	80	H	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-3 :	Evaluate how cloud computing and Service Oriented Architecture (SOA) can deliver business agility.			2	85	80	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-4 :	Implement IT governance to manage business realization from cloud IT services.			2	80	75	H	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-5 :	Critically appraise how the incorporation of cloud computing in an IT strategy can deliver on strategic business objectives.			2	75	85	H	-	-	H	-	-	-	-	-	-	-	-	-	-	-	-

Duration (hour)	9		9		9		9		9	
S-1	SLO-1	The four pillars of cloud computing	Moving to a cloud architecture and strategy to achieve business value.	Develop an IT strategy to deliver on strategic business objectives in the business strategy	Shared services delivered by a Service Oriented Architecture (SOA) in a Private or Public Cloud	Benefit Realization and it Governance				
	SLO-2	Cloud applications and Platforms								
S-2	SLO-1	Providing the cloud infrastructure	BPM, IS, Porter's Value chain model and BPR as a means of delivering business value	IT Project planning in the areas of ITaaS is essential in delivering a successful strategic IT Plan	Services, Databases and Applications on demand	Managing resources (people, process, technology), to realize benefit from Private/Public Cloud IT services				
	SLO-2	Cloud computing, Spectral efficiency, Sensors and perspiration								
S-3	SLO-1	Strategic inflection points in information Technology	Developing Business Strategy: Investigate business strategy models to gain competitive advantage for organizations	IT Project planning in the areas of SaaS is essential in delivering a successful strategic IT Plan	The effect on Enterprise Architecture and its traditional frameworks such as Zachman).	Gartner's 5 pillars of benefit realization				
	SLO-2	Cloud computing and its slogans								
S-4	SLO-1	User centered solution and cloud computing	Emphasize the roles of the strategic IS/IT leaders such as Chief Information Officer (CIO)	IT Project planning in the areas of IaaS is essential in delivering a successful strategic IT Plan	Customer Relationship Management	High Technology for private banking and Asset Management				
	SLO-2	For cloud vendors inflection point Is risk and opportunity								

S-5	SLO-1	Potential customers of cloud technology	The Chief Technology Officer (CTO) in planning and managing IT Strategic development in the organization.	Searching for an open architecture	Enterprise Resource Planning	Cloud Software for Private Banking
	SLO-2					
S-6	SLO-1	The cloud interests Small and Medium enterprises	Budgeting for cloud computing	Infrastructure as a Utility	Just-in-Time Inventories	Leadership Is based on Fundamentals
	SLO-2					
S-7	SLO-1	Virtual companies and the cloud	Service level agreements	Cloud System Architecture and its primitives	Machine-to-Machine and RFID Communications	Cloud Software For Asset Management
	SLO-2	Virtual networked objects				
S-8	SLO-1	Consumer technologies and the cloud	Outsourcing, Infrastructural inter dependencies, and the cloud	The User Organizations Business Architecture	Challenges Presented by Organization	Cloud Technology can Improve Fund Management
	SLO-2					
S-9	SLO-1	Social networks and multimedia messaging	Human resources at the CIO level	Financial Services Applications Architecture	Challenges Presented by Commercial vision	Criteria of Success in Asset Management Technology
	SLO-2		The transition from legacy to competitive system			

Learning Resources	1. Dimitris N. Chorafas: <i>Cloud Computing Strategies</i> , CRC Press, 2011.	3. David S. Linthicum, "Cloud Computing and SOA Convergence in Your Enterprise", Addison Wesley [ISBN: 0136009220], 2009.
	2. Arnold J Cummins, "Easiest Ever Guide to Strategic IT Planning" <a href="http://strategicitplanningguide.com/">http://strategicitplanningguide.com/</a> .	4. Charles Babcock, "Management Strategies for the Cloud Revolution", 1st Ed., Tata McGraw/Hill [ISBN: 0071740759], 2010.

#### Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#		Theory	Practice
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice		
Level 1	Remember	40 %	-	30 %	-	30 %	-	30 %	-	30%	-
Level 2	Apply	40 %	-	40 %	-	40 %	-	40 %	-	40%	-
	Analyze										
Level 3	Evaluate	20 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Create										
Total		100 %		100 %		100 %		100 %		100 %	

# CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
Mr.Saju G Nair, IBM,Bangalore,sajugnair@gmail.com	Dr.Khanna Nehemiah H, Professor, Ramanujan Computing Centre, Anna University	Mrs.J D Dorathi Jayaseeli,CSE,SRM IST

Course Code	18CSE375T	Course Name	DISTRIBUTED COMPUTING	Course Category	E	Professional Elective	L	T	P	C
							3	0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	CSE	Data Book / Codes/Standards	Nil		

Course Learning Rationale (CLR):		The purpose of learning this course is to:			Learning			Program Learning Outcomes (PLO)															
CLR-1 :	CLR-2 :	CLR-3 :	CLR-4 :	CLR-5 :	1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
					Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3	
CLR-1 :	Layout foundations of Distributed Systems.							H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLR-2 :	Get familiar with the idea of middleware and related issues							H	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLR-3 :	Understand in detail the system level and support required for distributed system							H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLR-4 :	Understand the issues involved in studying data and cryptographic algorithms							H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLR-5 :	Expose to the concept of design and implementation of distributed file systems							H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Course Learning Outcomes (CLO):		At the end of this course, learners will be able to:			2	80	85																
CLO-1 :	Fundamentals of Distributed System Concepts and access System				2	80	85																
CLO-2 :	An ability to familiar with various architecture models and Distributed File access techniques				2	75	80																
CLO-3 :	An ability to understand the security aspects of distributed system				2	85	80																

Duration (hour)	9	9	9	9	9
S-1	SLO-1 SLO-2	Introduction to Distributed Systems	Distributed Computing Model	Remote Procedure Call	Introduction of Security systems in distributed system
					Potential attacks and threats on computer systems
S-2	SLO-1 SLO-2	Characterization of Distributed Systems	Workstation model	Remote method invocation	Cryptography
		Examples of Distributed Systems	Workstation server model		Symmetric cryptosystem algorithm –DES
S-3	SLO-1 SLO-2	Architecture of Distributed Systems	Process pool model	Client server model basics concepts	Asymmetric cryptosystems
		Shared and Distributed Memory Architecture	Comparison of Distributed computing model	Client server addressing	File Models
S-4	SLO-1 SLO-2	Focus on resource sharing the web	Interprocess Communication	Client server implementations	Secure Channels-Authentication
					Message Integrity and confidentiality
S-5	SLO-1 SLO-2	Challenges in Distributed Systems	External data representation and multicast Communication	Client Server Architecture	Access control
					DFS Design
S-6	SLO-1 SLO-2	Design issues in Distributed systems	API for Internet protocol	Group Communication publish and subscribe systems	Security Management
					File catching in DFS
S-7	SLO-1 SLO-2	Networking and Internetworking basic introduction Types of Network	Network Virtualization and overlay networks	Shared memory approach	Issues in key distribution
				Distributed objects	Secure group management
					Implementation in DFS
					Authorization management

S-8	SLO-1	Network Principles	Case Study : interprocess Communication in UNIX	Case study : java RMI	Case study - Kerberos	Case study – Sun network File systems
	SLO-2					
S-9	SLO-1	Internet protocol	Case study - MPI	Case Study - CORBA	Case study - Epayment	Case study - Google File systems
	SLO-2					

Learning Resources	1. GeorgeCoulouris, JeanDollimore, TimKindberg, "DistributedSystemsConceptsandDesign" Fifth edition – 2011- AddisonWesley 2. SunitaMahajan, SeemaShah, "DistributedComputing" SecoundEdition–OxfordPress	3. Liu M.L., "Distributed Computing, Principles and Applications", Pearson and education, 2004. 4. Tanenbaum A.S., Van Steen M., "Distributed Systems: Principles and Paradigms", PearsonEducation, 2007.
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Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#		Theory	Practice
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice		
Level 1	Remember	40 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Understand										
Level 2	Apply	40 %	-	40 %	-	40 %	-	40 %	-	40%	-
	Analyze										
Level 3	Evaluate	20 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

# CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Mr. M.Ravichandran, CEO, Terafast	1.. Dr.K.Vivekanadan, Professor, PEC, k.vivekanadan@pec.edu	1. Dr. A.Murugan , SRMIST
2.		2. Dr. G.Maragatham, SRMIST 3. Ms. S. Aruna , SRMIST

Course Code	18CSE376T	Course Name	OPTICAL NETWORKS	Course Category	E	Professional Elective	L	T	P	C
							3	0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	CSE	Data Book / Codes/Standards			

Course Learning Rationale (CLR):	The purpose of learning this course is to:			Program Learning Outcomes (PLO)																				
CLR-1 :	Study the fundamentals of optical networks			1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15			
CLR-2 :	Gather knowledge about different types of components			Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3			
CLR-3 :	Learn single hop and multi hop networks						H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLR-4 :	Acquire knowledge about different WDM network design						H	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLR-5 :	Understand about OADM architecture						H	-	-	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLR-6 :	Gather knowledge about optical TDM and CDMA						H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:						2	80	85	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-1 :	Acquire knowledge about basic fundamentals of optical networks			2	75	80	H	H	-	-	-	-	-	-	-	-	-	-	-	-	-			
CLO-2 :	Understand various classifications of optical components			2	85	80	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-			
CLO-3 :	Develop the ability to apply optical concepts in single and multihop networks			2	80	75	H	H	-	-	-	-	-	-	-	-	-	-	-	-	-			
CLO-4 :	Gather knowledge about various multiplexing techniques			2	75	85	H	-	-	H	-	-	-	-	-	-	-	-	-	-	-			
CLO-5 :	Acquire knowledge about OADM concept			2	80	85	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-			
CLO-6 :	Apply various techniques to handle spectrum with a different perspective			2	80	85	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-			

Duration (hour)	9		9		9		9		9	
S-1	SLO-1	Introduction to optical networks	Components :Couplers – Principle of operation	Broadcast optical networks – characteristics of single hop networks	WDM Network Elements :Optical line terminals	Optical TDM Networks				
	SLO-2	TeleCommunication Network Architecture and services	Conservation of energy	Experimental WDM Systems	optical line amplifiers	Basics of TDM				
S-2	SLO-1	Optical Networks- Multiplexing Techniques	Isolators	Other Non – Pretransmission Coordination protocols	Optical Add/Drop Multiplexers	Optical TDM				
	SLO-2	Second Generation Optical Networks	Circulators	Pretransmission coordination protocols	OADM Architecture	Optical Sources				
S-3	SLO-1	Optical Layer	Multiplexers – Gratings, Diffraction Patterns	Special Case: Linear Bus with Attempt- and-Defer Nodes	Optical crossconnects	Modulation				
	SLO-2	Optical packet switching	Bragg and Fiber Gratings	AMTRAC and multichannel probabilistic scheduling	OXC Configurations	multiplexing				
S-4	SLO-1	Transmission Basics – wavelengths, Frequencies, and channel spacing	Filters – fabryperot filters	Single- Hop Case study : IBM Rainbow Protocol	WDM Network Design: Cost trade-offs	Transmission of Ultrafast OTDM signal using soliton				
	SLO-2	Standards, optical power and loss	Mach-Zehnder Interferometers, Arrayed Waveguide gratings	Model, Analysis	LTD and RWA problems	Demultiplexing				
S-5	SLO-1	WDM Networking Evolutions	Optical Amplifiers – Emissions	Multihop Networks: characteristics, topological optimization studies	Light path topology design	Clock Recovery				
	SLO-2	WDM Network Constructions	Erbium -Doped fiber amplifiers, Raman Amplifiers and Semiconductor optical amplifiers	Regular structures	Routing and wavelength assignment and conversion	Optical processing				

S-6	SLO-1	Optical Fiber- Transmission	Transmitters – Lasers, Light emitting diodes, tunable lasers	Near- Optimal Node Placement	Dimensioning Wavelength	Optical TDM network Architectures
	SLO-2	Single mode vs Multimode fiber	Direct and external modulation, pump sources	Shared- channel multihop systems	Routing Networks	Optical TDM proposals
S-7	SLO-1	Attenuation in Fiber	Detectors – photo detectors	Multihop case study – GEMNET	Statistical Dimensioning Models : First passage model	Optical CDMA Networks:
	SLO-2	Dispersion in Fiber	Front end amplifiers	GEMNET Architecture and properties	Blocking model	Basics of CDMA
S-8	SLO-1	Non Linear Effects – self phase modulation	Switches – large optical switches, optical switch technologies	Channel sharing	Maximum load dimensioning model : offline lightpath requests	Spread spectrum
	SLO-2	Cross phase modulation	Large electronic switches	Multicasting	Online RWA in rings	Code sequences
S-9	SLO-1	Solitons	Wavelength converters – optoelectronic Approach, optical gating	Shared – channel Multihop GEMNET	Access Networks : Network Architecture overview	CDMA Example
	SLO-2	Dispersion- Managed Solitons	Interferometric techniques, wave mixing	Performance Evaluation	Enhanced HFC	Optical CDMA

Learning Resources	1. Rajiv Ramaswami, Kumar N. Sivarajan, Galen H. Sasaki, Optical Networks A Practical Perspective, third Edition	3. U.Black, "Optical Networks: Third Generation Transport Systems"/Pearson Education
	2. Optical Switching Networks: Mayer & Martin, Cambridge University Press, 2008.	4. R. Ramaswami, & K.N. Sivarajan, "Optical Networks: A Practical Perspective", Morgan Kaufmann Publishers, 3rd Ed.

#### Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#		Theory	Practice
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice		
Level 1	Remember	40 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Understand										
Level 2	Apply	40 %	-	40 %	-	40 %	-	40 %	-	40%	-
	Analyze										
Level 3	Evaluate	20 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

# CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

#### Course Designers

Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Mr. Madhumaran, NOKIA digital and Networking, Technical Lead, p.madhumaran@nokia.com	1. Prof. Nilanjan Dey, Techno India College of Technology, Kolkata, nilanjan.dey@tict.edu.in	1. Prof. V.Sivakumar, SRMIST
2. Mr. N.Ramkumar, TCS Assistant Consultant, ram.kumarn@tcs.com	2. Prof. E.Rajesh, Galgotias University, Delhi, rajesh.e@galgotiasuniversity.edu.in	2. Prof. P.Visalakshi, SRMIST

Course Code	18CSE379T	Course Name	INTERNET OF THINGS			Course Category	E	Professional Elective				L	T	P	C																										
Pre-requisite Courses	Nil		Co-requisite Courses	Nil		Progressive Courses	Nil																																		
Course Offering Department	CSE			Data Book / Codes/Standards	Nil																																				
Course Learning Rationale (CLR):	The purpose of learning this course is to:				Learning			Program Learning Outcomes (PLO)																																	
CLR-1 :	Understand the basic concepts of IoT and its possible application areas				1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15																			
CLR-2 :	Understand the various IoT architectures along with compute and management stack across layers				Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3																			
CLR-3 :	Understand the architecture dissected at physical, Communication and Access levels																						H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
CLR-4 :	Introduce existing toolkits, available platforms, boards, software and languages for easy development of IoT products																						H	M	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
CLR-5 :	Understand the various enabling technologies for IoT including Big data analytics, Machine learning, Cloud and Streaming analytics																						H	H	H	M	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLR-6 :	Understand the underlying business model for IoT and also acquire skills for DIY (Do it Yourself)																						H	M	H	M	H	-	-	-	M	-	-	H	-	-	H	-	-	-	-
CLR-6 :	Understand the underlying business model for IoT and also acquire skills for DIY (Do it Yourself)																						H	M	H	H	H	-	-	-	H	-	-	H	-	-	H	-	-	-	-
Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:																																								
CLO-1 :	Appreciate the omnipotent presence of IoT in all fields across globe				2	80	85	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-																		
CLO-2 :	Compare and contrast various architectures and be able to justify the right choice for adoption				2	75	80	H	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-																		
CLO-3 :	Choose appropriate protocols for various levels/layers based on the requirement in hand				2	85	80	H	M	-	-	-	-	-	-	-	-	-	-	-	-	-	-																		
CLO-4 :	Implement using the available resources and demonstrate quick to deployment skills wherever applicable				2	80	75	H	H	H	M	-	-	-	-	-	-	-	-	-	-	-	-																		
CLO-5 :	Apply the tools and techniques towards integration in relevant areas of IoT product development				2	75	85	H	M	H	M	H	-	-	-	M	-	-	H	-	-	-	-																		
CLO-6 :	Showcase DIY approach given any implementable idea to product				2	80	85	H	M	H	H	H	-	-	-	H	-	-	H	-	-	-	-																		
Duration (hour)	9		9		9			9				9																													
S-1	SLO-1	Introduction to IOT	Drivers Behind New Network Architectures	Smart Objects: The "Things" in IoT	Data Analytics for IoT- Overview	Business Models for IoT: Introduction																																			
	SLO-2	What, Where and How of IoT?	Comparing IoT Architectures	Sensors, Actuators, and Smart Objects	IoT Data Analytics Challenges	Business Models																																			
S-2	SLO-1	Data Flow of IoT	The IoT World Forum (IoTWF) Standardized Architecture	Micro-Electro-Mechanical Systems (MEMS)	Relevance of ML and IoT- Overview	Business Model Innovation																																			
	SLO-2	Definition and characteristics of IOT	IT and OT Responsibilities in the IoT Reference Model	Smart Objects, Smart Objects: A Definition	Relevance of Big data and IoT- Overview	Value Creation in IoT																																			
S-3	SLO-1	Architecture of Internet of Things: Physical- Things	A simplified IoT architecture	Trends in Smart Objects	ML and getting Intelligence from Big Data	Laws of Information																																			
	SLO-2	Architecture of Internet of Things: Protocols-an Introduction	The core IoT functional stack	Sensor Networks	Big data analytics tools and techniques for IoT: Overview	Revenue Generation in the Internet of Things																																			
S-4	SLO-1	Architecture of Internet of Things: Logical- Functional Blocks	Layer 1: Things: Sensors Layer	Wireless Sensor Networks (WSNs)	MPP, NoSQL	Exemplary Business Model Scenarios for the Internet of Things																																			
	SLO-2	Architecture of Internet of Things: Logical- Communication Models	Layer 1: Things: Actuators Layer	Communication Protocols for Wireless Sensor Networks- a Introduction	Hadoop and YARN	Scenario 1: Product as a Service (PaaS)																																			
S-5	SLO-1	Architecture of Internet of Things: Logical- Communication API	Layer 2: Communications Network Layer: Access, Gateway	Communication Criteria- Introduction	Hadoop Eco system	Scenario 2: Information Service Providers																																			
	SLO-2	IOT enabling technologies	Layer 2: Communications Network Layer: Network, Management	Communication Criteria- Definitions	Apache Kafk, Spark, Storm, Flink,	Scenario 3: End-user Involvement																																			



S-6	SLO-1	Introduction to IoT Levels and Deployments	Layer 3: Applications and Analytics Layer:	IoT Access Technologies-Introduction	Lamba Architecture	Scenario 4: Right-time Business Analysis and Decision making
	SLO-2	IoT Deployment Levels: 1 to 6	Analytics Versus Control Applications,	IoT Access Technologies-Definitions	Edge Streaming Analytics for IoT	DIY- Smart Experience (DIYSE) Projects- a introduction
S-7	SLO-1	IoT Security and Privacy	Data Versus Network Analytics	IoT Application transport methods- Definitions	Edge Analytics core functions	Requirements for Enabling DiY in Eco- awareness Applications
	SLO-2	IoT Data Analytics, Protocols	Data Analytics Versus Business Benefits	The Toolkit Approach for End-user Participation in the Internet of Things:	Distributed analytics systems	Technologies and Standards Relevant for DiY Eco-awareness
S-8	SLO-1	IoT Environmental challenges: excess waste disposal	Smart Services	Existing Toolkits	Network Analytics	Sensor-actuator Technologies and Middleware as a Basis for a DiY Service Creation Framework
	SLO-2	Legal Challenges for a Privacy Framework- an IoT perspective	IoT Data Management And Compute Stack: The Hierarchy Of Edge, Fog, And Cloud	I/O Boards	IoT physical servers and cloud offerings (Cloud computing for IoT)	Device Integration, Middleware Technologies
S-9	SLO-1	Privacy Enhancing Technologies for IoT	Fog Computing	HW Based Systems, Introduction to Open source boards (Arduino, Raspberry Pi and other variants)	Relevance of Cloud connectivity and IoT- Overview	Semantic Interoperability- a requirement for IoT DiY
	SLO-2	Case Studies: Domain specific IOT Applications	Edge Computing	SW Based Solutions	Logical design using Python, Useful IoT libraries	DIY Smart Experiences Service Framework-an Introduction

Learning Resources	1. ArshdeepBahga, Vijay Madiseti, "Internet of Things, A Hands-on Approach", 1st Edition 2015, University Press, ISBN: 978-81-7371-954-7	4. IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things by Rob Barton, Gonzalo Salgueiro, David Hanes, Publisher: Cisco Press, Release Date: June 2017, ISBN: 9780134307091 ( <a href="https://www.oreilly.com/library/view/iot-fundamentals-networking/9780134307091/">https://www.oreilly.com/library/view/iot-fundamentals-networking/9780134307091/</a> )
	2. InternetofThings:LegalPerspectivesbyRolfH.Weber,RomanaWeber,Springer,2010 3. Uckelmann, D., Harrison, M., & Michahelles, F. (Eds.). Architecting the Internet of Things.doi:10.1007/978-3-642-19157-2,2011	

Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#		Theory	Practice
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice		
Level 1	Remember	40 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Understand										
Level 2	Apply	40 %	-	40 %	-	40 %	-	40 %	-	40%	-
	Analyze										
Level 3	Evaluate	20 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

# CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
Dr. Paventhan Arumugum, Director (R&D), ERNET India	Dr. S. Srinivasan, Professor and Head, Dept. of Computer Science & Engineering, Anna University, Madurai	Dr.Kayalvizhi Jayavel, SRMIST
Mr. Vinay Solanki, Head IoT, Lenovo (APAC & MEA)	Dr. R. Krishnamoorthy, Professor, Department of CSE and IT, BIT Campus, Anna University, Trichy	Dr. Sreekumar, SRMIST
Mr.Hariharan Ramalingam, Vertical Delivery Head, Wipro ltd	Dr.S.Chithra Selvaraj, Associate Professor, Department of IT, SSN College of Engineering	Mr.V.Haribaabu, SRMIST

Course Code	18CSE380T	Course Name	PERVASIVE COMPUTING	Course Category	E	Professional Elective	L	T	P	C
							3	0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Computer Science and Engineering		Data Book / Codes/Standards	Nil	

Course Learning Rationale (CLR):	The purpose of learning this course is to:			Learning			Program Learning Outcomes (PLO)																	
CLR-1 :	Understanding the basics of pervasive computing and its application			1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15			
CLR-2 :	Gain knowledge on the voice enabling			Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3			
CLR-3 :	Understand the fundamental elements of pervasive computing.						H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLR-4 :	Learn the design process of Pervasive Computing Environments and its solutions						H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLR-5 :	Familiarize with device connectivity & web applications concepts						H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLR-6 :	Introduce the concepts of wearale computing and security in pervasive computing						H	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:						2	80	85	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-1 :	Understand the fundamental elements of pervasive computing.			2	75	80	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-			
CLO-2 :	Learn the design process of Pervasive Computing Environments and its solutions			2	80	85	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-			
CLO-3 :	Familiarize hardware, software and the aspects involved in pervasive computing			2	80	75	H	H	-	-	-	-	-	-	-	-	-	-	-	-	-			
CLO-4 :	Apply the knowledge for implementing security			2	75	85	H	-	-	H	-	-	-	-	-	-	-	-	-	-	-			
CLO-5 :	Organize the functionalities and components of PDA in pervasive computing.			2	75	80	H	-	-	M	-	-	-	-	-	-	-	-	-	-	-			
CLO-6 :	Describe the user interface issues in pervasive computing.																							

Duration (hour)	9		9		9		9		9	
S-1	SLO-1	- INTRODUCTION	Device connectivity	WAP & VOICE TECHNOLOGY, WAP and Beyond: Introduction	Wearable Computing and Sensor Systems for Healthcare - Introduction	Security and Privacy in Pervasive Networks - Introduction				
	SLO-2	Pervasive Computing: Past, Present and Future Pervasive computing	Protocols: wireless	Components of the WAP	The Health Body Area Network	Security Classics - Perimeter Security - Access Control				
S-2	SLO-1	Pervasive Computing Market,	mobile phone technologies	architecture	Medical and Technological Requirements of Health Sensors	Hardening Pervasive Networks - Pervasive Computational Paradigms				
	SLO-2	m-Business	mobile phone technologies	WAP infrastructure,	Wearable Sensors for Vital Signals Monitoring	Pervasive Hardware				
S-3	SLO-1	Application examples: Retail,	mobile internet protocol	WAP security issues	Wearable Sensors for Activity Recognition	Pervasive Networking and Middleware				
	SLO-2	Application examples: Airline check-in and booking,	mobile internet protocol	Wireless Markup Language	Sensors and Signals for Emotion Recognition	Pervasive Applications				
S-4	SLO-1	Healthcare	Synchronization and replication protocol	WAP push	ntra-BAN Communications in Pervasive Healthcare Systems: Standards and Protocols - IEEE 802.15.4 and ZigBee	Pervasive Distributed Application				
	SLO-2	Tracking, Car information system,	Synchronization and replication protocol	Products	Bluetooth	Logic Based Level Security				
S-5	SLO-1	Sales Force Automation		i-Mode	Bluetooth Low Energy	Deterministic Access Models				
	SLO-2	Email access via WAP and voice	distributed services	VoiceTechnology: Basics of Speech recognition,	Integrated and Additional Solutions for Health BAN Communications	Predictive Statistical Schemes				

S-6	SLO-1	A Pervasive System for Volcano Monitoring	distributed message	VoiceTechnology: Basics of Speech recognition,	Introduction - Pervasiveness and Mobility in Computing and Communications	Privacy in Pervasive Networks - Problem Definition
	SLO-2	A Pervasive Computing Platform for Individualized Higher Education	transaction protocols	Voice Standards	Context Awareness	Challenges to Privacy Protection
S-7	SLO-1	Device Technology	Security	Voice Standards	Heterogeneity	Location Dependency
	SLO-2	Hardware,	Device Management		Wireless Technologies and Standards	Data Collection
S-8	SLO-1	Human machine interface	Web Application Concepts: WWW Architecture	Speech Applications,	Middleware	Internet Service Provider (ISP) Role
	SLO-2	Bio metrics,	Protocols	Speech Applications,	Future Trends: Beyond the Middleware	Data Ownership Private Systems
S-9	SLO-1	Operating systems	Transcoding	Speech and Pervasive Computing	Pervasive Computing in Extreme Areas; The Hiker's Personal Digital Assistant	Quality of Privacy (QoP)
	SLO-2	Java for pervasive devices	Client Authentication via Internet	Speech and Pervasive Computing	Pervasive Computing in Personal Health Systems; The MyHealthService Approach	Open Issues in Privacy of Systems 'Sharing' in Personal Networks

Learning Resources	1. JochenBurkhardt, Horst Henn, Stefan Hepper, Thomas Schaech & Klaus Rindtorff, "Pervasive Computing, Technology and Architecture of Mobile Internet Applications", Pearson Education,2012.ISBN-13: 978-0201722154	3. S. Poslad, "Ubiquitous Computing: Smart Devices, Environments and Interactions," Wiley, 2009 4. Frank Adelstein, Sandeep KS Gupta, Golden Richard III, Loren Schwiebert, "Fundamentals of Mobile and Pervasive Computing", McGraw Hill edition, 2006. ISBN-13: 978-0071412377
	2. UweHansmann, L. Merk, M. Nicklous, T. Stober, U. Hansmann, "PervasiveComputing (Springer Professional Computing) ", 2003, Springer Verlag,ISBN:3540002189	

#### Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#		Theory	Practice
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice		
Level 1	Remember Understand	40 %	-	30 %	-	30 %	-	30 %	-	30%	-
Level 2	Apply Analyze	40 %	-	40 %	-	40 %	-	40 %	-	40%	-
Level 3	Evaluate Create	20 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Total	100 %		100 %		100 %		100 %		100 %	

# CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
Suganya Anbumani Director of Engineering, Wealth Management, Redi2 Technologies Greater Boston Area	1. Dr. J. Prakash, MIT, Chennai, prakaiit@rediffmail.com	1.Dr.V.Kavitha, SRMIST
Saranya A T Associate at Cognizant Chennai	2. 2.Dr. Latha Karthigaa, PhD , Innovation Research Assistant, The University of Auckland	2. Mr. Haribaabu V, SRMIST

Course Code	18CSE381T	Course Name	CRYPTOGRAPHY	Course Category	E	Professional Elective	L	T	P	C
							3	0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Computer Science and Engineering		Data Book / Codes/Standards	Nil	

Course Learning Rationale (CLR):		Learning			Program Learning Outcomes (PLO)															
CLR-1 :		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
The purpose of learning this course is to:		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3	
Understand OSI security architecture and classical encryption techniques.																				
Acquire fundamental knowledge on the concepts of finite fields and number theory																				
Understand various block cipher and stream cipher models																				
Describe the principles of public key cryptosystems, hash functions and digital signature.																				
Gain a first-hand experience on encryption algorithms, encryption modes.																				
Course Learning Outcomes (CLO):		At the end of this course, learners will be able to:																		
CLO-1 :		2	80	85	H								H							
CLO-2 :		2	75	80	H															
CLO-3 :		2	85	80	H															
CLO-4 :		2	80	75	H						H									

Duration (hour)	9		9		9		9		9	
S-1	SLO-1	Introduction to Cryptography and Network Security	Groups, Rings, Fields	Block cipher principles-Introduction	Principles of Public-key Cryptosystems - Structure and key management	Message Authentication Codes				
S-2	SLO-1	OSI Security Architecture	Modular arithmetic	Data Encryption Standard	Principles of Public-key Cryptosystems – Applications for Public-key Cryptosystems	Requirements for Message Authentication Codes				
S-3	SLO-1	Introduction to Security attacks	Euclid's Algorithm	DES Example, Strength of DES	Requirements for Public-key Cryptosystems and Public – Key Cryptanalysis	Applications of Cryptographic Functions - Message Authentication Two Simple Hash Function				
S-4	SLO-1	Security mechanisms	Polynomial Arithmetic	Block cipher Modes of operation – Multiple Encryption	RSA algorithm - Key management	Security Requirements for Cryptographic hash Functions				
S-5	SLO-1	Symmetric cipher model	Finite Fields	Block cipher Modes of operation – Triple DES	RSA algorithm - Encryption and Decryption	Hash Algorithms - MD5				
S-6	SLO-1	Substitution techniques: Caesar cipher	Prime Numbers, Testing for Primality	Electronic Code Book, Cipher Block Chaining Mode	Diffie Hellman key exchange – Algorithm, Key Exchange Protocols	Hash Algorithms - SHA				
	SLO-2	Play fair Cipher		Cipher Feedback Mode, Output Feedback Mode and Counter Mode	Diffie Hellman key exchange – Man-in-the-Middle Attack					
S-7	SLO-1	Mono alphabetic cipher	Fermat's and Euler's Theorem	Advanced Encryption Standard – Structure and Transformation Functions	Elliptic curve: Arithmetic – Abelian Groups, Elliptic Curves over Real Numbers	Digital Signature Standard				
	SLO-2	Poly alphabetic ciphers , Onetime pad		AES Key Expansion and AES Example						
S-8	SLO-1	Hill Cipher -Encryption	The Chinese remainder theorem	Blowfish	Elliptic Curves over $Z_p$ , Elliptic Curves over	Applications pertaining to Encryption				

	SLO-2	Decryption			GF(2 <sup>m</sup> )	using different ciphers and modes
S-9	SLO-1 SLO-2	Transposition techniques, Steganography	Discrete Logarithms	RC5 algorithm	Elliptic Curve Cryptography	One-way hash algorithms.

Learning Resources	1. William Stallings, "Cryptography and Network Security", 6 <sup>th</sup> Edition, 2014, Pearson Education, ISBN: 9789332518773. 2. Atul Kahate, "Cryptography and Network Security", 2 <sup>nd</sup> Edition, 2009, McGraw Hill Education India Pvt Ltd, ISBN: 100070151458.	3. Web Tutorial: <a href="http://www.cis.syr.edu/~wedu/seed/cryptography.html">http://www.cis.syr.edu/~wedu/seed/cryptography.html</a> as on 14/04/2016
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Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#		Theory	Practice
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice		
Level 1	Remember Understand	40 %	-	30 %	-	30 %	-	30 %	-	30%	-
Level 2	Apply Analyze	40 %	-	40 %	-	40 %	-	40 %	-	40%	-
Level 3	Evaluate Create	20 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Total	100 %		100 %		100 %		100 %		100 %	

# CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Mohanraj N - PayPal	1. Dr. E. Sivasankar – Assistant Professor – NIT, Trichy	1. Dr. E. Sasikala, SRMIST
		2. Ms. S. Aruna, SRMIST
		3. Ms. G. Sujatha, SRMIST

Course Code	18CSE382T	Course Name	FORENSICS AND INCIDENT RESPONSE	Course Category	E	Professional Elective	L	T	P	C
							3	0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Computer Science and Engineering		Data Book / Codes/Standards	Nil	

Course Learning Rationale (CLR):		The purpose of learning this course is to:			Learning			Program Learning Outcomes (PLO)															
CLR-1 :	Gain knowledge on the basics of procedures for identification, preservation of electronic evidence	1	2	3	1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
CLR-2 :	Understand the purpose and usage of various forensic tools	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3				
CLR-3 :	Gain knowledge on how scientific evidence collection/extraction during investigation	H	80	85	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLR-4 :	Acquire knowledge on file systems and its innerworking	H	75	80	H	H	-	-	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLR-5 :	Understand the windows and linux investigation procedures	H	85	80	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLR-6 :	Introduce the report writing guidelines and principles	H	80	85	H	-	-	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Course Learning Outcomes (CLO):		At the end of this course, learners will be able to:																					
CLO-1 :	Acquire the knowledge on basics of procedures for identification, preservation of electronic evidence	2	80	85	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-2 :	Acquire the ability to identify the purpose and usage of various forensic tools	2	75	80	H	H	-	-	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-3 :	Understand how scientific evidence collection/extraction during investigation	2	85	80	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-4 :	Appreciate the concepts of file systems and its importance in forensic science.	2	80	75	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-5 :	Apply the knowledge of windows and Linux investigation procedures	2	75	85	H	-	-	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-6 :	Acquire the knowledge on forensic report writing guidelines and principles	2	80	85	H	-	-	-	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Duration (hour)	9	9	9	9	9	
S-1	SLO-1	Introduction to Incident Response	Introduction to ACPO Principles	Introduction to File System Analysis	Introduction to Investigating Systems	Investigating Hacker Tools
	SLO-2	Goals of Incident Response	ACPO Principles of Computer Based Evidence	What is a File System?	Investigating Windows Systems	What are the goals of tool analysis?
S-2	SLO-1	Introduction to Incident Response Methodology (IRM)	Introduction to computer Storage Formats	Five Data Categories	Where Evidence resides on Windows Systems	How are files compiled?
	SLO-2	Steps in Incident Response Methodology	Understanding Storage Formats for Digital Evidence	FAT Concepts	Conducting a Windows Investigation I	Static Analysis of Hacker Tools I
S-3	SLO-1	IRM: Pre-incident preparation	Forensic Duplication	FAT Analysis	Conducting a Windows Investigation II	Static Analysis of Hacker Tools II
	SLO-2	IRM: Detection of incidents	Forensic Duplication tools	FAT - The Big Picture	File Auditing	Dynamic Analysis of Hacker Tools I
S-4	SLO-1	IRM: Initial Response	Forensic Duplicate creation of HDD	Introduction to NTFS	Theft of Information	Dynamic Analysis of Hacker Tools II
	SLO-2	IRM: Formulate a Response Strategy	Qualified Forensic Duplicate creation	Files in NTFS	Handling the departing employee	Evaluating Computer Forensics Tools
S-5	SLO-1	IRM: Investigate the Incident	Restored Image	MFT Concepts	Investigating Unix Systems	Types of Forensic Tools
	SLO-2	IRM: Reporting	Mirror Image	MFT Attribute Concepts	Overview of steps - Unix Investigation	Tasks performed by Forensic Tools
S-6	SLO-1	Creating response toolkit - Windows	Forensic Duplication Tool Requirements	Other MFT Attribute Concepts	Reviewing pertinent logs	Tool comparisons
	SLO-2	Volatile Data Collection - Windows	Creating a Forensic Duplicate of a Hard Drive	Indexes in NTFS	Performing keyword searches	Computer Forensics Software Tools
S-7	SLO-1	In-depth data collection - Windows	Evidence Handling	NTFS Analysis - File System Category	Reviewing relevant files	Computer Forensics Hardware Tools
	SLO-2	Storing collected data - Windows	Types of Evidence	NTFS Analysis - Content Category	Identifying unauthorized user	Validating and Testing Computer

					accounts/groups	Forensics Software
S-8	SLO-1	Creating response toolkit - Unix	Challenges in Evidence Handling	NTFS Analysis - Metadata Category	Identifying rogue processes	Introduction to Forensic Report Writing
	SLO-2	Volatile Data Collection - Unix	Overview of Evidence Handling Procedure.	NTFS Analysis - File Name Category	Checking for unauthorized access points	Understanding the Importance of Reports
S-9	SLO-1	In-depth data collection - Unix	Evidence Handling Procedure	NTFS Analysis - Application Category	Analyzing trust relationships	Guidelines for Writing Reports
	SLO-2	Storing collected data - Unix	Evidence Handling reports	NTFS - The Big Picture	Detecting loadable kernel modules	A Template for Computer Forensics Reports

Learning Resources	1. Kevin Mandia, Chris Proise, "Incident Response and Computer Forensics", Tata McGraw Hill, 2006.	3. Eoghan Casey, "Handbook of Computer Crime Investigation's Forensic Tools and Technology", Academic Press, 1st Edition, 2001.
	2. Bill Nelson, Amelia Philips and Christopher Steuart, "Guide to Computer Forensics and Investigations", Course Technology, Cengage Learning, 4th Edition, ISBN: 1-435-49883-6, 2009.	4. Brian Carrier, "File System Forensic Analysis", Addison-Wesley Professional; 1st Edition 2005, ISBN-13: 978-0321268174

Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#		Theory	Practice
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice		
Level 1	Remember	40 %	-	30 %	-	30 %	-	30 %	-	30%	-
Level 2	Understand	40 %	-	40 %	-	40 %	-	40 %	-	40%	-
	Apply	40 %	-	40 %	-	40 %	-	40 %	-	40%	-
Level 3	Analyze	20 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Evaluate	20 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Create	20 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Total	100 %		100 %		100 %		100 %		100 %	

# CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Mr. Balan C, Scientist F, CDAC, cbalan@cdac.in	1.	1. Mr. A.R. Nagoor Meeran, SRMIST
2.	2.	2. Dr. C.N.S. Vinoth Kumar, SRMIST

Course Code	18CSE383T	Course Name	INFORMATION ASSURANCE AND SECURITY	Course Category	E	Professional Elective	L	T	P	C
							3	0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Computer Science and Engineering		Data Book / Codes/Standards	Nil	

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning			Program Learning Outcomes (PLO)																	
CLR-1 :	Understand the different ways the information systems may be compromised.	1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15			
CLR-2 :	Learn to model the various types of threats.	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3			
CLR-3 :	Understand the Information Assurance planning strategies.				H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLR-4 :	Acquire knowledge by analyzing software systems.				H	H	-	-	-	-	-	-	-	M	-	-	-	-	-	-	-	-
CLR-5 :	Understand and apply different countermeasures and protect information.				H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLR-6 :	Perform vulnerability testing.				H	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLR-6 :	Perform vulnerability testing.				H	-	-	-	-	-	-	-	-	-	M	-	-	-	-	-	-	-

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Learning			Program Learning Outcomes (PLO)														
CLO-1 :	Acquire the basic knowledge about the Information Assurance.	2	80	85	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CLO-2 :	Design an appropriate Policies for the organization.	2	75	80	H	H	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-3 :	Deliver professional, ethical, legal, security and social issues and responsibilities in an effective manner.	2	85	80	H	-	-	-	-	-	-	M	-	-	-	-	-	-	-
CLO-4 :	Develop risk management strategies for an enterprise.	2	80	75	H	H	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-5 :	Provide the understanding of different security mechanisms used in various areas of computing	2	75	85	H	-	-	H	-	-	-	-	-	-	-	-	-	-	-
CLO-6 :	Apply the current technical concepts and practices in the core information technologies.	2	80	85	H	-	-	-	-	-	-	-	M	-	-	-	-	-	-

Duration (hour)	9		9		9			9			9		
S-1	SLO-1	Information Assurance Basics	Information Security Planning	Information Assurance Process : Managing Information Assurance	Benefits of Incorporating Security Considerations	Information Assurance Detection and Recovery Processes							
	SLO-2	The Need for Information Assurance	Information Security Governance	Information Security project management	System Development Life Cycle	Intrusion Detection and Prevention System(IDPS)							
S-2	SLO-1	Key Information Security concepts	Policy, Standards and Practices	Technical aspects of implementing Information Security	Information Assurance in System Development Life Cycle	IDPS types							
	SLO-2	Critical characteristics of Information	Policy Management, Information Security Blueprint	Non-Technical aspects of implementing Information Security	Information Assurance in the Service Acquisition Life Cycle	IDPS detection methods							
S-3	SLO-1	MSR Model	Continuity Strategies	Structure of an Information Assurance	Physical and Environmental Security Controls	IDPS - Analysis							
	SLO-2	Security in System lifecycle	Crisis Management	Organizational Maturity, Asset Management	Handling of Media	Log Management Tools: SIEM							
S-4	SLO-1	NIST Approach to Securing SDLC	Information Asset Life Cycle, Plan,Do,Check,Act Model	APM Maturity model	Information Assurance Awareness, Training, and Education (AT and E), Purpose, Benefits	Honeypot/Honeynet							
	SLO-2	Security Professionals and Organizations	Current Practices : Due Care and Due Diligence	Overview of Risk Management	AT and E : Design, Development	Scanning and Analysis tools							
S-5	SLO-1	Communities of Interest	Specific Laws and Regulations	Risk Identificaion	AT and E : Assessment	Malware Detection							



	SLO-2	Information Security: Is it an art or Science?	International Laws and Acts	Risk Assessment	Types of Learning Programs	Penetration Test
S-6	SLO-1	Information Assurance Concepts : Defense in Depth	Standards and Best Practices	Risk control	Employment Policies and Practices	Physical Controls
	SLO-2	Information Assurance in Cyber Security	Plans for Information Assurance Strategy	Quantitative vs Qualitative Risk management practices	Security considerations for temporary employees, consultants and other workers	Special considerations for Physical security
S-7	SLO-1	CIA Triangle	Cryptology	Recommended risk control practices	Preventive Information Assurance Tools	Information Assurance Measurement Process
	SLO-2	The Need for Security	Cipher methods	Process , Secure design through threat modeling	Preventive Information Assurance controls	Metrics Program
S-8	SLO-1	Categories of Threats	Cryptographic algorithms	Importance of Policy	Positioning and staffing the Security function	Incident Handling Process
	SLO-2	Software Attacks types	Cryptographic tools	Information Assurance Policy	Credentials for Information Security Professionals	Continuity Strategies
S-9	SLO-1	Other vulnerabilities	Protocols for secure Communications	Policy Development Steps	Access control benefits	Computer Forensics
	SLO-2	Implications from Lack of Information Assurance	Approaches to implement Information Assurance	Certification, Accreditation, and Assurance	Access control Techniques, Administration	Examiner Prerequisites, Team Establishment

Learning Resources	1. Michael E. Whitman and Herbert J. Mattord, "Principles of Information Security", 5th edition, 2015, Thomson Publications, ISBN 1111899134.	3. William Stallings, "Cryptography and Network Security- Principles and Practice", 6th Edition, 2013, Pearson, ISBN: 9780136073734.
	2. Steven Hernandez, Corey Schou, "Information Assurance Handbook: Effective Computer Security and Risk Management Strategies", 1st Edition, 2014, McGraw Hill Osborne Media, ISBN: 0071821651, ISBN : 9780071821650	

Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#		Theory	Practice
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice		
Level 1	Remember Understand	40 %	-	30 %	-	30 %	-	30 %	-	30%	-
Level 2	Apply Analyze	40 %	-	40 %	-	40 %	-	40 %	-	40%	-
Level 3	Evaluate Create	20 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Total	100 %		100 %		100 %		100 %		100 %	

# CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Mr. P. Ananda Natarajan, Senior Associate Consultant, Infosys, Chennai.	1. Dr. S. Anbuchelian, Assistant Professor (S.I.G), IT Department, Anna University, Chennai anbuchelian@annauniv.edu	1. Ms. C. Fancy, SRMIST, fancy@srmist.edu.in
2. Mr. Surender Palanivel, GM, GGS Information Services Pvt. Ltd., Pune.		2. Dr. Vinoth Kumar, SRMIST vinothks1@srmist.edu.in

Course Code	18CSE384T	Course Name	SECURE SOFTWARE DEVELOPMENT LIFE CYCLE	Course Category	E	Professional Elective	L	T	P	C
							3	0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Computer Science and Engineering		Data Book / Codes/Standards	Nil	

Course Learning Rationale (CLR):		The purpose of learning this course is to:			Learning			Program Learning Outcomes (PLO)														
CLR-1 :	CLR-2 :	CLR-3 :	CLR-4 :	CLR-5 :	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Identify project security risks & selecting risk management strategies.	Analyze software security standards, policies, and guidelines to articulate and elaborate requirements	Use automated tools and secure coding practices to analyze and test existing code and reduce vulnerabilities	Select and integrate established security design patterns and address threat assessments to mitigate common vulnerabilities and achieve the target design	Participate in team-based peer reviews to analyze the security development life cycle and mitigate risks and vulnerabilities				Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3
CLO-1 :	CLO-2 :	CLO-3 :	CLO-4 :	CLO-5 :	3	80	70	L	H	-	L	L	-	-	-	L	L	-	H	-	-	-
Explain terms used in secured software development and life cycle process	Incorporate requirements into secured software development process and test software for security vulnerability	Identify vulnerable code in implemented software and describe attack consequences	Apply mitigation and implementation practices to construct attack resistant software	Apply secure design principles for developing attack resistant software	3	85	75	M	H	L	M	L	-	-	-	M	M	-	H	-	-	-
					3	75	70	M	H	M	H	L	-	-	-	M	L	-	H	-	-	-
					3	85	80	M	H	M	H	L	-	-	M	M	M	-	H	-	-	-
					3	85	75	H	H	M	H	L	-	-	-	M	M	-	H	-	-	-

Duration (hour)	9	9	9	9	9
S-1	SLO-1 SLO-2	Software Engineering- Process model	A Risk Management Framework	Introduction to Architectural Risk Analysis	Code Review with a Tool Catching Implementation Bugs with a Tool
S-2	SLO-1 SLO-2	Agile development-Agile Process Extreme Programming	The Five Stages of Activity	Common Themes among Security Risk Analysis Approaches	Software Penetration Testing
S-3	SLO-1 SLO-2	Need to secure development life cycle	Understanding the Business Context Gathering the Artifacts	Traditional Risk Analysis Terminology	Approaches to Static Analysis
S-4	SLO-1 SLO-2	Current Software Development Methods Fail to Produce Secure Software . Incentive to Review Code	Identifying the Business and Technical Risks	Knowledge Requirement	Modern Rules
S-5	SLO-1 SLO-2	Understanding Security Bugs Critical Mass	Synthesizing and Ranking the Risks	The Necessity of a Forest-Level View A Traditional Example of a Risk Calculation	Tools from Researchland
S-6	SLO-1 SLO-2	Proprietary Software Development Methods- CMMI, TSP, and PSP	Defining the Risk Mitigation Strategy	Modern Risk Analysis	Commercial Tool Vendors
S-7	SLO-1 SLO-2	SDL for Management	Carrying Out Fixes and Validating	Touchpoint Process: Architectural Risk Analysis	Abuse Cases
S-8	SLO-1 SLO-2	Managing the SDL	The Importance of Measurement	Limitations of Traditional Approaches	Key Characteristics of a Tool
					The Fortify Knowledge Base
					Knowledge for Software Security
					Touchpoint Process: Code Review
					Establishing a Metrics Program

S-9	SLO-1 SLO-2	Case study: A Short History of the SDL at Microsoft	The Digital Workbench	Getting Started with Risk Analysis	Use a Tool to Find Security Bugs	Continuous Improvement
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Learning Resources	1. <i>The Security Development Lifecycle: SDL: A Process for Developing Demonstrably More Secure Software (1st Edition) By Michael Howard, 2017.</i> 2. <i>Software Security: Building Security In by Gary McGraw. Addison-Wesley, 2006</i>	3. <i>Software Security Engineering: A Guide for Project Managers by Julia H. Allen, Sean Barnum, Robert J. Ellison, Gary McGraw, and Nancy Mead. Addison-Wesley, 2012</i>
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Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember Understand	40%	-	30%	-	30%	-	30%	-	30%	-
Level 2	Apply Analyze	40%	-	40%	-	40%	-	40%	-	40%	-
Level 3	Evaluate Create	20%	-	30%	-	30%	-	30%	-	30%	-
	Total	100 %		100 %		100 %		100 %		100%	

# CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
Mr.V.SelvaKumar, Assistant General Manager, Hexaware Technologies.	Dr.N.Prakash, Associate Professor, Department of Information technology, B.S.A Crescent Institute of Science and Technology.	1. Mr.Arivazhagan
		2. Dr. Naresh
		3. Mrs.B.Jothi, SRMIST

Course Code	18CSE385T	Course Name	SECURITY AUDIT AND RISK ASSESSMENT	Course Category	E	Professional Elective	L	T	P	C
							3	0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	CSE	Data Book / Codes/Standards	Nil		

Course Learning Rationale (CLR):		The purpose of learning this course is to:			Learning			Program Learning Outcomes (PLO)															
CLR-1 :	Understand the security audit planning strategies	1	2	3	1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
CLR-2 :	Gain knowledge about information risk							Engineering Knowledge															
CLR-3 :	Discover knowledge in collecting data about organization							Problem Analysis															
CLR-4 :	Acquire knowledge in various analysis on Information Risk Assessment							Design & Development															
CLR-5 :	Introduce the System Risk analysis							Analysis, Design, Research															
CLR-6 :	Understand the organizational and system specific risk							Modern Tool Usage															
CLR-6 :	Understand the organizational and system specific risk							Society & Culture															
CLR-6 :	Understand the organizational and system specific risk							Environment & Sustainability															
CLR-6 :	Understand the organizational and system specific risk							Ethics															
CLR-6 :	Understand the organizational and system specific risk							Individual & Team Work															
CLR-6 :	Understand the organizational and system specific risk							Communication															
CLR-6 :	Understand the organizational and system specific risk							Project Mgt. & Finance															
CLR-6 :	Understand the organizational and system specific risk							Life Long Learning															
CLR-6 :	Understand the organizational and system specific risk							PSO - 1															
CLR-6 :	Understand the organizational and system specific risk							PSO - 2															
CLR-6 :	Understand the organizational and system specific risk							PSO - 3															

Course Learning Outcomes (CLO):		At the end of this course, learners will be able to:			Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLO-1 :	Acquire the knowledge on various secure auditing techniques	2	80	85	H	-	-
CLO-2 :	Acquire the ability to identify knowledge in information risk	2	75	80	H	H	-
CLO-3 :	Understand the basic ideas about data collection workload	2	85	80	H	-	-
CLO-4 :	Appreciate the concepts of vulnerability catalogs and impact analysis scheme	2	80	75	H	H	-
CLO-5 :	Identify the knowledge in risk classification techniques	2	75	85	H	-	H
CLO-6 :	Acquire the knowledge on system specific risk	2	80	85	H	-	-

Duration (hour)	9	9	9	9	9	
S-1	SLO-1	Need for Audit Planning	What is Risk?	Data Collection-Introduction	Compiling Observations from Organizational	System Risk Analysis
	SLO-2	Steps in Audit Planning	Going Deeper with Risk	The Sponsor	Risk Documents	Risk Classification
S-2	SLO-1	Audit Risk Assessment	Components of Risk	The Project Team	Preparation of Threat and Vulnerability Catalogs	Risk Rankings
	SLO-2	Performing Audit	Putting it Altogether	The size and Breadth of the Risk Assessment	Threat Catalog	Risk Prioritization and Treatment
S-3	SLO-1	Internal Controls	Information Security Risk	Scheduling and Deadlines	Vulnerability Catalogs	Review of Audit Findings
	SLO-2	Audit Evidence	Information Security Risk Assessment Overview	Assessor and Organization Experience	Threat Vulnerability Pairs	Review of Security Incidents
S-4	SLO-1	Audit Testing	Assess Information Security Risk	Work load	Overview of the System Risk Computation	Review of Security Exceptions
	SLO-2	Follow up activities	Risk assessment and security Program	Data Collection Mechanisms	Designing the Impact Analysis Scheme	System Specific Risk Treatment
S-5	SLO-1	Security Monitoring and Auditing	Information Security Management in a Nutshell	Collectors	Confidentiality, Integrity	Information Security Risk Assessment Reporting
	SLO-2	Assurance and Trust	Drivers, Laws and Regulations	Containers	Availability	Risk Analysis Executive Summary
S-6	SLO-1	Need for Assurance	Federal Information Security Management	Executive Interview	Preparing the Impact Score	Methodology
	SLO-2	Role of Requirements in Assurance	Gramm-Leach-Bliley (GLBA)	Document Requests	Designing the Control analysis Scheme	Organizational
S-7	SLO-1	Audit Assurance in Software	Health Insurance Portability and	IT Asset Inventories	Designing the Likelihood Analysis Scheme	System Specific

		Development Phases	Accountability Act(HIPAA)			
	SLO-2	Building Secure and Trusted Systems	State Governments	Asset Scoping	Exposure	Results
S-8	SLO-1	Designing an Auditing System	ISO 27001	Business Impact Analysis and Other Assessments	Frequency	Organizational Analysis
	SLO-2	Auditing to detect Violations of a Security Policy	Drivers,Laws and Regulations	Critical Success Factor Analysis	Controls	System Specific
S-9	SLO-1	Auditing Mechanisms	Risk Assessment Framework	Profile & Control Survey	Likelihood	Risk Register
	SLO-2	Audit Browsing	Practical Approach	Consolidation	Final Risk Score	Post Mortem

Learning Resources	<ol style="list-style-type: none"> <li>1. Mark Talabis, "Information Security Risk Assessment Toolkit: Practical Assessments through DataCollectionandDataAnalysis", Syngress;1Edition.ISBN:978-1-59749-735-0.Nov2012.</li> <li>2. David L. Cannon, "CISA Certified Information Systems Auditor Study Guide", SYBEX Publication. ISBN:978-0-470-23152-4.</li> </ol>	<ol style="list-style-type: none"> <li>3. Thomas R.Peltier, "Information Security Risk Analysis", CRC Press, 2001</li> </ol>
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Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#		Theory	Practice
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice		
Level 1	Remember	40 %	-	30 %	-	30 %	-	30 %	-	30%	-
Level 2	Understand	40 %	-	40 %	-	40 %	-	40 %	-	40%	-
	Apply	40 %	-	40 %	-	40 %	-	40 %	-	40%	-
Level 3	Analyze	20 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Evaluate	20 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Create	20 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Total	100 %		100 %		100 %		100 %		100 %	

# CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1.Mr.PrasannaKumar,InfosysPrasanna_kumar11@infosys.com	1.Dr.E.Sivashankar, NIT Trichy,sivasankar@nitt.edu	1.Dr.G.Usha,SRMIST, Dr.M.B.MukeshKrishnan,SRMIST
2.Mr.Mithun, Cognizant,Mithun.SS@cognizant.com	2.Dr.KunvarSingh,NITTrichy,kunwar@nitt.edu	2.Mrs G.K. Sandhia,SRMIST

Course Code	18CSE386T	Course Name	PENETRATION TESTING AND VULNERABILITY ASSESSMENT	Course Category	E	Professional Elective				L	T	P	C
										3	0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Computer Science and Engineering		Data Book / Codes/Standards	Nil	

Course Learning Rationale (CLR):	The purpose of learning this course is to:			Learning			Program Learning Outcomes (PLO)																	
CLR-1 :	Gain knowledge on various security testing techniques and asses sensitiveness of assets.			1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15			
CLR-2 :	Gain knowledge on weaknesses of various OS, network and applications.			Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3			
CLR-3 :	Identify how security controls can be improved to prevent hackers gaining access to operating systems and networked environments.						H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLR-4 :	Acquire knowledge on methodologies and techniques of Hacking						H	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLR-5 :	To test and exploit systems using various tools.						H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLR-6 :	Understand the impact of hacking in real time machines						H	-	-	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLR-6 :							H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:			2	80	85	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-1 :	Acquire the knowledge on identifying security vulnerabilities			2	80	85	H	H	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-2 :	Acquire the ability to identify problems in network, OS and applications commonly exploited by hackers			2	75	80	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-3 :	Understand management of static and dynamic security controls in firewalls, IPS, IDS			2	85	80	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-4 :	Appreciate the concepts of hacking and gaining access to remote and local systems.			2	80	75	H	H	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-5 :	Apply the knowledge for creating better security controls.			2	75	85	H	-	-	H	-	-	-	-	-	-	-	-	-	-	-
CLO-6 :	Acquire the knowledge to prevent threats in targeted attacks and real time systems.			2	80	85	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Duration (hour)	9		9		9		9		9			
S-1	SLO-1	Introduction to penetration testing	Types of Scanning	Meterpreter Basics	Social engineering	DOS Attack	SLO-2	Introduction to penetration testing -2	Black, White and Grey Scanning	Working with Meterpreter session	Electronic and Non Electronic Social Engineering	DDOS Attack
S-2	SLO-1	Understanding basic Ethical Hacking terminologies	Foot Printing Stages	Exploit Modules	SET- Social Engineering Toolkit	Web application Vulnerability	SLO-2	Understanding basic Ethical Hacking terminologies -2	Foot Printing Stages-2	Payload Modules	Social Engineering Prevention Techniques	Security assessment of public Domains
S-3	SLO-1	Batch Programming Basics	DNS Information Gathering	Privilege Escalation	Buffer Over Flow Attack	Phishing and its Types	SLO-2	Batch Programming Basics - 2	NS Lookup	Vertical and horizontal Privilege Escalation	Stack Based Buffer overflow	Cross Site Request Forgery
S-4	SLO-1	Taking control using batch programs	Network Information Gathering	Token Stealing	Heap Based buffer overflow	DOM Based XSS	SLO-2	Taking control using batch programs-2	NMap	Active and Passive stealing	Deep packet inspection	Brup Suite
S-5	SLO-1	Open web Application Security Project(OWASP)	Scanning	Network Sniffing	SQL Injection –Introduction	Password Cracking	SLO-2		Port, Network and OS	Active and passive sniffing	SQL Injection Types	John the Ripper
S-6	SLO-1	Stages of Ethical Hacking	Nmap Scripting	Creating Backdoors	Error Based SQL,	Dictionary Attack, Brute Force Attack	SLO-2			Persistent and Non-Persistent	Union Based SQL	Rainbow Table Attack,
S-7	SLO-1	Vulnerability Research	Vulnerability Scanning	Key Loggers	Blind SQL	Shoulder Sniffing, Spidering						

	SLO-2		Nessus	Software and Hardware Key loggers	Boolean-based SQL injection, Time-based SQL injection	Offline Cracking
S-8	SLO-1	Impact of Hacking	'Who is' Information Gathering	ARP Poisoning	SQL Map,DVWA	Wifi Hacking
	SLO-2		Wireshark	Maltigo	SQL injection Counter Measures	Aircrack
S-9	SLO-1	Introduction to Kali OS	Enumeration	Man In The Middle Attack	Steganography	Documentation and Reporting
	SLO-2	Installation and configuration	Active and Passive Enumeration	Port Forwarding	Steganography counter measures	Dradis Framework

Learning Resources	1. David Kennedy, Jim O'Gorman, Devon Kearns, and Mati Aharoni, <i>METASPLOIT The Penetration Tester's Guide</i> , No Starch Press,2011.	3. Sean-Philip Oriyano, <i>Penetration Testing Essentials</i> , JohnWiley & Sons,2017. 4. Leebrotherston, AmandaBerlin, <i>DefensiveSecurityhandbook</i> , O'reilly,2017
	2. Wil Allsopp, <i>Advanced Penetration Testing: Hacking the worlds most Secure Networks</i> , 1st Edition, John Wiley & Sons,2017	

Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#		Theory	Practice
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice		
Level 1	Remember	40 %	-	30 %	-	30 %	-	30 %	-	30%	-
Level 2	Understand	40 %	-	40 %	-	40 %	-	40 %	-	40%	-
	Apply										
Level 3	Analyze	20 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Evaluate										
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

# CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
Mr. S Manigandan, prnc Cyber Researcher, Symantec Inc manigandan_s@symantec.com		1. Geogen George, SRMIST 2. Ms. Poornima, SRMIST 3. Mr. Selvakumaraswamy, SRMIST

Course Code	18CSE472T	Course Name	MALWARE ANALYSIS	Course Category	E	Professional Elective	L	T	P	C
							3	0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Computer Science and Engineering		Data Book / Codes/Standards	Nil	

Course Learning Rationale (CLR):		Learning			Program Learning Outcomes (PLO)																	
The purpose of learning this course is to:		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15			
CLR-1 :	Understand the fundamentals of static and dynamic analysis.	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3			
CLR-2 :	Gain knowledge about running malware in virtual environment.				H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLR-3 :	Study about disassembly constructs and its structures.				H	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLR-4 :	Study about new processors and file types using the IDA SDK				H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLR-5 :	Explore popular plug-ins that make writing IDA scripts easier, allow collaborative reverse engineering				H	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLR-6 :	Understand how to best approach the subject of Android malware threats and analysis.				H	-	-	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Course Learning Outcomes (CLO):		At the end of this course, learners will be able to:			H	-	-	-	-	-	-	-	-	-	-	-	-	-	-			
CLO-1 :	Gain knowledge about the different forms of malware.	2	80	85	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-			
CLO-2 :	Set up a safe virtual environment to analyze malware.	2	75	80	H	H	-	-	-	-	-	-	-	-	-	-	-	-	-			
CLO-3 :	Navigate, comment, and modify disassembly.	2	85	80	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-			
CLO-4 :	Use code graphing to quickly make sense of cross references and function calls	2	80	75	H	H	-	-	-	-	-	-	-	-	-	-	-	-	-			
CLO-5 :	Use IDA's built-in debugger to tackle hostile and obfuscated code.	2	75	85	H	-	-	H	-	-	-	-	-	-	-	-	-	-	-			
CLO-6 :	Learn procedures for recognizing and analyzing Android malware threats quickly and effectively.	2	80	85	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-			

Duration (hour)	9		9		9		9		9	
S-1	SLO-1	The Goals of Malware Analysis	The Structure of a Virtual Machine	Disassembly Theory	Cross-References	Introduction to the Android Operating System and Threats				
	SLO-2	Malware Analysis Techniques	Creating Your Malware Analysis Machine	The Why and how of Disassembly	Function Calls	Malware Threats, Hoaxes, and Taxonomy				
S-2	SLO-1	Types of Malware	Using Your Malware Analysis Machine	Reversing and Disassembly Tools.	IDA Graphing	Open Source Tools				
	SLO-2	General Rules for Malware Analysis	The Risks of Using VMware for Malware Analysis	Getting started with IDA.	Console Mode IDA	Collections				
S-3	SLO-1	Antivirus Scanning	Record/Replay: Running Your Computer in Reverse	IDA Data Displays	IDA's Batch Mode	File Data, Metadata				
	SLO-2	Hashing- Fingerprint for Malware	Sandboxes: The Quick-and-Dirty Approach	Disassembly Navigation.	Customizing IDA's	Creating a JAR File, VisualThreat Modeling				
S-4	SLO-1	Finding Strings	Running Malware	Disassembly Manipulation.	Library Recognitions	Automation				
	SLO-2	Packing Files	Monitoring with Process Monitor	Recognizing Data Structure Use	Augmenting Function Information	Processor Emulation				
S-5	SLO-1	Detecting Packers with PEiD	Viewing Processes with Process Explorer	Creating IDA Structures	Augmenting Predefined Comments	Configuring Emulated Devices within AVD				
	SLO-2	Portable Executable File Format	Comparing Registry Snapshots with Regshot	Using Structure Templates	The Infamous Patch Program Menu	Using the ADB Tool				
S-6	SLO-1	Static, Runtime, and Dynamic Linking	Faking a Network	Importing New Structures	IDA Output Files and Patch Generation	Installing Samples to Devices and Emulators				
	SLO-2	Exploring Dynamically Linked Functions with Dependency Walker	Packet Sniffing with Wireshark	Using Standard Structures	IDA Scripting	Application Storage and Data Locations				



S-7	SLO-1	<i>Imported and Exported Functions</i>	<i>Using INetSim</i>	<i>IDA TIL Files</i>	<i>IDA Software Development Kit</i>	<i>Devices View, LogCat View</i>
	SLO-2	<i>PotentialKeylogger.exe: An Unpacked Executable</i>	<i>Basic Dynamic Tools in Practice</i>	<i>C++ Reversing Primer- The this Pointer</i>	<i>The IDA Application Programming Interface</i>	<i>Application Tracing</i>
S-8	SLO-1	<i>Examining PE Files with PEview</i>	<i>Levels of Abstraction</i>	<i>Virtual Functions and Vtables</i>	<i>Writing a Plug-in, Plug-in User Interface Options</i>	<i>Build Your Own Sandbox</i>
	SLO-2	<i>Viewing the Resource Section with Resource Hacker</i>	<i>Reverse-Engineering</i>	<i>The Object Life Cycle</i>	<i>IDA Loader Modules</i>	<i>USB-cleaver, Torec</i>
S-9	SLO-1	<i>Using Other PE File Tools</i>	<i>The x86 Architecture</i>	<i>Name Mangling, Runtime Type Identification</i>	<i>Processor Module Architecture</i>	<i>Static and Dynamic Analysis of Uploaded Malware Samples.</i>
	SLO-2	<i>PE Header Summary</i>	<i>Recognizing C Code Construct in Assembly</i>	<i>Inheritance Relationships, C++ Reverse Engineering References</i>	<i>Real World Applications- Vulnerability Analysis.</i>	<i>Capabilities and Limitations of the Emulators.</i>

Learning Resources	<ol style="list-style-type: none"> <li>1. Michael Sikorski, <i>Practical Malware Analysis – The Hands-On Guide to Dissecting Malicious Software</i>, Kindle Edition, No Starch Press; 1 edition (1 February 2012), ISBN: 1593272901.</li> <li>2. Chris Eagle, <i>The IDA Pro Book, 2nd Edition</i>, No Starch Press, 2011. ISBN-10: 1-59327- 289-8.</li> </ol>	<ol style="list-style-type: none"> <li>3. Ken Dunham, <i>Android Malware and Analysis</i>, Kindle Edition, Auerbach Publications. InternationalStandardBookNumber-13:978-1-4822-5220-0.</li> </ol>
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Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#		Theory	Practice
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice		
Level 1	Remember	40 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Understand										
Level 2	Apply	40 %	-	40 %	-	40 %	-	40 %	-	40%	-
	Analyze										
Level 3	Evaluate	20 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

# CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
Mr. P.Santhosh, Information Security Risk Analyst, PricewaterhouseCoopers Pvt Ltd, Bangalore, Karnataka 560008. Email: santhoshshivam72@gmail.com	Dr.L.Kavisankar Associate Professor, Dept. Of CSE, Hindustan Institute of Science and Technology Email: lkavis@hindustanuniv.ac.in	1. Mr. V. Joseph Raymond, SRMIST
		2.Ms. Ida Seraphim, SRMIST

Course Code	18CSE474T	Course Name	CYBER LAW	Course Category	E	Professional Elective	L	T	P	C
							3	0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Computer Science and Engineering		Data Book / Codes/Standards	Nil	

Course Learning Rationale (CLR):	The purpose of learning this course is to:			Program Learning Outcomes (PLO)																	
CLR-1 :	Understand the basics of cyber law and cyber security			1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CLR-2 :	familiarize the issues those are specific to amendment rights			Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3
CLR-3 :	Become aware on copyright issues in software's																				
CLR-4 :	Understand the Cyber-crimes and Cyber Frauds																				
CLR-5 :	Understand the Legal Framework																				
CLR-6 :	understand ethical laws of computer for different countries																				

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:			3	80	70	L	H	H	H	L	H	L	H	H	H	L	H	H	H	H
CLO-1 :	Gain in-depth knowledge on information on cyber security and issues specific to amendment rights			3	80	70	L	H	H	H	L	H	L	H	H	H	L	H	H	H	H
CLO-2 :	Apply the knowledge on copyright issues within software packages			3	85	75	L	H	H	H	L	H	L	H	H	H	L	H	H	H	H
CLO-3 :	Comprehend ethical laws of computer for various countries			3	75	70	L	H	H	H	L	H	L	H	H	H	L	H	H	H	H
CLO-4 :	Defines the Cyber-crimes and frauds			3	85	80	L	H	H	H	L	H	L	H	H	H	L	H	H	H	H
CLO-5 :	Apply the knowledge of Legal framework			3	85	75	L	H	H	H	L	H	L	H	H	H	L	H	H	H	H
CLO-6 :	Construct the secured environment			3	80	70	L	H	H	H	L	H	L	H	H	H	L	H	H	H	H

Duration (hour)	9		9		9		9		9	
S-1	SLO-1	Introduction	Overview Of The Information Technology Act, 2000	Cyber-crimes / Cyber Frauds	Cyber Crimes& Legal Framework	Cyber Security				
	SLO-2	History of Internet and World Wide Web	Applicability of the Act	Definition of cyber crime	Cyber Crimes against Individuals, Institution and State	Network and website Security Risks				
S-2	SLO-1	Need for cyber law	Scheme of the Act	First Cyber crime	Hacking	Hacking				
	SLO-2	Cyber-crime on the rise	Important provisions of the Act	Digital Forgery	E-business Risk management issues					
S-3	SLO-1	Important terms related to cyber law	Digital Signature under the IT Act, 2000	Types of cyber frauds	Cyber Stalking/Harassment	Firewall				
	SLO-2		E-Governance	Cyber Pornography	Security framework					
S-4	SLO-1	Cyber law in India	Attribution, Acknowledgement and Dispatch of Electronic Records	Cyber frauds in India	Identity Theft & Fraud	Cryptocurrency				
	SLO-2		Certifying Authorities	Preventive measures	Cyber Terrorism	Blockchain –Technology Stack :Protocol, Currency				
S-5	SLO-1	Need for cyber law in India	Controller of Certifying Authorities (CCA)	Cyber crimes	Cyber Defamation	Crowd Funding				
	SLO-2		Security Guidelines for Certifying Authorities	Who commits cyber-crimes?	Right to Privacy and Data Protection on Internet	Bitcoin Prediction Markets				
S-6	SLO-1	History of cyber law in India	Electronic Signature Certificates	Penalties and offences under the IT Act, 2000	Concept of privacy	Smart Property				
	SLO-2		Duties of Subscribers		Self-regulation approach to privacy	Smart Contract				

S-7	SLO-1	Information Technology Act, 2000	Penalties and Offences	Offences under other legislations	Ingredients to decide confidentiality of information	Decentralized Governance Services
	SLO-2				Intellectual Property Issues in Cyber Space	E Payments
S-8	SLO-1	Overview of other laws amended by the IT Act, 2000	Intermediaries	Investigation of cyber-crimes in India	Interface with Copyright Law	Digital Token based E payment systems
	SLO-2				Interface with Patent Law	E Wallet
S-9	SLO-1	National Policy on Information Technology 2012	rules issued under the IT Act, 2000	Regulatory Authorities	Trademarks & Domain Names Related issues	Online financial services in India
	SLO-2				Dispute Resolution in Cyberspace	Law to Protect online financial service fraud

Learning Resources	1. Justice Yatindra Singh, Cyber Laws, Universal Law Publishing Co, New Delhi, (2012).	5. Sudhir Naib, The Information Technology Act, 2005: A Handbook, OUP, New York, (2011)
	2. Verma S, K, Mittal Raman, Legal Dimensions of Cyber Space, Indian Law Institute, New Delhi, (2004)	6. Upadhyaya and A. Upadhyaya, Material Science and Engineering, Anshan Publications, 2007
	3. S. R. Bhansali, Information Technology Act, 2000, University Book House Pvt. Ltd., Jaipur (2003).	7. Vasu Deva, Cyber Crimes and Law Enforcement, Commonwealth Publishers, New Delhi, (2003).
	4. Blockchain, Blueprint for a new Economy, Melanie Swan, 2017 –O'Reilly	8. Essential CyberSecurity Science, Josiah Dykstra, 2017 –O'Reilly

Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#		Theory	Practice
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice		
Level 1	Remember Understand	40 %	-	30 %	-	30 %	-	30 %	-	30%	-
Level 2	Apply Analyze	40 %	-	40 %	-	40 %	-	40 %	-	40%	-
Level 3	Evaluate Create	20 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Total	100 %		100 %		100 %		100 %		100 %	

# CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
Mr. Kesawan HCL Technologies	Dr. Surendran Rajendran AMA International University Bahrain	Dr.M.B Mukesh Krishnan, SRMIST
Mr.Celeian, Symantec		Mrs.R.Vidhya, SRMIST

Course Code	18CSE475T	Course Name	MOBILE AND WIRELESS SECURITY	Course Category	E	Professional Elective	L	T	P	C
							3	0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	CSE	Data Book / Codes/Standards	Nil		

Course Learning Rationale (CLR):		Learning			Program Learning Outcomes (PLO)																	
CLR-1 :		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15			
The purpose of learning this course is to:																						
CLR-1 : understand the fundamentals of mobile cellular networks and IEEE wireless networks		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life-Long Learning	PSO - 1	PSO - 2	PSO - 3			
CLR-2 : Learn the basic security fundamentals					H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLR-3 : understand the security issues in Wi-Fi and Wi-Max					H	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLR-4 : explore the security issues in Next generation mobile networks					H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLR-5 : understand the security issues and key management in ad-hoc networks.					H	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLR-6 : study the hacking techniques in IEEE 802.11					H	-	-	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Course Learning Outcomes (CLO):		At the end of this course, learners will be able to:																				
CLO-1 : understand the fundamentals of mobile cellular networks and IEEE wireless networks		2	80	85	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-			
CLO-2 : Identify various possibilities for security threats in wireless networks.		2	75	80	H	H	-	-	-	-	-	-	-	-	-	-	-	-	-			
CLO-3 : Handle the security threats in Wi-Fi networks.		2	85	80	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-			
CLO-4 : Solve the security attacks in mobile IP networks		2	80	75	H	H	-	-	-	-	-	-	-	-	-	-	-	-	-			
CLO-5 : Prevent the attacks in ad-hoc networks.		2	75	85	H	-	-	H	-	-	-	-	-	-	-	-	-	-	-			
CLO-6 : Protect the 802.11 Networks from attacks.		2	80	85	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-			

Duration (hour)	9	9	9	9	9	
S-1	SLO-1	Introduction to mobile cellular networks	Wi-Fi Security	Security in Next Generation Mobile Networks	Security in Ad Hoc Networks	Overview of Wireless security-Hacking
	SLO-2	Cellular network basic concepts	Attacks on wireless networks	SIP	Motivations and application fields	Scanning and Enumerating 802.11 Networks
S-2	SLO-1	IEEE wireless networks, WLAN: IEEE 802.11	IEEE 802.11 security mechanisms	VoIP security flaws	Routing protocols	Windows Sniffing/Injection Tools
	SLO-2	WMAN mobile: IEEE 802.20	WEP (Wired Equivalent Privacy) and Shortcomings	Making VoIP secure	Attacks to routing protocols	Attacking 802.11 Wireless Networks
S-3	SLO-1	Mobile Internet networks	Security in 802.1x	IP Multimedia Subsystem (IMS)	Security mechanisms - Basic protections and existing tools	Security Through Obscurity
	SLO-2	Security in the digital age	Authentication	IMS architecture and security	Key management architectures	Attacking WPA-Protected 802.11 Networks
S-4	SLO-1	Threats and risks to TeleCommunication systems	The 802.11i security architecture	4G security	Protections using asymmetric cryptography	Breaking Authentication: WPA-PSK
	SLO-2	From wireline vulnerabilities to vulnerabilities in wireless Communications	Radio security policies	Confidentiality	Protections using symmetric cryptography	Breaking Authentication: WPA Enterprise
S-5	SLO-1	Security services	Authentication in wireless networks	Security of IP-Based Mobile Networks	Protection against data modification	Attack 802.11 Wireless Clients
	SLO-2	Symmetric and asymmetric	Layer 3 security mechanisms	Vulnerabilities of Mobile IP networks	Protection against tunnel attacks	Attacking the Application Layer

		<i>cryptography</i>				
S-6	SLO-1	Hash functions	WiMAX Security	Discovery mechanisms and Authenticity of the mobile location	Key Management in Ad Hoc Networks	Dynamically Generating Rogue APs and Evil Servers with Karmetasplit
	SLO-2	Electronic signatures and MAC	Security evolution in WiMAX standards	Data protection (IP tunnels)	The threshold cryptography technique and Self-managed PKI	Direct Client Injection Techniques
S-7	SLO-1	Public Key Infrastructure (PKI) and electronic certificates	WiMAX low layers	IPv6 mobility mechanisms	Key agreement technique within MANETs and Cryptographic identifiers	Overview of Bluetooth Scanning and Reconnaissance
	SLO-2	Management of cryptographic keys	Security according to the IEEE-802.16e standard	Mobile IPv6 bootstrapping	The Resurrecting Duckling technique	Bluetooth Eavesdropping
S-8	SLO-1	Cryptographic protocols	Authentication with PKMv2-RSA, PKMv2-EAP	Mobility with Mobile IPv4	Group key management within ad hoc networks	Commercial Bluetooth Sniffing
	SLO-2	IPsec protocol suite	SA-TEK 3-way handshake	Protocol and security	Security services and challenges for group Communications within MANETs	Open-Source Bluetooth Sniffing
S-9	SLO-1	Authentication mechanisms	GTEK updating algorithm	Mobility with MOBIKE	Comparison metrics	ZigBee Security
	SLO-2	Access control-Firewalls	Algorithms associated with the TEKs	IP mobility with HIP	Approaches for Group key management	ZigBee Attacks

Learning Resources	<ol style="list-style-type: none"> <li>Hakima Chaouchi, Maryline Laurent-Maknavicius, "Wireless and Mobile Network Security Basics, Security in On-the-shelf and Emerging Technologies", John Wiley &amp; Sons Inc, 2009.</li> <li>Johnny Cache, Joshua Wright, Vincent Liu, "Hacking Exposed Wireless: Wireless Security Secrets &amp; Solutions", Second Edition, McGraw-Hill, 2010.</li> </ol>	<ol style="list-style-type: none"> <li>Lei Chen, Jiahuang Ji, Zihong Zhang, "Wireless Network Security: Theories and Applications", Higher Education Press, 2013.</li> </ol>
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Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	40 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Understand										
Level 2	Apply	40 %	-	40 %	-	40 %	-	40 %	-	40%	-
	Analyze										
Level 3	Evaluate	20 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

# CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts

Course Code	18CSE476T	Course Name	DATABASE SECURITY	Course Category	E	Professional Elective	L	T	P	C
							3	0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Computer Science and Engineering		Data Book / Codes/Standards	Nil	

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning			Program Learning Outcomes (PLO)														
CLR-1 :	Demonstrate understanding of Fundamentals of Security in database technology with its security architecture in modern computer systems in a typical enterprise.	1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CLR-2 :	Formulate a working definition of database security and administration and Identify contemporary practices of operating system security.	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3
CLR-3 :	To identify risks and vulnerabilities in operating systems from a database perspective.																		
CLR-4 :	Demonstrate the knowledge and skills for administration of user, profiles, password policies, privileges and roles.																		
CLR-5 :	Manage database security Model on application level and Conduct database auditing for security and reliability																		
CLR-6 :	Implement typical security projects on enterprise systems.																		

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3
CLO-1 :	Students are able to identify fundamentals of data , securityof data and security issues	3	85	75	M	H	L	H	L	-	-	-	H	H	M	H	-	-	-
CLO-2 :	Students are obtaining knowledge about architecture of data base security and Operating System Security	3	85	75	M	H	L	M	L	-	-	-	M	L	M	H	-	-	-
CLO-3 :	Develop and implement a security plan for an enterprise level database (password policies, auditing policies, user privileges, profile, and roles).	3	75	70	M	H	M	H	H	H	-	-	M	L	H	H	-	-	-
CLO-4 :	Students are able to design and implement access control rules to assign privileges and protect data in databases.	3	85	85	M	H	H	H	L	-	H	-	M	L	H	H	-	-	-
CLO-5 :	Identify some of the factors driving the need for Database security and classify particular examples of attacks	3	85	75	H	H	M	H	L	M	-	M	M	L	-	H	-	-	-
CLO-6 :	Students implement database auditing and Virtual Private Database to protect data in databases	3	80	85	H	H	H	H	H	-	-	-	H	H	M	H	-	-	-

Duration (hour)	9		9		9		9		9	
S-1	SLO-1	Importance of Data,Identity Theft	Installing a typical database product	Introduction-Authentication-Creating Users	Database Application Security Models: Introduction	Virtual Private Databases: Introduction-Overview				
	SLO-2			SQL Server User	Types of Users	Implementation of VPD using Views				
S-2	SLO-1	Levels of data security	Security architecture: Database Management Systems	Removing,Modifying Users-Default, Remote Users	Security Models	Application Context in Oracle				
	SLO-2	Authorization in databases	Information Security Architecture			Implementing Oracle VPD				
S-3	SLO-1	ACL Application Vulnerabilities	Database Security,Basics of Security in distributed databases	Database Links-Linked Servers	Application Types-Application Security Models	Viewing VPD Policies and Application contexts using Data Dictionary				
	SLO-2		Asset Types and value-Security Methods			Policy Manager Implementing Row and Column level Security with SQL Server				
S-4	SLO-1	Database security issues	Operating system security principles	Remote Servers-Practices for Administrators and Managers	Data Encryption.Excessive privileges, SQL Injections	Auditing Database Activities:				
	SLO-2	Access to key fields,Access to surrogate information								
S-5	SLO-1	Problems with data extraction	Security Environment	Best Practices Profiles	Countermeasures of Malware, Countermeasures of Weak Audit Trail	Creating DLL Triggers with Oracle				
	SLO-2	Access control in SQL		Password Policies						

S-6	SLO-1	Discretionary security in SQL, Schema level	Components	Introduction-Defining and Using Profiles	DB Vulnerabilities and Misconfiguration	Auditing Server Activity with SQL Server 2000
	SLO-2					
S-7	SLO-1	Authentication, Table level	Authentication Methods	Designing and Implementing Password Policies	Countermeasures of Denial of Service, Stolen Database Backups	Using Oracle Database Activities
	SLO-2		User Administration			
S-8	SLO-1	SQL system tables, Mandatory security in SQL	Password Policies	Granting and Revoking User Privileges	CONTROL METHODS: Access Control, Access control models for XML databases, Inference Policy	Security Project Case study-
	SLO-2		Vulnerabilities			
S-9	SLO-1	Data protection,	E-mail Security	Creating, Assigning and Revoking User Roles-Best Practices	User Identification, Authentication, Accountability, Password Cryptography	Security and Auditing Project Case Study Data Protection and the IoT
	SLO-2					

Learning Resources	1. Alfred Basta, Melissa Zgola and Dana Bullaboy "Database Security" 1st Edition Cengage, 2012 (Unit 1 to III)	3. Hassan A. Afyouni, "Database Security and Auditing", Third Edition, Cengage Learning, 2009. (UNIT III to V)
	2. Michael Gertz and Sushil Jajodia (Editors), Handbook of Database Security: Applications and Trends, ISBN-10: 0387485325. Springer, 2007	4. <a href="http://airconline.com/ijist/V6N2/6216ijist18.pdf">http://airconline.com/ijist/V6N2/6216ijist18.pdf</a> (Unit IV)

Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#		Theory	Practice
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice		
Level 1	Remember	40%	-	30%	-	30%	-	20%	-	30%	-
Level 2	Understand	40%	-	40%	-	40%	-	40%	10%	40%	-
	Apply	40%	-	40%	-	40%	-	40%	10%	40%	-
Level 3	Analyze	20%	-	30%	-	30%	-	20%	10%	30%	-
	Evaluate	20%	-	30%	-	30%	-	20%	10%	30%	-
	Create	20%	-	30%	-	30%	-	20%	10%	30%	-
	Total	100 %		100 %		100 %		100 %		-	

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Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
Mr.Prithivi R, Teradata DBA, T.C.S Company	Dr.N.P.Gopal, Professor, Department of Computer Applications, National Institute of Technology, Trichy	1. Mrs.S.Amudha/SWE, SRMIST
Mr.Jero Terrence, Project Developer in Data warehousing and Data Mining, T.C.S Company	Dr.G.R.KanagaChidambaresan, Asso.Prof, Vel Tech University, Chennai	2. Dr. Madhavan/CSE, SRMIST
-	Dr.Kannimuthu Asso.Prof, Karpagam College of Engineering, Coimbatore	3. Dr.MB.MukeshKrishnan/IT, SRMIST

Course Code	18CSE477T	Course Name	SECURITY GOVERNANCE, RISK AND COMPLIANCE	Course Category	E	Professional Elective			
						L	T	P	C
						3	0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Computer Science and Engineering		Data Book / Codes/Standards	Nil	

Course Learning Rationale (CLR):	<i>The purpose of learning this course is to:</i>			Learning			Program Learning Outcomes (PLO)																																
CLR-1 :	<i>Analyze the expanding role of IT governance and its effect on organizations</i>			1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15																		
CLR-2 :	<i>Be aware of management issues in IT governance</i>			Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3																		
CLR-3 :	<i>Analyze the role of risk to an organization and ways to identify key risk factors</i>																					M	H	H	M	M	M	M	M	M	M	M	M	M	M	M	M	M	
CLR-4 :	<i>Evaluate various risks and appropriate actions</i>																					M	H	H	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M
CLR-5 :	<i>Develop naming conventions for the resources in a system</i>																					M	H	H	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M
CLR-6 :	<i>Create and justify several appropriate policies and procedures to manage resources in a system.</i>																					M	H	H	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M
Course Learning Outcomes (CLO):	<i>At the end of this course, learners will be able to:</i>																					3	80	70	M	H	H	H	H	M	M	M	M	M	M	M	M	M	M
CLO-1 :	<i>Having an overview of IT governance</i>			3	85	75	M	H	H	H	H	M	M	M	M	M	M	M	M	M	M																		
CLO-2 :	<i>Undergo an risk assessment</i>			3	75	70	M	H	H	H	H	M	M	M	M	M	M	M	M	M	M																		
CLO-3 :	<i>Describe legal and ethical considerations related to the handling and management of enterprise information assets.</i>			3	85	80	M	H	H	H	H	M	M	M	M	M	M	M	M	M	M																		
CLO-4 :	<i>Specify what constitutes admissible evidence in a legal proceeding and how to acquire and maintain this information.</i>			3	85	75	M	H	H	H	H	M	M	M	M	M	M	M	M	M	M																		
CLO-5 :	<i>Create a set of policies that implement a specified organizational objective.</i>			3	80	70	M	H	H	H	H	M	M	M	M	M	M	M	M	M	M																		
CLO-6 :	<i>Justify several appropriate policies and procedures to manage resources in a system.</i>			3	80	70	M	H	H	H	H	M	M	M	M	M	M	M	M	M	M																		

Duration (hour)	9		9		9		9		9	
S-1	SLO-1	<i>Introduction to IT Governance</i>	<i>overview of Industry Best Practice Standards</i>		<i>Security mindset</i>		<i>Trends</i>		<i>Creation of policies</i>	
	SLO-2									
S-2	SLO-1	<i>IT Risk Management Life Cycle</i>	<i>Model and Guidelines covering some aspect of IT governance</i>		<i>Design principles</i>		<i>Auditing</i>		<i>Maintenance of policies</i>	
	SLO-2									
S-3	SLO-1	<i>IT Risk framework</i>	<i>principles of Business/IT Alignment Excellence,</i>		<i>System/security life-cycle</i>		<i>Cost / benefit analysis</i>		<i>Prevention</i>	
	SLO-2									
S-4	SLO-1	<i>IT Risk identification</i>	<i>principles of Program/Project Management Excellence</i>		<i>Security implementation mechanisms</i>		<i>Asset management</i>		<i>Avoidance</i>	
	SLO-2									
S-5	SLO-1	<i>IT Risk Security Governance</i>	<i>principles of IT Service Management and Delivery Excellence</i>		<i>Information assurance analysis model</i>		<i>Standards</i>		<i>Incident response</i>	
	SLO-2									
S-6	SLO-1	<i>IT Risk assessment</i>	<i>principles of Vendor Management</i>		<i>Disaster recovery</i>		<i>Enforcement</i>		<i>Domain integration</i>	
	SLO-2									
S-7	SLO-1	<i>IT Risk evaluation</i>	<i>Outsourcing Excellence</i>		<i>Forensics</i>		<i>Legal issues</i>		<i>Social engineering</i>	
	SLO-2									
S-8	SLO-1	<i>IT Risk response,</i>	<i>critical success factors</i>		<i>threats</i>		<i>Disaster recovery</i>		<i>Protocol attacks</i>	
	SLO-2				<i>vulnerabilities</i>					



S-9	SLO-1	IT Risk monitoring and reporting	Case Study	attacks	security related issues and incidents	Security awareness
	SLO-2			countermeasures		

Learning Resources	1. Iannarelli, J. G., & O'Shaughnessy, M. O. (2015). <i>Information governance and security: Protecting and managing your company's proprietary information</i> . Waltham, MA: Butterworth Heinemann, Elsevier.	3. <i>Legal Issues in Information Security</i> , Joanna Lyn Grama, 2015. Jones & Bartlett Learning, Second Edition, ISBN: 978-1-284-05474-3.
	2. van Wyk, K. R., Graff, M. G., Peters, D. S., & Burley, D. L. (2015). <i>Enterprise software security: A confluence of disciplines</i> . Upper Saddle River, NJ: Pearson Education.	4. <i>Ethics of Big Data</i> , Kord Davis, 2012. O'Reilly Media, ISBN: 978-1449311797

Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember Understand	40 %	-	30 %	-	30 %	-	30 %	-	30%	-
Level 2	Apply Analyze	40 %	-	40 %	-	40 %	-	40 %	-	40%	-
Level 3	Evaluate Create	20 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Total	100 %		100 %		100 %		100 %		100 %	

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Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
Mr. Kesawan HCL Technologies	Dr. Surendran Rajendran AMA International University Bahrain	1. Dr.M.B Mukesh Krishnan, SRMIST
Mr.Celeian, Symantec		2. Ms. Ramaprabha.J,SRMIST
		3. Dr. G. Usha,SRMIST

Course Code	18CSE478T	Course Name	OPERATION SYSTEM SECURITY	Course Category	E	Professional Elective	L	T	P	C
							3	0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Computer Science and Engineering		Data Book / Codes/Standards	Nil	

Course Learning Rationale (CLR):		The purpose of learning this course is to:			Learning			Program Learning Outcomes (PLO)																
CLR-1 :	CLR-2 :	CLR-3 :	CLR-4 :	CLR-5 :	CLR-6 :	1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
						Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3	
CLR-1 :	To introduce students to a broad range of operating system security topics								H	H	M	M	M	L	L	L	H	M	L	H	H	H	H	H
CLR-2 :	To introduce students network and system security plans								H	H	M	M	M	L	L	L	H	M	L	H	H	H	H	H
CLR-3 :	To introduce students security design								H	H	M	M	M	L	L	L	H	M	L	H	H	H	H	H
CLR-4 :	To introduce students security threats and risks								H	H	M	M	M	L	L	L	H	M	L	H	H	H	H	H
CLR-5 :	To introduce students system and application security tools								H	H	M	M	M	L	L	L	H	M	L	H	H	H	H	H
CLR-6 :	To introduce students Network monitoring and audit logs and resolution of any security breach								H	H	M	M	M	L	L	L	H	M	L	H	H	H	H	H
Course Learning Outcomes (CLO):		At the end of this course, learners will be able to:																						
CLO-1 :	Identify and assess current and anticipated security risks and vulnerabilities					3	80	70																
CLO-2 :	Monitor, evaluate and test security conditions and environment					3	85	75																
CLO-3 :	Develop an organizational security plan that provides for periodic reviews of security policies and procedures					3	75	70																
CLO-4 :	Evaluate tools and technologies for use in protecting the network and individual network systems					3	85	80																
CLO-5 :	Implement security plan and monitor solutions					3	85	75																
CLO-6 :	Monitor and evaluate audit logs and set administrator alerts					3	80	70																

Duration (hour)	9		9		9		9		9	
S-1	SLO-1	Secure operating systems	What is a secure OS?	Information Protection And Security	Kali Linux	Implementation of strong password				
	SLO-2	Security goals								
S-2	SLO-1	Trust model	Nature of threats/attacks	Requirements	Installation and Configuration	Implementation of buffer overflow attack				
	SLO-2			Computer System Assets						
S-3	SLO-1	Threat model	Parts of an OS	Design Principles	Information Gathering Tools	Creation of child process using fork() function				
	SLO-2									
S-4	SLO-1	Access Control fundamentals: Lampson's access matrix	Processes & Threads	Protection of Memory	Vulnerability Analyses Tools	Executing programs with exec() functions				
	SLO-2									
S-5	SLO-1	Mandatory protection systems	Secure handling of Processes & Threads, Concurrency	User-Oriented Access Control	Wireless Attacks	Communication among multiple processes				
	SLO-2									
S-6	SLO-1	Reference monitor	Memory management	Data-Oriented Access Control	Website Penetration Testing	Automating simple jobs simple scripts				
	SLO-2									
S-7	SLO-1	Secure operating system definition	Secure memory management	File Sharing	Exploitation Tools	Executing programs at periodic intervals using at and crontab				
	SLO-2			Access Rights						

S-8	SLO-1	Assessment criteria	Secure Communication and messaging	Simultaneous Access	Forensics Tools	Building own shell interpreter with limited features (mini project)
	SLO-2			Trusted Systems		
S-9	SLO-1	OS Security Assessment	Security perspective: end-user	Trojan Horse Defense	Social Engineering	Retrofitting security into operating systems
	SLO-2		Hardware/Architecture support for OS security			

Learning Resources	<ol style="list-style-type: none"> <li>1. Abraham Silberschatz, Peter Baer Galvin and Greg Gagne, "Operating System Concepts", John Wiley &amp; Sons, Inc., 9th Edition, 2012</li> <li>2. William Stallings, "Operating System: Internals and Design Principles", Prentice Hall, 7th Edition, 2012</li> <li>3. Tom Adelstein and Bill Lubanovic, "Linux System Administration", O'Reilly Media, Inc., 1st Edition, 2007</li> <li>4. Trent Jaeger, "Operating Systems Security", Morgan &amp; Claypool Publishers, 2008</li> <li>5. Michael J. Palmer, "Guide to Operating Systems Security", Thomson/Course Technology, 2004</li> </ol>
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Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember Understand	40 %	-	30 %	-	30 %	-	30 %	-	30%	-
Level 2	Apply Analyze	40 %	-	40 %	-	40 %	-	40 %	-	40%	-
Level 3	Evaluate Create	20 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Total	100 %		100 %		100 %		100 %		100 %	

# CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
Mr. Kesawan HCL Technologies	Dr. Surendran Rajendran AMA International University Bahrain	1. Dr.M.B Mukesh Krishnan, SRMIST
Mr.Celeian, Symantec		2. Mr. M.V. Ranjith Kumar, SRMIST
		3. Mrs. S. Aruna Sankaralingam, SRMIST

Course Code	18CSE361T	Course Name	WEB PROGRAMMING	Course Category	E	Professional Elective			
						L	T	P	C
						3	0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Computer Science and Engineering		Data Book / Codes/Standards	Nil	

Course Learning Rationale (CLR):	The purpose of learning this course is to:			Learning			Program Learning Outcomes (PLO)																	
CLR-1 :	Web has become ubiquitous in nature			1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15			
CLR-2 :	Organizations have integrated the Internet "seamlessly" into their information systems and the Web offers endless opportunity to do so.			Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3			
CLR-3 :	This course provides the basic concepts and techniques used to design, develop, and deploy web applications satisfying the requirements in terms of flexibility, availability and scalability.						H	H	H	H	H	M	L	M	H	M	H	M	M	H	H	H	H	M
Course Learning Outcomes (CLO):							At the end of this course, learners will be able to:				H	H	H	H	M	L	M	H	M	M	H	H	H	H
CLO-1 :	Understand different internet Technologies, web 2.0 and create a basic website using HTML and Cascading Style Sheets			1	80	70	H	H	H	H	M	L	M	H	M	M	H	H	H	H	M			
CLO-2 :	Design a dynamic web page with validation using JavaScript objects and by applying different event handling mechanisms			1	85	75	H	H	H	H	M	L	M	H	M	M	H	H	H	H	M			
CLO-3 :	Design a server side program using Servlets and JSP			1	75	70	H	H	H	H	M	L	M	H	M	M	H	H	H	H	M			
CLO-4 :	Design a simple web page in PHP, and to present data in XML format.			2	85	80	H	H	H	H	M	L	M	H	M	M	H	H	H	H	M			
CLO-5 :	Get overviews of java specific web services architecture and to enable rich client presentation using AJAX.			2	85	75	H	H	H	H	M	L	M	H	M	M	H	H	H	H	M			

Duration (hour)	9		9		9		9		9	
S-1	SLO-1	Understanding Internet , Difference between websites and web server	An introduction to JavaScript	Java Servlet Architecture	An introduction to PHP	Introduction to Ajax				
	SLO-2	Internet technologies Overview	Java Script Terminologies	Servlet Life Cycle	Using PHP, Variables, Program control	Ajax Client Server Architecture				
S-2	SLO-1	Understanding websites and web servers:	Introduction to DOM Model	Form GET and POST actions	Built-in functions	Introduction to XMLHttpRequest Object				
	SLO-2	Understanding the difference between internet and	DOM Model	Session Handling ,	Connecting to Database	XMLHttpRequest Object				
S-3	SLO-1	Web 2.0: Basics, RIA Rich Internet Applications	Introduction to Objects	Understanding Cookies,	Using Cookies	Introduction to Call Back Methods				
	SLO-2	collaborations tools	Built-in objects: Math Object	Installing and Configuring Apache Tomcat Web Server	Regular Expressions	Call Back Methods				
S-4	SLO-1	HTML5.0 Introduction	Built-in objects: String Object	Introduction to JSP	Introduction to XML	Introduction to Web Services				
	SLO-2	HTML5.0 Elements Headers ,Linking,Images,List	Date Object	Understanding Java Server Pages	Basic XML Concepts	Java web services Basics				
S-5	SLO-1	HTML5.0 Elements Tables, Formatting,Frames	Boolean Object	Applications on JSP	Introduction to DTD	Introduction to SOAP				
	SLO-2	CSS Introduction	Object Collections	Introduction to JSTL	Document Type Definition	Elements of SOAP				
S-6	SLO-1	CSS Types	Regular Expressions	Understanding of JSTL	Introduction to XML	Introduction to WSDL				

	SLO-2	CSS : Positioning, Text Flow and Box Model	Examples of Regular Expressions	JSP Standard Tag Library(JSTL)	XML Schema	Creating, Publishing a WSDL
S-7	SLO-1	XHTML Introduction	Exception Handling	Creating HTML forms by embedding JSP code	DOM and Presenting XML	Testing and Describing a Web services(WSDL)
	SLO-2	XHTML Elements:Headers, Linking, Images, List	Validation	Creating HTML forms by embedding JSP code	XML Parsers	Consuming a web service
S-8	SLO-1	XHTML Elements: Tables, Formatting, Frames	Event Handling Concept	Creating HTML forms by embedding JSP code	XML Validation	Introduction to Database Driven web service from an application
	SLO-2	CSS 3 Introduction	Introduction to DHTML	Creating HTML forms by embedding JSP code	XSL Transformation	Database Driven web service from an application
S-9	SLO-1	CSS 3 Types	DHTML with JavaScript	Lab 6: Creating HTML forms by embedding JSP code	XSLT Transformation	Applications on Database Driven web service
	SLO-2	CSS 3: Positioning, Text Flow and Box Model		Creating HTML forms by embedding JSP code	News Feed (RSS and ATOM)	Applications on Database Driven web service

Learning Resources	<p>1. Deitel, Deitel and Nieto, <i>Internet and World Wide Web : How to Program, 5th Edition, 2012, Prentice Hall, ISBN-13:978-0-13-215100-9</i></p> <p>2. Stephen Wykooop, <i>Running a perfect website, QUE, 2nd Edition, 2001. ISBN 13: 9780789709448</i></p> <p>3. Chris Bates, <i>Web Programming : Building Intranet applications, 3rd Edition, 2009, Wiley Publications, ISBN 13:9780470017753.</i></p>	<p>3. Jeffrey C. Jackson, <i>“Web Technologies A computer Science Perspective”, 2011, Pearson, ISBN 9780133001976</i></p> <p>4. <a href="https://www.W3Schools.com">https://www.W3Schools.com</a></p>
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Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#		Theory	Practice
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice		
Level 1	Remember	40%	-	30%	-	30%	-	30%	-	30%	-
	Understand										
Level 2	Apply	40%	-	40%	-	40%	-	40%	-	40%	-
	Analyze										
Level 3	Evaluate	20%	-	30%	-	30%	-	30%	-	30%	-
	Create										
	Total	100 %		100 %		100 %		100 %		100%	

# CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts Dr.R.Jebakumar

Course Code	18CSE362T	Course Name	INTEGRATIVE PROGRAMMING AND TECHNOLOGY			Course Category	E	Professional Elective					L	T	P	C										
Pre-requisite Courses		Nil		Co-requisite Courses		Nil		Progressive Courses		Nil																
Course Offering Department		Computer Science and Engineering			Data Book / Codes/Standards		Nil																			
Course Learning Rationale (CLR):		The purpose of learning this course is to:					Learning			Program Learning Outcomes (PLO)																
CLR-1 :	Understand the concepts and features of Integrative programming					1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15			
CLR-2 :	Gain knowledge on Java network programming and JDBC for integrating applications					Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3			
CLR-3 :	Gain knowledge on Java component based technology for integrating reusable components across applications								H	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLR-4 :	Acquire knowledge on XML and JSON technology for data representation and exchange in integrating applications								H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLR-5 :	Acquire knowledge in Java Messaging Service								H	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLR-6 :	Understand interoperability between programming languages								H	-	-	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Course Learning Outcomes (CLO):		At the end of this course, learners will be able to:							2	80	85	H	H	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-1 :	Understand the basic ideas in Integrative coding					2	75	80	H	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
CLO-2 :	Acquire the ability to code java socket programming and java application to integrate databases					2	85	80	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
CLO-3 :	Acquire the ability to develop Enterprise Java bean components and Java based Web services					2	80	75	H	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
CLO-4 :	Appreciate the concepts of ML and JSON techniques in data representation and exchange for integrating applications					2	75	85	H	-	-	H	-	-	-	-	-	-	-	-	-	-	-	-		
CLO-5 :	Acquire the knowledge for developing JMS based enterprise application integration					2	75	85	H	-	-	H	-	-	-	-	-	-	-	-	-	-	-	-		
Duration (hour)	9		9		9		9		9					9												
S-1	SLO-1	Programming paradigms an overview	Java network programming and RMI overview	Component Based technology overview	Data representation and exchange techniques in integrating applications overview	Interoperability between programming languages an overview																				
	SLO-2	Integrative programming an overview,	Java networking basics	Java beans concept and feature for reusability	Understanding XML and JSON for data representation and exchange	Understanding Java platform runtime environment and JVM																				
S-2	SLO-1	Integrative coding and its supporting Object Oriented concepts like inheritance, interface polymorphism .	Socket programming for TCP	Visual Java Beans components features and steps for creation	Understanding XML validation, Schema,	Understanding Java Native Interface(JNI) concepts in integrating native application code in java applications																				
	SLO-2	Object oriented design pattern for integrative coding overview..	Options and features for socket programming	Integrating visual beans to different applications	Understanding XML parsers DOM and SAX variant parsers.	Java tools for JNI programming																				
S-3	SLO-1	Creational design pattern, structural design pattern, Behavioral design pattern	UDP programming using Datagram	Enterprise Java platform overview	Understanding Integration of Enterprise applications with XML	Java libraries for JNI support																				
	SLO-2	Concept of Inversion of Control	options and features for UDP programming	Enterprise java bean components features and types	JSON encoding and decoding implementation	Understanding Usage of IDE for JNI programming																				
S-4	SLO-1	Application Architecture overview	Secure socket Communication	Session bean concepts and its types	Concept of Messaging Queue in integrating software systems to exchange information Asynchronously	Understanding concepts in JNI programming .Name mangling and function signatures DLL ,The JNIEnv argument																				
	SLO-2	Multi-tier architecture for integrating application packages like client side,	IP multicast and Multicast socket programming	Entity bean concepts and types	JMS and its role in integrating application in java enterprise platform	Understanding Accessing of Java Strings, Passing and using Java objects in native code																				

		middleware and databases				
S-5	SLO-1	Enterprise application architecture, overview	RMI and distributed applications	Implementing Enterprise application through integrating session and Entity beans	JMS features and benefits	Exception handling in JNI
	SLO-2	JEE platform and its features	Understanding stub and skeleton concept in RMI	Java web services an overview	JMS service providers	Threading concept in JNI
S-6	SLO-1	Understanding Design principles in Enterprise applications	RMI programming application steps	SOAP based web services .WSDL, SOAP message	Concept of Message queues	Python integration in java platform overview
	SLO-2	Enterprise application integration overview	RMI programming implementation	JAX-WS implementation for SOAP based webservice	Point to point messaging domain features	Jython programming concepts and features
S-7	SLO-1	Role of Design Patterns in Enterprise application integration,	Concepts in Java Database connectivity in integrating java applications with various databases	RESTful web services features	Application scenario for integrating applications through p2p messaging	Installation of Jython for developing applications to run in java platform.
	SLO-2	Designing distributed object interfaces	Understanding Types of data base connectivity Different drivers	JAX-RS implementation for Restful web services	Concept of publish/subscribe method of messaging	Jython programming basics
S-8	SLO-1	Front controller patterns	JDBC application program concepts and implementation	Integrating web services component to client application	Application scenario for integrating applications through publish/subscribe method based messaging	Accessing Java features and libraries of java in Jython code
	SLO-2	Facade patterns,	Java persistence API overview	Service discovery, UDDI	Message driven beans in Enterprise JavaBeans	Java swing based GUI development in Jython
S-9	SLO-1	Adapter patterns	Java Data Objects(JDO) concepts	Policy and security for web services	Features and environmental setup for implementing Message driven beans	Understanding Jython JDBC connectivity
	SLO-2	Concepts of DAO	Java persistence API frameworks overview	Comparison between SOAP and RESTful web services	Understanding and using JMS in Message driven beans	Integrating Jython code in Java application

Learning Resources	<p>1. KogentLearningSolutionsInc, JAVA Serve rProgramming Java EE7 BlackBook , 5<sup>th</sup> ed., Weily India, 2016.</p> <p>2. ElliotteRustyHarold, JavaNetworkprogramming, O'Reilly, 2013</p>	<p>3. Cay S. Horstmann , D. R., Core Java Volume II - Advanced Features 10<sup>nd</sup> ed., John Wiley &amp; Sons, 2013.</p>
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Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#		Theory	Practice
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice		
Level 1	Remember	40 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Understand	40 %	-	30 %	-	30 %	-	30 %	-	30%	-
Level 2	Apply	40 %	-	40 %	-	40 %	-	40 %	-	40%	-
	Analyze	40 %	-	40 %	-	40 %	-	40 %	-	40%	-
Level 3	Evaluate	20 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Create	20 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Total	100 %		100 %		100 %		100 %		100 %	

# CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Mr. Venketasan Palavesam Delivery Head L & T		1.Mr. K. Navin, SRMIST
2. K.S.Kumar COO MindZen, India private Ltd		Mr S.Ramaraj and Dr. Parthiban

Course Code	18CSE364T	Course Name	SYSTEM ADMINISTRATION AND MAINTENANCE	Course Category	E	Professional Elective	L	T	P	C
							3	0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	
Course Offering Department	Computer Science and Engineering		Data Book / Codes/Standards	Nil	

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning			Program Learning Outcomes (PLO)																	
CLR-1 :	Understand the factors that make Authentication/Authorization and stores of system Administration	1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15			
CLR-2 :	Acquire a knowledge and understanding of the specific problems in the Enterprise Security, and be able to apply some of the techniques	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3			
CLR-3 :	Identify the specific challenges that inherent in the Budget and Desktop Deployment of system Administration that are able to apply some of the techniques that can be of use in comprehending and changing them				H	H	H	H	H	-	-	-	H	H	-	H	-	-	-	-	-	-
CLR-4 :	Evaluate and understand the specific problems inherent in the system maintenance and evolution of package- based operating system, and be able to apply techniques for designing change-resistant systems from pre- packaged code.				M	H	M	M	H	H	-	-	-	M	H	-	H	-	-	-	-	-
CLR-5 :	Analyze and apply system maintenance technical concepts that relate to UPS software administration				M	H	M	H	H	H	-	-	-	M	H	-	H	-	-	-	-	-
					H	H	M	H	H	H	-	-	-	M	H	-	H	-	-	-	-	-

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:																			
CLO-1 :	Explain terms used in make Authentication/Authorization and stores of system Administration	3	80	70	H	H	H	H	H	-	-	-	H	H	-	H	-	-	-	
CLO-2 :	Incorporate a knowledge and understanding of the specific problems Enterprise Security, and be able to apply some of the techniques	3	85	75	M	H	H	M	H	-	-	-	M	H	-	H	-	-	-	
CLO-3 :	Identify challenges that inherent in maintenance and evolution of package-based operating system, and be able to apply techniques	3	75	70	M	H	M	H	H	-	-	-	M	H	-	H	-	-	-	
CLO-4 :	Apply techniques for designing change-resistant systems from pre-packaged code.	3	85	80	M	H	M	H	H	-	-	-	M	H	-	H	-	-	-	
CLO-5 :	Apply system maintenance technical concepts that relate to UPS software administration	3	85	75	H	H	M	H	H	-	-	-	M	H	-	H	-	-	-	

Duration (hour)	9		9		9		9		9	
S-1	SLO-1	Authentication/Authorization	Thin client support:	Issues relating to proposal construction and endorsement: New project development issues,	Customization of Operating System and maintenance of system:3 types of media to use when backing up your data and when each method is appropriate,	UPS: Identify the specifications of UPS,				
	SLO-2									
S-2	SLO-1	Storage: Storage Area Networks	LTSP, Citrix	RFC construction, RFP Process,	How to create automated backups to ensure you always have a recent backup,	Switch-on and Switch-off procedure of UPS,				
	SLO-2									
S-3	SLO-1	Network Attached Storage	Windows Terminal services,	Budgeting,	Learn how to manually backup data, How to make an exact copy of a hard drive	Measurement of Input/output voltage/current levels, battery charge level,				
	SLO-2									
S-4	SLO-1	Storage Virtualization, Enterprise Backup and Restoration Issues	Sun Ray Services	Budgeting for new projects	Hardware Troubleshooting: The danger in not diagnosing problems first,	Identifying status of UPS from front panel indicators,				
	SLO-2									
S-5	SLO-1	Enterprise Service Deployment: Clustering and fault tolerance,	Enterprise Security:	Desktop Deployment and Management, Alternative Desktops: SUS	Learn how to test your RAM ,	carryout routine maintenance of battery, battery terminals, loose contacts etc.,				
	SLO-2									
S-6	SLO-1	Virtualization of services, Grids/On Demand/N1	Disaster Recovery	RIS,	check your hard drive for errors	Test UPS as per specification. Verification of back-up time.				
	SLO-2									
S-7	SLO-1	Enterprise Applications: Enterprise Resource Planning,	Policies	Sun Java Desktop,	PC Cleaning: The best cleaning supplies to use,	Circuit tracing and fault finding practice				
	SLO-2									



S-8	SLO-1	Customer Relationship Management,	Planning	Xandros	How to increase airflow and increase your computers lifespan	Servicing of UPS by simulating more likely faults and systematic approach to identify and rectify them
	SLO-2					
S-9	SLO-1	Office Automation	Procedures	Lindows	How to clean your computer	backup times its dependence on battery's load and its calculations
	SLO-2					

Learning Resources	1. Tittel, et al, A Guide to Microsoft Exchange Server 5.5, Course Technology	2. Hughes and Thomas, Novell's Guide to NetWare 5 Networks, IDG	3. Harvel et al, Unix and Windows 2000 Handbook, Prentice Hall
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Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#		Theory	Practice
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice		
Level 1	Remember	40%	-	30%	-	30%	-	30%	-	30%	-
	Understand										
Level 2	Apply	40%	-	40%	-	40%	-	40%	-	40%	-
	Analyze										
Level 3	Evaluate	20%	-	30%	-	30%	-	30%	-	30%	-
	Create										
	Total	100 %		100 %		100 %		100 %		100%	

# CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
		1. Mr.S.Selvakumara Samy., SRMIST

Course Code	18CSE365T	Course Name	FUNDAMENTALS OF VIRTUALIZATION	Course Category	E	Elective	L	T	P	C
							3	0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Computer Science and Engineering		Data Book / Codes/Standards	Nil	

Course Learning Rationale (CLR):	The purpose of learning this course is to:			Learning			Program Learning Outcomes (PLO)																	
CLR-1 :	Understand about Computing Virtualization tools, applications and techniques			1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15			
CLR-2 :	Understand CPU virtualization, memory virtualization			Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3			
CLR-3 :	How to configure VM CPU and memory options						L	H	-	H	L	-	-	-	-	-	L	L	-	H	-	-	-	-
CLR-4 :	Understand storage and network virtualization						M	H	L	M	L	-	-	-	-	-	M	L	-	H	-	-	-	-
CLR-5 :	Acquire knowledge about virtualization security						M	H	M	H	L	-	-	-	-	-	M	L	-	H	-	-	-	-
CLR-6 :	Learn about many case studies						M	H	M	H	L	-	-	-	-	-	M	L	-	H	-	-	-	-
CLR-6 :	Learn about many case studies						H	H	M	H	L	-	-	-	-	-	M	L	-	H	-	-	-	-
Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:			3	80	70	L	H	-	H	L	-	-	-	L	L	-	H	-	-	-			
CLO-1 :	Able to define, distinguish Computing Virtualization tools, applications and techniques			3	85	75	M	H	L	M	L	-	-	-	M	L	-	H	-	-	-			
CLO-2 :	Create a virtual environment and install VM with several guest operating systems			3	75	70	M	H	M	H	L	-	-	-	M	L	-	H	-	-	-			
CLO-3 :	Able to configure virtual machine CPU and memory options			3	85	80	M	H	M	H	L	-	-	-	M	L	-	H	-	-	-			
CLO-4 :	Able to configure VM storage and network options			3	85	75	M	H	M	H	L	-	-	-	M	L	-	H	-	-	-			
CLO-5 :	Identify threats and able to security to virtualized environment			3	80	70	H	H	-	H	L	-	-	-	M	L	-	H	-	-	-			
CLO-6 :	Investigate and discuss about case studies			3	80	70	L	H	-	H	L	-	-	-	L	L	-	H	-	-	-			

Duration (hour)	9		9		9			9				9		
S-1	SLO-1	Overview Of Virtualization -Basics of Virtualization -	Creating a Virtual machine- Performing P2V Conversions	Managing Storage for a virtual machine-Understanding storage virtualization	Theory Network Device Virtualization - VLANs	Case study: Load balancing								
	SLO-2	Virtualization Types – Desktop Virtualization	Loading your Environment	Configuring VM Storage options	VRF Instances- VFI's -Virtual Firewall Contexts Network Device Virtualization	Autonomic computing								
S-2	SLO-1	Storage Virtualization – System-level Operating Virtualization – Application Virtualization-	Building a new Virtual machine	Tuning practices for VM storage	Fundamentals of Virtualization security-Virtualization architecture	Xen para virtualization								
S-3	SLO-1	Virtualization Advantages	Managing CPUs for a virtual machine-Understanding CPU Virtualization	SCSI- Speaking SCSI- Using SCSI buses – Fiber Channel – Fiber Channel Cables – Fiber Channel Hardware Devices – iSCSI Architecture – Securing iSCSI	Threats to a virtualized environment	Any Simulation tool								
S-4	SLO-2		Configuring VM CPU options	Server virtualization concepts	How security must adapt to virtualization	Webhosting								
S-5	SLO-1	Understanding Hypervisors	Tuning practices for VM CPUs	Introduction to server virtualization, Types of server virtualization technologies	Securing hypervisors-Hypervisor configuration and security	KVM virtualization								
S-6	SLO-2			Limitations of server virtualization										
S-7	SLO-1	Understanding Virtual Machines Assignment-Installing windows, Linux on a virtual machine	Managing Memory for a virtual Machine-Understanding memory virtualization, Configuring VM memory options	Managing Networking for a virtual machine-understanding network virtualization	Designing virtual networks for security-comparing virtual and physical networks	Microsoft Virtual Server								

S-8	SLO-2		Tuning practices for VM memory	Configuring VM network options	Virtual network security considerations	Live migration
S-9				Tuning practices for Virtual networks	Configuring virtual switches for security	

Learning Resources	1. William von Hagen, Professional Xen Virtualization, Wrox Publications, January, 2008 2. Virtualization Essentials by Matthew Portnoy ISBN: 978-1118176719	3. Virtualization Security: Protecting Virtualized Environments, Dave Shackleford, Sybex Publications, 2013 4. Kumar Reddy, Victor Moreno, Network Virtualization, Cisco Press, July, 2006. 5. David Marshall, Wade A. Reynolds, Advanced Server Virtualization: VMware and Microsoft Platform in the Virtual Data Center, Auerbach Publications, 2006.
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Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember Understand	40 %	-	30 %	-	30 %	-	30 %	-	30%	-
Level 2	Apply Analyze	40 %	-	40 %	-	40 %	-	40 %	-	40%	-
Level 3	Evaluate Create	20 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Total	100 %		100 %		100 %		100 %		100 %	

# CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
	Ms. SS. Subashka, SRMIST, Ramapuram	1. Mrs. TYJ Naga Malleswari SRMIST
	Mr. B.S. Vidhyasagar, SRMIST, Vadapalani	2. Mrs Sasirekha Sankar, SRMIST
		3. Dr. MB. Mukesh krishnan SRMIST

Course Code	18CSE366T	Course Name	HUMAN COMPUTER INTERACTION	Course Category	E	Professional Elective	L	T	P	C
							3	0	0	3

Pre-requisite Courses	NA	Co-requisite Courses	NA	Progressive Courses	//Course code
Course Offering Department	Computer Science and Engineering			Data Book / Codes/Standards	NA

Course Learning Rationale (CLR):	The purpose of learning this course is to:			Learning			Program Learning Outcomes (PLO)																																	
CLR-1 :	Understand the basic concepts of HCI			1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15																			
CLR-2 :	Learn the various design and software processes			Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3																			
CLR-3 :	Become familiar with different models of HCI and evaluation techniques																																							
CLR-4 :	Learn web interface design																																							
CLR-5 :	Learn mobile interface design																																							

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:																					
CLO-1 :	Explain why it is important to design interactive products that are usable			3	75	70																
CLO-2 :	Explain key terms used in interactive design			3	75	70																
CLO-3 :	Explain the need for different models and the importance of evaluation			3	65	60																
CLO-4 :	Gain knowledge on web interface design			3	55	50																
CLO-5 :	Attain knowledge on mobile interface design			3	55	50																

Duration (hour)	9	9	9	9	9
S-1	Human: I/O Channels, Memory	Interactive design basics: Design process, Navigation design	Cognitive models: Introduction and GOMS	Designing web interfaces:	Mobile Interface design:
S-2	Thinking: Reasoning and Problem Solving, Emotion	Screen design and layout, Iteration and prototyping	Linguistic model	Introduction and Brainstorming session	Introduction and Brainstorming session
S-3	Individual differences, Psychology design of interactive systems	Software process: Software lifecycle, Usability engineering	Physical and device models	Drag and Drop,	Mobile Ecosystem: Platforms
S-4	Computer: Devices, Physical controls, sensors and special devices	Iterative design and prototyping, Design rationale	Organizational issues, Capturing requirements	Direct Selection	Application frameworks
S-5	Readability of text, Memory, Processing and networks	Design rules: Principles, Standards	Communication and collaboration models:	Contextual tools	Types of mobile applications: Widgets,
S-6	Interaction: Basics and Models	Guidelines, Golden rules	face-to-face and conversation	Overlays	Application, Games
S-7	Frameworks, Ergonomics, Interaction styles	Evaluation techniques: Goals, evaluation through expert analysis	Text based Communication and Group working	Inlays and Virtual pages	Mobile Information Architecture
S-8	WIMP interface elements, Interactivity	Evaluation through user participation	Task analysis: Introduction and Task decomposition comparison	Process flow	Mobile design: Elements and Tools
S-9	Paradigms: Interactive paradigms	Universal design: Principles, Multi-modal interaction User support: Requirements and Approaches	Knowledge based analysis	Case Study discussion	Case Study discussion

Learning Resources	1. <i>Human Computer Interaction by Alan Dix, Janet Finlay, Gregory D.Abowd and Russell Beale – Third Edition - Pearson Education – 2004</i>	4. <i>Designing Web Interfaces by Bill Scott and Theresa Neil – First Edition – O'Reilly Media Inc. – 2009</i> 5. <i>Mobile Design and Development by Brian Fling - First Edition – O'Reilly Media Inc. – 2009</i>
	2. <i>Human Computer Interaction by K.Meena and R.Sivakumar – 2015 – Prentice Hall India</i> 3. <i>Designing the User Interface: Strategies for Effective Human Computer Interaction by Ben Shneiderman and Catherine Plaisant – Fifth Edition - 2009 – Pearson Addison Wesley</i>	

Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#		Theory	Practice
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice		
Level 1	Remember	40 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Understand										
Level 2	Apply	40 %	-	40 %	-	40 %	-	40 %	-	40%	-
	Analyze										
Level 3	Evaluate	20 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

# CA – 3 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

SLO – Session Learning Outcome

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
	<i>Dr.T.Nagarajan, Professor and Head,Dept. of IT, SSN college of Engineering.</i>	1. <i>Dr. M. Thenmozhi, SRMIST</i>
		2. <i>Dr.S Prabhakaran, SRMIST</i>
		3. <i>Dr. Alice Nithya , SRMIST</i>

Course Code	18CSE397T	Course Name	COMPUTATIONAL DATA ANALYSIS	Course Category	E	Professional Elective	L	T	P	C
							3	0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Computer Science and Engineering		Data Book / Codes/Standards	Nil	

Course Learning Rationale (CLR):		Learning			Program Learning Outcomes (PLO)																	
The purpose of learning this course is to:		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15			
CLR-1 :	Understand the underlying assumptions, verify them, and propose appropriate actions if some assumptions do not hold	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge																	
CLR-2 :	Identify appropriate statistical learning methods for the given problem involving real data.				Problem Analysis																	
CLR-3 :	Evaluate performance of the chosen regression and classification techniques and compare them				Design & Development																	
CLR-4 :	Show, analytically or empirically, the optimal balance between precision within training data and prediction power.				Analysis, Design, Research																	
CLR-5 :	Use training and testing data to evaluate performance of the chosen regression and classification techniques and compare them.				Modern Tool Usage																	
CLR-6 :	Illustrate results with appropriate plots and diagrams.				Society & Culture																	
Course Learning Outcomes (CLO):		At the end of this course, learners will be able to:			Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3									
CLO-1 :	Acquire the knowledge on methods, theory, mathematics and algorithms in data analysis	2	80	85	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-			
CLO-2 :	Acquire the ability to To formulate and model mathematical and computational tasks	2	75	80	H	H	-	-	-	-	-	-	-	-	-	-	-	-	-			
CLO-3 :	Understand the basic ideas about high-level data analysis, concepts and techniques	2	85	80	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-			
CLO-4 :	Acquire the ability identify other possible problems with messy data, such as multi-collinearity, understand their consequences, and propose solutions.	2	80	75	H	H	-	-	-	-	-	-	-	-	-	-	-	-	-			
CLO-5 :	Apply the knowledge To build from scratch the basic components of a data analysis pipeline	2	75	85	H	-	-	H	-	-	-	-	-	-	-	-	-	-	-			
CLO-6 :	To Show, analytically or empirically, the optimal balance between precision within training data and prediction power.	2	80	85	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-			

Duration (hour)	9	9	9	9	9	
S-1	SLO-1	General Introduction	Generative Algorithms: Multivariate Normal	Unsupervised Learning:	Regularization and Model Selection:	Decision Tree and Random Forest:
	SLO-2	Supervised Learning	Linear Discriminant Analysis	PCA	Cross Validation,	Entropy
S-2	SLO-1	Least Squares and Nearest Neighbors	Naive Bayes	Mixture Models	Hill Climbing	Building Tree Bagging features
	SLO-2	Statistical Models	Laplacian Smoothing	Bayesian Graphical Models	Bayesian Optimization	Bagging Samples
S-3	SLO-1	Discriminative Algorithms	Multiclass Classification	Power Method	Bayesian Regression	Random Forest Adaboost
	SLO-2	Supervised Learning Concept	K-NN	Oja's algorithm	Bayesian Logistic	Gradient Tree Boosting
S-4	SLO-1	Linear Regression	Multi-class Fisher Discriminant Analysis	EM Algorithm	Regression Forward and	Boosting and Regularization Paths
	SLO-2	The Gauss-Markov Theorem	Multinomial Regression	Variational Inference	Backward Regression	Learning Ensembles
S-5	SLO-1	Multiple Regression	Support Vector Machines and Kernel Methods	Matrix Factorization/Completion	Lasso	Proximity Plots
	SLO-2	Maximum Likelihood	Intuition, Geometric Margins,	Independent Component Analysis	elastic-net	Random Forests and Overfitting
S-6	SLO-1	Normal Equation	Optimal Margin Classifier	The Google PageRank Algorithm	Proximal Gradient	Neural Network: Concept
	SLO-2	Gradient Descent	Lagrangian Duality, Soft-margin,	Principal Components, Curves and Surfaces	Prox-SVRG	Deep Neural Network
S-7	SLO-1	Stochastic Gradient	Loss function, Stochastic Subgradient	Cluster Analysis	Coordinate Proximal Gradient	Backpropagation

			Method			
	SLO-2	SVRG	Kernel, SMO algorithm	Proximity Matrices	Pathwise Coordinate Descent	Convolutional Neural Network;
S-8	SLO-1	Linear Classification	Coordinate Gradient Descent	Dissimilarities Based on Attributes	Principal Components Regression	Bayesian Neural Nets
	SLO-2	Linear Discriminant Analysis	Kernel PCA, Kernel Logistic Regression	Object Dissimilarity	Incremental Forward Stage wise Regression	Bayes, Boosting and Bagging
S-9	SLO-1	Logistic Regression	Kernel Ridge Regression	Clustering Algorithms	The Dantzig Selector	Fitting Neural Networks
	SLO-2	Newton Method	Multiclass SVM	Combinatorial Algorithms	The Grouped Lasso	Issues in Training Neural Networks

Learning Resources	1. Hastie, Tibshirani and Friedman, <i>The Elements of Statistical Learning, Data Mining, Inference and Prediction</i> , 2 <sup>nd</sup> ed., Springer, 2008.	3. Andrew Ng, CS229 Lecture notes: <a href="http://cs229.stanford.edu/notes/cs229-notes1.pdf">http://cs229.stanford.edu/notes/cs229-notes1.pdf</a>
	2. Mohri, Rostamizadeh and Talwalkar, <i>Foundations of Machine Learning</i> , The MIT Press Cambridge, Massachusetts London, England, 2012	

Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#		Theory	Practice
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice		
Level 1	Remember	40 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Understand										
Level 2	Apply	40 %	-	40 %	-	40 %	-	40 %	-	40%	-
	Analyze										
Level 3	Evaluate	20 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

# CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
Mr. Jayaraj Chandrasekaran, UST Global, Chennai, <a href="mailto:jayaraj.chandrasekaran@ust-global.com">jayaraj.chandrasekaran@ust-global.com</a>	Dr. Devaki, Rajalakshmi Engineering College, Professor, Department of Computer Science and Engineering.	Mrs. S. Nagadevi
		Dr. G. Vadivu

Course Code	18CSE461T	Course Name	INTERNET SECURITY AND CYBER FORENSICS	Course Category	E	Professional Elective			
						L	T	P	C
						3	0	0	3

Pre-requisite Courses	18CSC302J	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Computer Science and Engineering		Data Book / Codes/Standards	Nil	

Course Learning Rationale (CLR):	The purpose of learning this course is to:			Learning			Program Learning Outcomes (PLO)																
CLR-1 :	Study about various threats associated with security and information warfare			1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15		
CLR-2 :	Study about email security and the Importance of Firewalls and their types			Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3		
CLR-3 :	Impart an introduction to the need of computer forensics						L	H	-	L	L	-	-	-	-	-	L	L	-	H	-	-	-
CLR-4 :	Study the tools and tactics associated with cyber forensics						M	H	-	M	L	-	-	-	H	M	M	-	H	-	-	-	
CLR-5 :	Analyze and validate computer forensics data						M	H	M	H	H	-	-	H	M	M	-	H	-	-	-		
Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:						3	75	70	H	H	M	H	M	-	-	H	M	M	-	H	-	-
CLO-1 :	Have thorough knowledge about various threats associated with security and information warfare			2	85	80	L	H	-	L	L	-	-	-	L	L	-	H	-	-			
CLO-2 :	Have in-depth knowledge about email security and understand the Importance of Firewalls and their types			2	85	75	M	H	-	M	L	-	-	-	M	L	-	H	-	-			
CLO-3 :	Understand the need of computer forensics			2	80	75	M	H	M	H	L	-	-	H	M	M	-	H	-	-			
CLO-4 :	Utilize the tools and tactics associated with cyber forensics			3	75	70	M	H	M	H	H	-	-	H	M	M	-	H	-	-			
CLO-5 :	Analyze and validate computer forensics data and apply them for solving computer forensics issues			3	75	70	H	H	M	H	M	-	-	H	M	M	-	H	-	-			

Duration (hour)	9		9		9			9			9		
S-1	SLO-1	IPSec Protocol – Basics	PGP – Confidentiality and Authentication	Computer Forensics Fundamentals: Introduction to Computer Forensics, Use of Computer Forensics in Law Enforcement, Computer Forensics Assistance to Human Resources/Employment Proceedings	Processing Crime and Incident Scenes: Identifying Digital Evidence			Computer Forensics Analysis and Validation, Determining what data to collect and analyze					
	SLO-2	IPSec Protocol - Documents	PGP – Compression and E-mail compatibility via Radix-64 conversion	Computer Forensics Services, Benefits of Professional Forensics Methodology, Steps Taken by Computer Forensics Specialists, Who Can Use Computer Forensic Evidence?	Collecting Evidence in Private-Sector Incident Scenes, Processing Law Enforcement Crime Scenes			Validating Forensics Data, Validating with Hexadecimal Editors, Validating with Computer Forensics Programs					
S-2	SLO-1	IPSec Protocol – Security Associations	MIME	Types of Computer Forensics Technology: Types of Military Computer Forensic Technology	Preparing for a Search			Data Hiding Techniques - Hiding Partitions, Marking Bad Clusters, Bit-Shifting					
	SLO-2	Hashed Message Authentication Code (HMAC)	S/MIME	Types of Law Enforcement: Computer Forensic Technology	Securing a Computer Incident or Crime Scene , Seizing Digital Evidence at the Scene			Using Steganography to Hide Data,					
S-3	SLO-1	IP Authentication Header	Internet Firewalls for Trusted System: Roles of Firewalls	Types of Business Computer Forensic Technology	Storing Digital Evidence, Obtaining a Digital Hash			Examining Encrypted Files, Recovering Passwords					
	SLO-2	IP ESP	Firewall related terminology	Specialized Forensics Techniques	Reviewing a Case			Performing Remote Acquisition, Remote Acquisitions with Runtime Software					
S-4	SLO-1	Key Management Protocol for IPSec – OAKLEY Key Determination Protocol	Types of Firewalls	Types of Computer Forensics Systems: Internet Security Systems, Intrusion Detection Systems, Firewall Security Systems	Working with Windows and DOS Systems			Network Forensics					



	SLO-2	Key Management Protocol for IPsec – ISAKMP	Packet filters	Storage Area Network Security Systems, Network Disaster Recovery Systems, Public Key Infrastructure Systems	Understanding File Systems, Exploring Microsoft File Structures	Securing a Network
S-5	SLO-1	Transport layer Security : SSL and TLS	Circuit level gateways	Wireless Network Security Systems, Satellite Encryption Security Systems, Instant Messaging (IM) Security Systems , Net Privacy Systems	Examining NTFS Disks	Email Investigations – Exploring the Role of E-mail in Investigations, Exploring the Roles of the Client and Server in E-mail
	SLO-2	SSL Protocol	Application level gateways	Identity Management Security Systems, Identity Theft, Biometric Security Systems, Homeland Security Systems	Understanding Whole Disk Encryption	Investigating E-mail Crimes and Violations: Examining E-mail Messages, Viewing E-mail Headers, Examining E-mail Headers, Examining Additional E-mail Files
S-6	SLO-1	SSL Record Protocol	Firewall designs	Understanding Computer Investigation: Preparing a Computer Investigation, Taking a Systematic Approach	Understanding the Windows Registry	Tracing an E-mail Message, Using Network E-mail Logs
	SLO-2	SSL Change Cipher Spec Protocol	Screened Host Firewall (Single – Homed Bastion Host)	Procedures for Corporate High-Tech Investigations	Understanding Microsoft Startup Tasks, Understanding MS-DOS Startup Tasks, Understanding Virtual Machines	Understanding E-mail Servers - Examining UNIX E-mail Server Logs, Examining Microsoft E-mail Server Logs, Examining Novell GroupWise E-mail Logs, Using Specialized E-mail Forensics Tools
S-7	SLO-1	SSL Alert Protocol	Screened Host Firewall (Dual – Homed Bastion Host)	Understanding Data Recovery Workstations and Software	Current Computer Forensics Tools: Software/ Hardware Tool	Cell Phone and Mobile Devices Forensics
	SLO-2	SSL Handshake Protocol	Screened Subnet Firewall	Conducting an Investigation, Completing the Case	Evaluating Computer Forensics Tool Needs	Understanding Mobile Device Forensics
S-8	SLO-1	Cryptographic Computations – Computing the Master Secret	SET for E-Commerce Transactions: Business requirements for SET	Data Acquisition: Understanding Storage Formats for Digital Evidence, Determining the Best Acquisition Method, Contingency Planning for Image Acquisitions, Using Acquisition Tools	Types of Computer Forensics Tools, Tasks Performed by Computer Forensics Tools	Mobile Phone Basics, Inside Mobile Devices
	SLO-2	Cryptographic Computations – Converting the Master Secret into Cryptographic Parameters	SET System Participants	Validating Data Acquisitions, Performing RAID Data Acquisitions	Computer Forensics Software Tools, Command-Line Forensics Tools, UNIX/Linux Forensics Tools, Other GUI Forensics Tools	Inside PDAs
S-9	SLO-1	TLS Protocol	SET Cryptographic Operation Principles, Dual Signature, Authentication and Message Integrity	Using Remote Network Acquisition Tools	Computer Forensics Hardware Tools, Forensic Workstations, Using a Write-Blocker, Recommendations for a Forensic Workstation	Understanding Acquisition Procedures for Cell Phones and Mobile Devices
	SLO-2	Cryptographic Computations for TLS	SET Payment Processing	Using Other Forensics Acquisition Tools	Validating and Testing Forensics Software, Using National Institute of Standards and Technology (NIST) Tools, Using Validation Protocols	Mobile Forensics Equipment
Learning Resources	1. Man Young Rhee, "Internet Security: Cryptographic Principles, Algorithms and Protocols", Wiley Publications, 2003 2. Christopher Steuart, Bill Nelson, Amelia Phillips, "Guide Computer Forensics and Investigations", Cengage Learning, India, Fourth Edition, 2013.			2. John R. Vacca, "Computer Forensics: Computer Crime Scene Investigation", Charles RiverMedia, 2002. 3. Richard E. Smith, "Internet Cryptography", Pearson Education, 3rd Edition, 2008. 4. Marjie T. Britz, "Computer Forensics and Cyber Crime: An Introduction", Pearson Education, 3rd Edition, 2013.		

Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember Understand	40 %	-	30 %	-	30 %	-	30 %	-	30%	-
Level 2	Apply Analyze	40 %	-	40 %	-	40 %	-	40 %	-	40%	-
Level 3	Evaluate Create	20 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Total	100 %		100 %		100 %		100 %		100 %	

# CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
	1. Dr.L.Kavisankar, Associate Professor, Department of Computer Science and Engineering, Hindustan Institute of Technology and Science, Chennai, India	1. Mr. S.Saminathan, SRMIST
		2. Dr.M.B.Mukesh Krishnan, SRMIST

Course Code	18CSE462T	Course Name	DATA CENTRE ADMINISTRATION AND MANAGEMENT	Course Category	E	Professional Elective			
						L	T	P	C
						3	0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Computer Science and Engineering		Data Book / Codes/Standards	Nil	

Course Learning Rationale (CLR):		The purpose of learning this course is to:			Learning			Program Learning Outcomes (PLO)																
CLR-1 :	Critically discuss data center networking technologies			1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15			
CLR-2 :	Evaluate key concepts in data center design			Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3			
CLR-3 :	Concepts related to data center maintenance						L	-	-	M	-	-	-	-	-	-	-	-	-	-	H	L	-	-
CLR-4 :	Design, build and configure a data centers						M	M	H	H	H	-	-	-	-	-	-	-	-	-	H	M	H	-
CLR-5 :	Expose to implementing the various system management practices						M	H	H	H	H	-	-	-	-	-	-	-	-	-	H	H	H	-
							M	H	H	H	H	H	-	M	-	-	-	-	-	-	H	M	H	H
Course Learning Outcomes (CLO):		At the end of this course, learners will be able to:																						
CLO-1 :	Manage Server Systems and Data Centres Infrastructure Management			1	90	85																		
CLO-2 :	Utilize the Storage, Bandwidth, Efficiency of systems and other resources for Data centre.			3	85	80																		
CLO-3 :	Monitoring the Networks and Resources. .			3	85	80																		
CLO-4 :	Planning for Flexible resource allocation			3	80	75																		
CLO-5 :	Administer the data centers			3	80	75																		

Duration (hour)	9		9		9		9		9	
S-1	SLO-1	Data center Architecture	SLO-1	Data Center design	SLO-1	Data Center Maintenance	SLO-1	Data Center HVAC	SLO-1	System Management Best Practices
	SLO-2		SLO-2		SLO-2		SLO-2		SLO-2	
S-2	SLO-1	Data center Requirements	SLO-1	Characteristics of an Outstanding Design	SLO-1	Network Operations Center, Network Monitoring	SLO-1	Reasons for Strict Environmental Requirements	SLO-1	Server Cluster Best Practices
	SLO-2		SLO-2		SLO-2		SLO-2		SLO-2	
S-3	SLO-1	Data center prerequisites	SLO-1	Characteristics of an Outstanding Design	SLO-1	Datacenter physical security	SLO-1	Need for Energy-Efficient HVAC Systems	SLO-1	Data Storage Best Practices
	SLO-2		SLO-2		SLO-2		SLO-2		SLO-2	
S-4	SLO-1	Physical Area for Equipment and Unoccupied Space	SLO-1	Guidelines for Planning a Data Center	SLO-1	Data center Logical security	SLO-1	Air-Conditioning Systems	SLO-1	Network Management Best Practices
	SLO-2		SLO-2		SLO-2		SLO-2		SLO-2	
S-6	SLO-1	Required power to run all the devices	SLO-1	Data Center structures	SLO-1	Data center Cleaning	SLO-1	Air Circulation in a Data Center	SLO-1	Security Guidelines Internet security
	SLO-2		SLO-2		SLO-2		SLO-2		SLO-2	
S-7	SLO-1	Required cooling and HVAC Required weight	SLO-1	Raised Floor Design and Deployment	SLO-1	Floor Surface Cleaning	SLO-1	Placement of Hardware Racks	SLO-1	Best Practices for System Administration
	SLO-2		SLO-2		SLO-2		SLO-2		SLO-2	
S-8	SLO-1	Budget Constraints	SLO-1	Design and Plan against Vandalism	SLO-1	Subfloor and Above-Ceiling Plenum Cleaning	SLO-1	Top-to-Bottom Cooled Racks	SLO-1	Device Naming, Naming Practices
	SLO-2		SLO-2		SLO-2		SLO-2		SLO-2	
S-9	SLO-1	Selecting a Geographic Location Safety from Natural hazards	SLO-1	Data center design case study	SLO-1	Equipment Cleaning	SLO-1	Front-to-Front Cooled Racks	SLO-1	Load balancing, Terminology, Advantages &Types of load balancing
	SLO-2		SLO-2		SLO-2		SLO-2		SLO-2	

Learning Resources	<ol style="list-style-type: none"> <li>1. Mouricio Arregoces, "Data Centre Fundamentals", Cisco Press ,2003</li> <li>2. Administering Data Centers: Servers, Storage and Voice over IP, Kailash Jayaswal.</li> <li>3. Kevin Corbin, Ron Fuller, David Jansen, "NX-OS and Cisco Nexus Switching: Next-Generation Data Center Architectures" Cisco Press; 1 edition [ISBN: 9781587058929], 2010.</li> <li>4. SilvanoGai, TommiSalli, Roger Andersson, "Cisco Unified Computing System" Cisco Press; 1 edition, [ISBN: 9781587141935], 2010.</li> </ol>	<ol style="list-style-type: none"> <li>5. Nash Darukhanawalla, Patrice Bellagamba, "Interconnecting Data Centers Using VPLS" Cisco Press; 1 edition, [ISBN: 9781587059926], 2009.</li> <li>6. Robert W. Kembel, Roger Cummings (Introduction), "The Fibre Channel Consultant" Northwest Learning Assoc; 3rd edition, [ISBN: 0931836840], 1998.</li> <li>7. Robert W Kembal "Fiber Channel Switched Fabric" Northwest Learning Associates, inc. [ISBN: 0931836719], 2009.</li> <li>8. John L. Hufferd, "ISCSI", Addison-Wesley Boston [ISBN: 978- 0201784190], 2003.</li> </ol>
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Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#		Theory	Practice
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice		
Level 1	Remember	40 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Understand										
Level 2	Apply	40 %	-	40 %	-	40 %	-	40 %	-	40%	-
	Analyze										
Level 3	Evaluate	20 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

# CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
Dr.M.S.Sricharan/Wipro Technologies		Dr. B.Amutha, Professor and Head, Department of CSE, SRM IST Dr. G.Vadivu, Professor and Head, Department of IT, SRM IST

Course Code	18CSE463T	Course Name	IT SERVICE MANAGEMENT AND OPERATIONS	Course Category	E	Professional Elective	L	T	P	C
							3	0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Computer Science and Engineering		Data Book / Codes/Standards	Nil	

Course Learning Rationale (CLR):	The purpose of learning this course is to:			Learning			Program Learning Outcomes (PLO)																																
CLR-1 :	To develop an awareness of the opportunities that information technology can have for enhancing service firms' competitiveness.			1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15																		
CLR-2 :	To appreciate the organizational significance of managing the IT service encounter to achieve internal and external customer satisfaction.			Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3																		
CLR-3 :	To understand new service development from both a product and process perspective.																					L	H	L	H	L	L	M	L	L	L	L	L	M	L	L	L	L	L
CLR-4 :	To gain an appreciation of the complexities associated with implementing change during IT services.																					L	H	L	H	L	L	M	L	L	L	L	L	M	L	L	L	L	L
CLR-5 :	to understand how an integrated ITSM framework																					L	H	L	H	L	L	M	L	L	L	L	L	M	L	L	L	L	L
CLR-6 :	To Understand practical implementation of Information Technology Service Management																					L	H	L	H	L	L	M	L	L	L	L	L	M	L	L	L	L	L
CLR-6 :	To Understand practical implementation of Information Technology Service Management																					L	H	L	H	L	L	M	L	L	L	L	L	M	L	L	L	L	L

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:			3	80	70	L	H	L	H	L	L	M	L	L	L	M	L	L	L	L
CLO-1 :	Illustrate the basic concepts of Service Science, Management, and Engineering			3	85	75	L	H	L	H	L	L	M	L	L	L	M	L	L	L	L
CLO-2 :	Examine the principle of IT service processes			3	75	70	L	H	L	H	L	L	M	L	L	L	M	L	L	L	L
CLO-3 :	Skills for planning, estimating, and resourcing for IT services			3	85	80	L	H	L	H	L	L	M	L	L	L	M	L	L	L	L
CLO-4 :	Manage the scope changes and the organizational changes in IT services			3	85	75	L	H	L	H	L	L	M	L	L	L	M	L	L	L	L
CLO-5 :	Ability to identify IT services as a means to provide functionality and value to customers in the context of specific case studies			3	80	70	L	H	L	H	L	L	M	L	L	L	M	L	L	L	L
CLO-6 :	Ability to understand the needs and targets of the different stakeholders (service providers, customers, suppliers/partners) in the services value chain.			3	80	70	L	H	L	H	L	L	M	L	L	L	M	L	L	L	L

Duration (hour)	9		9		9		9		9	
S-1	SLO-1	Introduction	IT Project/Service Management	Communication Management	Service management concepts and frameworks	Planning and delivery processes				
	SLO-2	Overview of Service Science, Management, Engineering								
S-2	SLO-1	IT Infrastructure	Planning	Team Building in IT Services	Services and service management	Service reporting				
	SLO-2									
S-3	SLO-1	RFID Applications	Estimating	IT service project in a start-up company	Customer-facing services	Service availability and continuity management				
	SLO-2									
S-4	SLO-1	Data Storage Management	Resourcing	Smaller IT service organization	Resource-facing services	Capacity management				
	SLO-2									
S-5	SLO-1	IT Service Strategy	IT Project/Service Change	Soft Skills in IT Service Management	The service lifecycle. Processes. Functions. Roles	Information security management				
	SLO-2									
S-6	SLO-1	Approach, and Practice	Quality	Presentation skills	Service strategy	Customer relationship management				

S-7	SLO-2					
	SLO-1	<i>IT Infrastructure Library</i>	<i>Issue</i>	<i>Negotiation skills</i>	<i>Service portfolio</i>	<i>Supplier relationship management.</i>
S-8	SLO-2					
	SLO-1	<i>e-Business Case Study</i>	<i>Risk Management</i>	<i>Job interview skills</i>	<i>Service catalog management</i>	<i>Service management tools</i>
S-9	SLO-2					
	SLO-1	<i>IT service report of IBM e-business at Ford Motor</i>	<i>Evaluate issue, and mitigate risk in IT service management</i>	<i>IBM perspectives of IT Service Management</i>	<i>Service level agreements.</i>	<i>Tool assessment framework</i>
	SLO-2				<i>Operational level agreements</i>	<i>Analysis of specific ITSM tools</i>

Learning Resources	1. Service Management, Fourth Edition, J.A. Fitzsimmons and M.J. Fitzsimmons, McGraw Hill. 2. Services Marketing, Valerie Zeithaml, Mary Jo Bitner, and Dwayne Gremler, McGraw-Hill. 3. Introduction to Operations Research, Hillier and Lieberman	4. Service modeling, Principles and Applications. Vilho Räsänen, Wiley 5. Understanding Service Business, S.E. Sampson, Wiley.
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Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	40 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Understand										
Level 2	Apply	40 %	-	40 %	-	40 %	-	40 %	-	40%	-
	Analyze										
Level 3	Evaluate	20 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

# CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
<i>Mr. Kesawan HCL Technologies</i>	<i>Dr. Surendran Rajendran</i> <i>AMA International University Bahrain</i>	<i>1. Dr.M.B Mukesh Krishnan, SRMIST</i>
<i>Mr.Celeian, Symantec</i>		<i>2. Mr.C.Santhanakrishnan, SRMIST</i>
		<i>3. Mr. G. Senthil Kumar , SRMIST</i>

Course Code	18CSE464T	Course Name	COMPUTER GRAPHICS AND GAME PROGRAMMING	Course Category	E	Professional Elective			
						L	T	P	C
						3	0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Computer Science and Engineering			Data Book / Codes/Standards	Nil

Course Learning Rationale (CLR):	The purpose of learning this course is to:			Learning			Program Learning Outcomes (PLO)																		
CLR-1 :	Understand the fundamental concepts of generating basic output primitives			1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15				
CLR-2 :	Know the basics of transformations and curves and surface representations			Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3				
CLR-3 :	Know the various visible surface detection methods and various color models						-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLR-4 :	Learn the interfaces of Unity and its installation procedure						-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLR-5 :	Know the various objects in Unity to develop games						-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:						2	80	85	-	-	H	-	-	-	-	-	-	-	-	-	-	-	M	-
CLO-1 :	Have a very good understanding of generating various output primitives			2	75	80	-	-	-	-	-	-	-	-	-	-	-	-	-	-	M	-			
CLO-2 :	Posses the ability to represent various curves and surfaces			2	85	80	-	-	-	-	-	-	-	-	-	-	-	-	-	-	M	-			
CLO-3 :	Have a clear understanding of various visible surface detection algorithms and color models			2	80	75	-	-	H	-	H	-	-	-	H	-	-	-	-	-	-	-			
CLO-4 :	Apply the knowledge to install and explore the interfaces of Unity			2	75	85	-	-	H	-	H	-	-	-	H	-	-	-	-	-	-	-			
CLO-5 :	Possess the ability to design and implement games using Unity			2	75	85	-	-	H	-	H	-	-	-	H	-	-	-	-	-	-	-			

Duration (hour)	9		9		9		9		9		
S-1	SLO-1	Graphics systems Overview and IO devices	Basic Three-Dimensional Concepts	Classification of visible surface detection Algorithms	Introduction to Unity Installation and its interface	Concept of collisions					
	SLO-2										
S-2	SLO-1	Applications of Computer Graphics	Clipping operations-Point, Line and Polygon	Back-face detection, Depth buffer method and A-buffer method	Game objects, 2D&3D and its transformation	Introduction to Prefabs					
	SLO-2										
S-3	SLO-1	Line drawing algorithms	Curve, Text and Exterior Clipping	Scan line method, Depth sorting method, BSP and Area sub division method	Fundamentals of models, materials and shaders	Handling sprites and adding UI to the game					
	SLO-2										
S-4	SLO-1	Circle drawing algorithms	Polygon Clipping algorithms	Octree, Ray casting method and curved surfaces	How to sculpt terrain	Basics of particle systems					
	SLO-2										
S-5	SLO-1	Ellipse drawing algorithms	Plane equations and meshes	Basic models of illumination	Adding environments	Basics of animation					
	SLO-2										
S-6	SLO-1	Filled area primitives	Curved line& surfaces	Halftone and dithering techniques	Using lights	Designing a complex game					
	SLO-2										
S-7	SLO-1	Basics of Geometric transformations	Quadratic surfaces and Blobby objects	Properties of Light, RGB Color Model	Using cameras	Basics of audio in Unity					
	SLO-2										
S-8	SLO-1	Reflection and shearing -2D	Fractals	YIQ, and CMY color model	Designing a basic game	Basics of audio in Unity					

	SLO-2					
S-9	SLO-1	2D viewing and window to viewport	Bezier and B-Spline curves and surfaces	HSV and HLScolor model, Color selection	Introduction to scripting	Requirements for mobile game development
	SLO-2					

Learning Resources	1. Donald Hearn & M.PaulineBaker, "Computer Graphics C Version", 2nd Edition, Pearson Education, 2010, ISBN 978-93-325-3587-9	4. Joseph Hocking, "Unity in Action: Multiplatform game development in C#", 2nd Edition, Manning Publications Company, ISBN: 9781617294969
	2. John F.Hughes, Andries VanDam, Morgan McGuire, David F.Sklar, James D.Foley, Steven K.Feiner, KurtAkeley, "Computer Graphics: Principles and Practice",3rd Edition, Addison-Wesley Professional, 2013, ISBN-13: 0785342399523	
	3. Mike Geig, "Unity 2018 Game Development in 24 Hours, Sams Teach Yourself " 3rd Edition, Pearson Education, 2018, ISBN-13:978-0134998138, ISBN-10:0134998138	5. Dr. Edward Lavieri, "Getting Started with Unity 2018 - Third Edition: A Beginner's Guide to 2D and 3D game development with Unity ", Packt Publishing Ltd., 2018, ISBN-10: 1788830105, ISBN-13: 978-1788830102.

Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember Understand	40 %	-	30 %	-	30 %	-	30 %	-	30%	-
Level 2	Apply Analyze	40 %	-	40 %	-	40 %	-	40 %	-	40%	-
Level 3	Evaluate Create	20 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Total	100 %		100 %		100 %		100 %		100 %	

# CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
Valiyullasha, Bugtreat Technologies, UK, coe@bugtreat.com	C.M.T.Karthigeyan, Assistant Professor, Government College of Engineering, Bargur, email: c.m.t.karthigeyan@gcebargur.ac.in	P.Rajasekar, Assistant Professor, Department of Information Technology, Faculty of E&T,&SRMIST, email: rajasekp@srmist.edu.in



Course Code	18CSE465T	Course Name	COMPUTATIONAL MEDIA			Course Category	E	Professional Elective							L	T	P	C										
								3	0	0	3																	
Pre-requisite Courses	Nil			Co-requisite Courses	Nil			Progressive Courses	Nil																			
Course Offering Department	Computer Science and Engineering			Data Book / Codes/Standards	Nil																							
Course Learning Rationale (CLR):	The purpose of learning this course is to:						Learning			Program Learning Outcomes (PLO)																		
CLR-1 :	Understand the fundamental concepts of analog and digital data						1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15				
CLR-2 :	Know the basics of bitmap, DCT and color models						Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3				
CLR-3 :	Learn the various tools for digital image processing									-	-	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
CLR-4 :	Know the basics of digital audio representation									2	80	85	-	-	H	-	-	-	-	-	-	-	-	-	-	M	-	
CLR-5 :	Understand the concepts of video and its compression methods									2	85	80	-	-	H	-	-	-	-	-	-	-	-	-	-	-	M	-
										2	80	75	-	-	H	-	-	-	H	-	-	-	-	-	-	M	-	
							2	75	85	-	-	H	-	H	-	-	-	H	-	-	-	-	-	-	-			
Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:																											
CLO-1 :	Have a very good understanding of analog and digital data						2	80	85	-	-	H	-	-	-	-	-	-	-	-	-	-	-	-	-			
CLO-2 :	Have a clear understanding of bitmap, DCT and color models						2	75	80	-	-	H	-	-	-	-	-	-	-	-	-	-	-	M	-			
CLO-3 :	Possess the ability to handle various tools for digital image processing						2	85	80	-	-	H	-	-	-	-	-	-	-	-	-	-	-	M	-			
CLO-4 :	Apply the knowledge to represent digital audio						2	80	75	-	-	H	-	-	-	-	H	-	-	-	-	-	M	-				
CLO-5 :	Possess the ability to compress the video						2	75	85	-	-	H	-	H	-	-	-	H	-	-	-	-	-	-	-			
Duration (hour)	9			9			9			9			9															
S-1	SLO-1	Introduction	Bitmaps- Frequency in digital images	Tools for digital image processing	Introduction of digital audio representation	Tools for digital audio processing																						
	SLO-2																											
S-2	SLO-1	Analog to digital conversion	Discrete Cosine Transform	Digital image file types	Audio waveforms	Dynamics processing- Audio restoration																						
	SLO-2																											
S-3	SLO-1	Data storage	Aliasing	Indexed colors - Dithering	Pulse code modulation & audio digitization	Digital audio filters and related processing																						
	SLO-2																											
S-4	SLO-1	Data Communication	Color models	Channels, layers and masks	Sampling rate and aliasing	Pulse code modulation & audio digitization																						
	SLO-2																											
S-5	SLO-1	Data Communication	Color models	Blending modes	quantization and quantization error	Designing and implementing your own file																						
	SLO-2																											
S-6	SLO-1	Compression methods	Color models	Pixel point processing	Frequency analysis	Digital audio compression																						
	SLO-2																											
S-7	SLO-1	Compression methods	Vector graphics	Spatial filtering	Frequency analysis	Fundamental concepts in video																						
	SLO-2																											
S-8	SLO-1	Standards and standardization organizations	Vector graphics	Resampling and interpolation	Statistical analysis of an audio file	Basic video compression																						
	SLO-2																											
S-9	SLO-1	Mathematical modeling tools for the study of digital media	Algorithmic art and procedural modeling	Digital image compression	MIDI	MPEG 1 and 2																						
	SLO-2																											

Learning Resources	1. Jennifer Burg, "The Science of Digital Media", Pearson Education, ISBN: 978-01324335802	3. Fred Halsall, "Multimedia Communications: Applications, Networks, Protocols and Standards", Pearson Education India, 2002, ISBN-10: 8131709949 and ISBN-13: 978-8131709948
	2. Ze-Nian Li and Mark.s.Drew, "Fundamentals of Multimedia", Pearson Education International, ISBN 0-13-127256-X	

Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	40 %	-	30 %	-	30 %	-	30 %	-	30%	-
Level 2	Understand	40 %	-	40 %	-	40 %	-	40 %	-	40%	-
	Apply	40 %	-	40 %	-	40 %	-	40 %	-	40%	-
Level 3	Analyze	20 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Evaluate	20 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Create	20 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Total	100 %		100 %		100 %		100 %		100 %	

# CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
Valiyullasha, Bugtreat Technologies, UK, coe@bugtreat.com	C.M.T.Karthigeyan, Assistant Professor, Government College of Engineering, Bargur, email: c.m.t.karthikeyan@gcebargur.ac.in	P.Rajasekar, Assistant Professor, Department of Information Technology, Faculty of E&T,&SRMIST, email: rajasekp@srmist.edu.in

Course Code	18CSE345T	Course Name	INTERNET OF THINGS ARCHITECTURE AND PROTOCOLS	Course Category	E	Professional Elective				L	T	P	C
										3	0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil	
Course Offering Department	CSE		Data Book / Codes/Standards	Nil		

Course Learning Rationale (CLR):	The purpose of learning this course is to:			Learning			Program Learning Outcomes (PLO)																	
CLR-1 :	Understand Data and Knowledge Management and use of Devices in IoT Technology.			1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15			
CLR-2 :	Understand State of the Art – IoT Architecture.			Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3			
CLR-3 :	To Understand the Architectural Overview of IoT						H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLR-4 :	Understand the IoT Reference Architecture and RealWorld Design Constraints						H	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLR-5 :	To Understand the various IoT Protocols ( Datalink, Network, Transport, Session, Service)						H	M	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLR-6 :	Understand and apply IoT protocols appropriately						H	H	H	M	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:						2	80	85	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-1 :	Interpret the vision of IoT architecture from a global context.			2	75	80	H	H	-	-	-	-	-	-	-	-	-	-	-	-	-			
CLO-2 :	Implement state of the art architecture in IoT.			2	85	80	H	M	-	-	-	-	-	-	-	-	-	-	-	-	-			
CLO-3 :	Compare and Contrast the use of Devices, Gateways and Data Management in IoT.			2	80	75	H	H	H	M	-	-	-	-	-	-	-	-	-	-	-			
CLO-4 :	Implement using the available resources and demonstrate quick to deployment protocols wherever applicable			2	75	85	H	H	H	M	H	-	-	-	M	-	-	H	-	-	-			
CLO-5 :	Apply the protocols and Techniques towards integration in relevant areas of IoT Product development			2	80	85	H	M	H	H	H	-	-	-	H	-	-	H	-	-	-			
CLO-6 :	Choose appropriate protocols for various layers ( Datalink, Network, Transport, Session, Service)			2	80	85	H	M	H	H	H	-	-	-	H	-	-	H	-	-	-			

Duration (hour)	9		9		9		9			9		
S-1	SLO-1	M2M and IoT- Relevance and Transition	Data Management- Introduction	Introduction to RFID	Transport Layer Protocols - Introduction	Service Layer Protocols- Introduction						
	SLO-2	Building an architecture	Managing M2M data: Data generation,	Introduction to NFC	TCP	oneM2M						
S-2	SLO-1	Main design principles and needed capabilities	Data acquisition, Data validation	WSN(Large topic),	MPTCP	ETSI M2M						
	SLO-2	IoT architecture outline	Data storage, Data processing	Narrow band IoT (NB-IoT)	UDP	OMA						
S-3	SLO-1	M2M and IoT Technology Fundamentals	Data remanence, Data analysis	WiFi	DCCP	BBF						
	SLO-2	Devi ces and Gateways-Introduction	Data management,	PLC Communication Protocols: A comparison	SCT	Understanding Security and Interoperability						
S-4	SLO-1	Basic Devices	Business processes in IoT	Popular radio protocols and its security drawbacks	TLS	Modes of attack: DoS, Getting Access, Guess, Man in Middle, Sniff, Post Scan						
	SLO-2	Gateways	Everything as a Service (XaaS)	802.15.4 in depth	DTLS	Modes of attack: Web Crawl, Search Features and Wild Cards, Breaking Cipher						
S-5	SLO-1	Advanced devices	M2M and IoT Analytics	Network Layer Protocols- Introduction	Session Layer-HTTP	Tools for achieving Security: VPN, X.509, Authentication,						
	SLO-2	Need for networking	Knowledge Management	IPv4	CoAP	Tools for achieving Security: User names and Passwords, Message Brokers,						
S-6	SLO-1	State of the art-ETSI M2M	Data Link Layer Protocols: PHY/MAC Layer:3GPP MTC	IPv6	Implementation demo of CoAP	Tools for achieving Security: Provisioning servers, Centralization versus decentralization,						

S-7	SLO-2	IoT Reference model-IoT Domain model	IEEE 802.11	6LoWPAN in depth	MQTT	The need for interoperability:
	SLO-1	Information model	IEEE 802.15	6TISCH	Implementation demo of MQTT	Combining Security and Interoperability
	SLO-2	Functional model	Wireless HART	ND	MQTT-SN	Need for Security in IoT Protocols – Introduction
S-8	SLO-1	Communication model	Z-Wave	DHCP	Implementation demo of MQTT-SN	Security in IoT Protocols :MAC 802.15.4
	SLO-2	Safety, privacy, trust, security model	Bluetooth, Bluetooth Low Energy	ICMP	XMPP	Security in IoT Protocols :6LoWPAN,
S-9	SLO-1	Introduction to Protocols- Physical, Data Link	Zigbee, Zigbee Smart Energy	RPL	AMQP	Security in IoT Protocols :RPL
	SLO-2	Introduction to Protocols- Network, Transport, Application	DASH7	CORPL, CARP	Introduction to Contiki- Practical demo	Security in IoT Protocols: Application Layer

Learning Resources	<p>1. Uckelmann, D., Harrison, M., &amp; Michahelles, F. (Eds.). <i>Architecting the Internet of Things</i>.doi:10.1007/978-3-642-19157-2, 2011</p> <p>2. <i>IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things</i> by Rob Barton, Gonzalo Salgueiro, David Hanes, Publisher: Cisco Press, Release Date: June 2017, ISBN: 9780134307091 (<a href="https://www.oreilly.com/library/view/iot-fundamentals-networking/9780134307091/">https://www.oreilly.com/library/view/iot-fundamentals-networking/9780134307091/</a>)</p> <p>3. Jan Holler, Vlasios Tsiatsis, Catherine Mulligan, Stefan Avesand, Stamatis Karnouskos, David Boyle, "From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence", 1<sup>st</sup> Edition, Academic Press, 2014</p>	<p>4. Peter Waher, "Learning Internet of Things", PACKT publishing, BIRMINGHAM – MUMBAI</p> <p>5. Daniel Minoli, "Building the Internet of Things with IPv6 and MIPv6: The Evolving World of M2M Communications", ISBN: 978-1-118- 47347-4, Willy Publications</p>
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Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember Understand	40 %	-	30 %	-	30 %	-	30 %	-	30%	-
Level 2	Apply Analyze	40 %	-	40 %	-	40 %	-	40 %	-	40%	-
Level 3	Evaluate Create	20 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Total	100 %		100 %		100 %		100 %		100 %	

# CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
Mr. Vinay Solanki, Head IoT, Lenovo (APAC & MEA)	Dr.Zayaraj, Professor / CSE, PEC, Pondicherry	Dr. S.Babu, SRMIST
Dr. Paventhan Arumugum, Director (R&D), ERNET India	Dr.Vijalakshmi Associate Professor / CSE, PEC, Pondicherry	Dr.Kayalvizhi Jayavel, SRMIST
Shiv Kumar Ganesh, Full Stack Developer, Altimetrik	Dr.P.Yogesh, Professor/IT, Anna University, Chennai.	Mr.V.Haribaabu, SRMIST

Course Code	18CSE346T	Course Name	NETWORK PROGRAMMING	Course Category	E	Professional Elective			
						L	T	P	C
						3	0	0	3

Pre-requisite Courses	18CSC302J	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Computer Science and Engineering		Data Book / Codes/Standards	Nil	

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning			Program Learning Outcomes (PLO)																
CLR-1 :	To learn different socket function and implement client server applications using sockets	1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15		
CLR-2 :	To conduct experiments to know how different internet protocols like TCP/IP works	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3		
CLR-3 :	To analyze various application program like TELNET, DNS, DHCP				L	H	-	H	L	-	-	-	-	L	L	-	H	-	-	-	-
CLR-4 :	Build different application like Routing, Load balancing & Security				M	H	L	M	L	-	-	-	-	M	L	-	H	-	-	-	-
CLR-5 :	To apply protocols get adapted to emerging technologies				M	H	M	H	L	-	-	-	-	M	L	-	H	-	-	-	-
					H	H	M	H	L	-	-	-	-	M	L	-	H	-	-	-	-
Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:																				
CLO-1 :	Become familiar with elementary socket functions	3	80	70	L	H	-	H	L	-	-	-	L	L	-	H	-	-	-		
CLO-2 :	Design and implement client –server applications using Sockets	3	85	75	M	H	L	M	L	-	-	-	M	L	-	H	-	-	-		
CLO-3 :	Learn about functions that convert between names and numeric values and protocols	3	75	70	M	H	M	H	L	-	-	-	M	L	-	H	-	-	-		
CLO-4 :	Analyze network programs	3	85	80	M	H	M	H	L	-	-	-	M	L	-	H	-	-	-		
CLO-5 :	Build network applications	3	85	75	H	H	M	H	L	-	-	-	M	L	-	H	-	-	-		

Duration (hour)	9		9		9		9		9	
S-1	SLO-1	Introduction	Socket function	Get sock opt function	DNS	Internet Protocol				
	SLO-2	simple daytime client	connect function	set sock opt function	resolvers and name servers					
S-2	SLO-1	protocol independence	bind function	IPV4	gethostbyname function	IPV4				
	SLO-2	Error handling	listen function	ICMP	gethostbyaddr function					
S-3	SLO-1	simple daytime server	accept function	TCP socket options	getservbyname function	IPV6 interoperability				
	SLO-2	Roadmap to client/server.	Fork function		getservbyport function					
S	SLO-1	Overview of TCP/IP protocol- TCP	exec function	UDP Echo server and client	tcp_connect function-	Daemon processes				
4-5	SLO-2	connection establishment and termination	concurrent servers	recvfrom function	tcp_listen function	Daemon processes and the inetd/superserver				
S-6	SLO-1	TCP state transition diagram – Time-wait state	close function-getsocname and getpeername	send to function	udp_client					
	SLO-2	SCTP association establishment and termination	TCP Echo server, TCP Echo client	Connect function with UDP	udp_connect	Advanced I/O functions				
S-7	SLO-1	TCP port numbers and concurrent servers	normal startup and termination		udp_server function					
	SLO-2	Buffer size and limitations	POSIX signal handling, Wait and Waitpid functions	dg_cli function	BOOTP	Advanced I/O functions				
S	SLO-1	standard internet services	Termination of server process, Crashing and rebooting of server host	lack of flow control with UDP	DHCP					
8-9	SLO-2	protocol usage by common, Internet applications								

Learning Resources	<ol style="list-style-type: none"> <li>1. W.Richard Stevens, Bill Fenner, Andrew M. Rudoff " Unix Network programming " 3rd edition, Volume – 1, Pearson Education , 2015 R.F.Gilberg, B.A.Forouzan, Data Structures, 2<sup>nd</sup> ed., Thomson India, 2005</li> <li>2. Douglas.E.Comer " Internetworking with TCP/IP " principles, protocols and architecture, 6th Edition , Volume 1, Pearson Education,2013</li> </ol>	<ol style="list-style-type: none"> <li>3. Behrouz A.Forouzan , " TCP/IP protocol suite", 4th edition, Mc Graw Hill education private limited,2010</li> <li>4. Wendell Odom , " IP networking ", 1st edition, Pearson Education 2012</li> </ol>
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Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember Understand	40 %	-	30 %	-	30 %	-	30 %	-	30%	-
Level 2	Apply Analyze	40 %	-	40 %	-	40 %	-	40 %	-	40%	-
Level 3	Evaluate Create	20 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Total	100 %		100 %		100 %		100 %		100 %	

# CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
Dr.Viswanadham, Teken BIM Technologies Pvt. Ltd, 9962514477, Viswanathan_alladi@yahoo.com	Dr. Latha, Prof & Head, CSE dept, SAIRAM engg college,latha.cse@sairam.edu.in, 8754502224	1. MrsT.Manoranjitham, SRMIST
		2. Mr. Godwin , SRMIST
		3. Ms. Vinoth, SRMIST

Course Code	18CSE445T	Course Name	INTERNET OF THINGS SECURITY	Course Category	E	Professional Elective	L	T	P	C
							3	0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	
Course Offering Department	Computer Science and Engineering		Data Book / Codes/Standards	Nil	

Course Learning Rationale (CLR):	The purpose of learning this course is to:			Learning			Program Learning Outcomes (PLO)																															
CLR-1 :	Understand the fundamentals, various attacks and importance of Security aspects in IoT			1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15																	
CLR-2 :	Understand the techniques, protocols and some idea on security towards Gaming models			Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3																	
CLR-3 :	Understand the relevance of Blockchain, its techniques towards IoT																					L	H	M	H	M	-	-	-	M	L	-	H	-	H	-	-	-
CLR-4 :	Understand the operations of Bitcoin blockchain, crypto-currency as application of blockchain technology																					L	H	M	H	M	-	-	-	M	L	-	H	-	H	-	-	-
CLR-5 :	Understand the essential components of IoT																					L	H	M	H	M	-	-	-	M	L	-	H	-	H	-	-	-
CLR-6 :	Understand security and privacy challenges of IoT																					L	H	M	H	M	-	-	-	M	L	-	H	-	H	-	-	-
Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:																					3	80	70														
CLO-1 :	Incorporate the best practices learnt to identify the attacks and mitigate the same			3	85	75																																
CLO-2 :	Adopt the right security techniques and protocols during the design of IoT products			3	75	70																																
CLO-3 :	Apply the skills learnt towards gaming designs			3	85	80																																
CLO-4 :	Assimilate and apply the skills learnt on cipers and blockchains when appropriate			3	85	75																																
CLO-5 :	Describe the essential components of IoT			3	80	70																																
CLO-6 :	Find appropriate security / privacy solutions for IoT			3																																		

Duration (hour)	9		9		9		9		9	
S-1	SLO-1	Fundamentals of IoT and Security and its need	Prevent Unauthorized Access to Sensor Data	Block ciphers	Introduction to Blockchain	Introduction of IoT devices				
	SLO-2	IoT Security Requirements	,M2M Security,	Message integrity	Modeling faults and adversaries	Difference among IoT devices, computers, and embedded devices.				
S-2	SLO-1	IoT and cyber-physical systems	RFIDSecurity,	Authenticated encryption	Byzantine Generals problem	sensors and actuators in IoT				
	SLO-2	IoT security (vulnerabilities, attacks, and countermeasures),	Cyber Physical Object Security, ,	Hash functions	Consensus algorithms and their scalability problems	Accelerometer, photoresistor, buttons				
S-3	SLO-1	Security engineering for IoT development	Hardware Security,	Merkle trees and Elliptic curves	digital signatures, verifiable random functions, Zero-knowledge systems	motor, LED, vibrator,				
	SLO-2	IoT security lifecycle	Front-end System Privacy Protection, Management, Secure IoT Databases	Public-key crypto (PKI),	blockchain, the challenges, and solutions,	analog signal vs. digital signal				
S-4	SLO-1	Data Privacy	Networking Function Security	Trees signature algorithms	proof of work, Proof of stake,	Networking in IoT				
	SLO-2	Device/User Authentication in IoT	IoT Networking Protocols,	Crypto-currencies,	alternatives to Bitcoin consensus, Bitcoin scripting language and their use	Real-time communication				
S-5	SLO-1	Introduction to Authentication Techniques	SecureIoT Lower Layers,	Bitcoin P2P network,	Ethereum and Smart Contracts,	Bandwidth efficiency				
	SLO-2	Data Trustworthiness in IoT	SecureIoT Higher Layers,	Distributed consensus, , ,	Smart Contract Languages and verification	data analytics in IoT - simple data				

					challenges	analyzing methods
S-6	SLO-1	Human IoT Trust Relationship	Secure Communication	Incentives and proof-of-work	comparing Bitcoin scripting vs. Ethereum Smart Contracts	IoT architecture, component and technology
	SLO-2	Trust and Reputation Systems	Links in IoTs, Back-end Security - Secure Resource	Mining, scripts and smart contracts	Hyperledger fabric	Case study: discussion on specific IoT applications and their design considerations
S-7	SLO-1	Trust Negotiation	Game Theory Foundation	Wallets: hot and cold storage, anonymity, altcoins	Mechanisms in permissioned blockchain	cybersecurity overview in IoT
	SLO-2	IoT Privacy Preservation Issues	Mixed-strategy, ,	Credential management for connected devices: Security credential management system (SCMS),	Pseudo-anonymity vs. anonymity	General cybersecurity concepts in IoT
S-8	SLO-1	Attack Models - Attacks to Sensors in IoTs,	Nash equilibrium	VehicleBased Security System (VBSS),	Zcash and Zk-SNARKS for anonymity preservation	security threats in IoT
	SLO-2	Attacks to RFIDs in IoTs,	Repeated games	PKI design, Certification provisioning	Attacks on Blockchains	data privacy in IoT
S-9	SLO-1	Attacks to Network Functions in IoTs,	Bayesian games	Pseudonyms (privacy-by design),	Sybil attacks, selfish mining	device/User authentication in IoT
	SLO-2	Attacks to Back-end Systems and security in Front end Systems	Coalitional games.	Misbehavior detection and Revocation,	51% attacks	data trustworthiness problem in IoT

Learning Resources	1. B. Russell and D. Van Duren, "Practical Internet of Things Security," Packt Publishing, 2016.	5. T. Alpcan and T. Basar, "Network Security: A Decision and Game-theoretic Approach," Cambridge University Press, 2011.
	2. Fei HU, "Security and Privacy in Internet of Things (IoT): Models, Algorithms, and Implementations," CRC Press, 2016	6. Security and the IoT ecosystem, KPMG International, 2015
	3. Narayanan et al., "Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction," Princeton University Press, 2016.	7. Internet of Things: IoT Governance, Privacy and Security Issues" by European Research Cluster
	4. A. Antonopoulos, "Mastering Bitcoin: Unlocking Digital Cryptocurrencies," O'Reilly, 2014	8. Ollie Whitehouse, "Security of Things: An Implementers' Guide to Cyber-Security for Internet of Things Devices and Beyond", NCC Group, 2014
		9. Josh Thompson, 'Blockchain: The Blockchain for Beginners, Guild to Blockchain Technology and Blockchain Programming', CreateSpace Independent Publishing Platform, 2017.

Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	40 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Understand										
Level 2	Apply	40 %	-	40 %	-	40 %	-	40 %	-	40%	-
	Analyze										
Level 3	Evaluate	20 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

# CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
	Dr.A.Amuthan, Associate Dean, Dept. of CSE, Pondicherry Engg. College, Pondicherry	Dr.M.Murali Dr.Kayalvizhi Jayavel Mr. H.Karthikeyan



Course Code	18CSE446T	Course Name	ADVANCED DATABASE SYSTEMS	Course Category	E	Professional Elective	L	T	P	C
							3	0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Computer Science and Engineering		Data Book / Codes/Standards	Nil	

Course Learning Rationale (CLR):		The purpose of learning this course is to:			Learning			Program Learning Outcomes (PLO)															
CLR-1	CLR-2	CLR-3	CLR-4	CLR-5	CLR-6	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CLR-1 :	Familiarize with the various query processing, join and optimization techniques								Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3
CLR-2 :	Improve their ability to choose the appropriate techniques for any parallel and distributed database systems								H	H	L	M	L	-	-	-	M	M	M	-	-	-	-
CLR-3 :	Familiarize with the various object based databases techniques								H	H	L	M	L	-	-	-	M	M	M	-	-	-	-
CLR-4 :	Familiarize with the various Motivation, Structure, Storage, Application and Evaluation of XML Queries								H	H	L	M	L	-	-	-	M	M	M	-	-	-	-
CLR-5 :	Expose to the concepts of Performance Tuning, Temporal, Spatial, Multimedia and Mobile data bases								H	M	L	M	L	-	-	-	M	M	M	-	-	-	-
CLR-6 :	Expose to the latest Spatial and Geographic data, R Trees and Multimedia databases								H	M	-	M	L	-	-	-	M	M	M	-	-	-	-
Course Learning Outcomes (CLO):		At the end of this course, learners will be able to:																					
CLO-1 :	Acquire the knowledge on query processing, join and optimization on a database					2	80	85															
CLO-2 :	Acquire the ability to identify & design a parallel and distributed database					2	75	80															
CLO-3 :	Understand the basic ideas about various object based databases					2	85	80															
CLO-4 :	Apply the knowledge of XML on various applications					2	80	75															
CLO-5 :	Appreciate the concepts of Performance Tuning, Temporal, Spatial, Multimedia and Mobile data bases					2	75	85															
CLO-6 :	Appreciate the concepts of latest Spatial and Geographic data, R Trees and Multimedia databases					2	80	85															

Duration (hour)	9		9		9		9		9	
S-1	SLO-1	Overview of query processing	Introduction to Parallel Databases	Overview of object based databases	Introduction to XML	Performance Tuning				
	SLO-2	Measures of query cost	I/O parallelism	Complex data types		Improving set orientation				
S-2	SLO-1	Selection Operation	Interquery Parallelis	Structured types in SQL	Motivation	Tuning of bulk loads and updates				
	SLO-2	Sorting	Intraquery Parallelism	Inheritance in SQL		Location of bottlenecks				
S-3	SLO-1	Join Operation-Nested loop join	Intraoperation Parallelism	Table inheritance	Structure of XML data	Tunable parameters				
	SLO-2	Merge join and Hash join	Interoperation Parallelism			Tuning of hardware				
S-4	SLO-1	Projection, set operation, Outer join and Aggregation	Query Optimization	Array and multiset Types in SQL	XML document scheme	Tuning of the schema and Indices				
	SLO-2	Evaluation of Expressions	Design of Parallel Systems			Tuning of Physical design				
S-5	SLO-1	Overview of query optimization	Homogeneous and heterogeneous database	Object –identity and reference Types in SQL	Querying and transformation	Tuning of concurrent transactions				
	SLO-2	Transformation of relational expressions - Equivalence Rules	Distributed data Storage			Introduction to Temporal, Spatial, Multimedia and Mobile data bases				
S-6	SLO-1	Join Ordering	Distributed transactions	Implementing O-R features	Application program interface to XML	Performance benchmarks				
	SLO-2	Enumeration of Equivalent Expression	Commit protocols			Time in databases				
S-7	SLO-1	Estimating statistics of expression results Catalog Information	Concurrency control in distributed databases	Persistent programming languages – Persistence of objects	Storage of XML data	Spatial and Geographic data				
	SLO-2	Selection Size and Join size Estimation	Distributed query processing			Representation of Geographic data				

S-8	SLO-1	Size Estimation for other Operation, Estimation of Number of Distinct Values	Availability	Persistent C++ systems	XML applications.	Spatial Queries
	SLO-2	Choice of evaluation plans-Cost based join order Selection		Persistent Java systems		Indexing of Spatial Data
S-9	SLO-1	Cost based optimization with equivalence rules	Heterogeneous distributed databases.	Object-relational mapping	Evaluation of XML Queries	R Trees
	SLO-2	Heuristics in optimization, Optimizing Nested Sub queries		Object-oriented versus object-relational.		Multimedia databases

Learning Resources	<ol style="list-style-type: none"> <li>Abraham Silberschatz, Henry F Korth, S Sudarshan, "Database System Concepts", McGraw Hill Education –2013</li> <li>Raghu Ramakrishnan, "Database Management Systems", -McGrawHill Education-2014</li> <li>Elmasri Navathe, Somayajulu, Gupta, "Fundamentals of Database Systems, Pearson Education, 4<sup>th</sup> Edition, 2006</li> <li>CJ Date, AKannan, SSwamynathan, "An Introduction to Database Systems", Pearson Education, 8<sup>th</sup> Edition, 2006</li> </ol>
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Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#		Theory	Practice
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice		
Level 1	Remember Understand	40 %	-	30 %	-	30 %	-	30 %	-	30%	-
Level 2	Apply Analyze	40 %	-	40 %	-	40 %	-	40 %	-	40%	-
Level 3	Evaluate Create	20 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Total	100 %		100 %		100 %		100 %		100 %	

# CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Dr. Mariappan Vaithilingam, Engineering Leader Amazon, dr.v.m@ieee.org		1. Mr. Elizer, SRMIST
2. Mr. Badinath, SDET, Amzon, sbadhrinath@gmail.com		2. Mrs. Sasi Rekha Sankar, SRMIST
		3. Ms. Hemavathy, SRMIST

Course Code	18CSE447T	Course Name	EDGE COMPUTING	Course Category	E	Professional Elective	L	T	P	C
							3	0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Computer Science and Engineering		Data Book / Codes/Standards	Nil	

Course Learning Rationale (CLR):	The purpose of learning this course is to:			Learning			Program Learning Outcomes (PLO)																	
CLR-1 :	Understand the concepts of IoT			1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15			
CLR-2 :	Understand the IoT and M2M Communication			Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3			
CLR-3 :	Understand the protocols and standards of IoT						H	L	H	M	H	H	H	H	H	H	H	H	M	H	H	H	H	H
CLR-4 :	Understand the Fog computing Architecture and its components						H	L	H	M	H	H	H	H	H	H	H	H	M	H	H	H	H	H
CLR-5 :	Understand the integration of Fog and Cloud Computing						H	L	H	M	H	H	H	H	H	H	H	H	M	H	H	H	H	H
CLR-6 :	Understand the concepts of IoT						H	L	H	M	H	H	H	H	H	H	H	H	M	H	H	H	H	H
Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:						3	80	70	H	L	H	M	H	H	H	H	H	M	H	H	H	H	H
CLO-1 :	Apply concepts of IoT			3	85	75	H	L	H	M	H	H	H	H	H	M	H	H	H	H	H			
CLO-2 :	Apply the M2M protocol in IoT.			3	75	70	H	L	H	M	H	H	H	H	H	M	H	H	H	H	H			
CLO-3 :	Equip themselves familiar with Fog computing in IoT			3	85	80	H	L	H	M	H	H	H	H	H	M	H	H	H	H	H			
CLO-4 :	Familiarize with IoT standard and protocols			3	85	75	H	L	H	M	H	H	H	H	H	M	H	H	H	H	H			
CLO-5 :	Acquaint with Fog and Cloud computing in IoT			3	80	70	H	L	H	M	H	H	H	H	H	M	H	H	H	H	H			
CLO-6 :	Apply concepts of IoT			3	80	70	H	L	H	M	H	H	H	H	H	M	H	H	H	H	H			

Duration (hour)	9		9		9		9			9		
S-1	SLO-1	Introduction to IoT	IoT Architecture	Fog Computational Model	BIG DATA			Case Study-1: Edge analytics in Irrigation System				
	SLO-2	Technologies in IoT	Data Acquisition, Data Aggregation and Data Analysis	Fog Simulators	Data Types in Big data			Machine Learning in Edge for automation in Irrigation system				
S-2	SLO-1	IoT Applications- Smart Home, Wearable, Connected Cars, Industrial IoT	IoT Protocols- COAP, MQTT	iFogSim	Characteristics of BIG DATA			Case study 2: Edge analytics for Water Quality Monitoring				
	SLO-2	Smart Cities, Agriculture, Smart Retail, smart Grid, Healthcare	XMPP, AMQP, Low power Lossy Network routing	FogTorch	Benefits of Big Data			Machine Learning in Edge for automation in water quality monitoring				
S-3	SLO-1	Challenges in IoT- Delivering Value to Customers, Hardware Compatibility Issues, Data Connectivity Issues	Communication Methods- Bluetooth, Zigbee Z-wave, 6LowPAN	Cisco IoX and Fog Application	Big Data Application-			Case Study 3: IoT- Edge system for Hydroponics system				
	SLO-2	Incorrect Data Capture Capabilities, Analytic Challenges, Data Security challenges,	Wireless Fidelity	Contiki/Cooja	Layered Big Data Architecture- Data Ingestion, Data collection, Data Processing Layer			Deep Learning in Edge for automation in hydroponics system				
S 4-5	SLO-1	Introduction to Edge Computing	4G	NS3	Data storage, Data Query and Visualization Layer			Case Study 4: IoT-Edge for Smart Energy Management				
	SLO-2				Big Data Implementation- Hortonworks, Cloudera, MAP R			Case Study 5: IoT- Edge for water demand forecasting				
S-6,7	SLO-1	Need for Edge Computing- Improved Performance , Compliance, Data Privacy, And Data Security	Sigfox, NeUL	Software Defined Multi-Tier Fog Architecture								

	SLO-2	Reduced Operational Cost	LoRaWAN	PVFOg simulator	Apache Projects for Big Data	Demand forecasting at Edge
S-8,9	SLO-1	Challenges in Edge/Fog Computing	5G	System Model analysis	Edge Computing for Big Data	

Learning Resources	<ol style="list-style-type: none"> <li>1. Ashton Kevin, (2009), "That Internet of Things Thing," <i>RFID Journal</i>, pp. 4986.</li> <li>2. Maria Rita Palattella et al., (2013), "Standardized protocol stack for the internet of (important) things," <i>IEEE Communications Surveys and Tutorials</i>, 15(3), pp. 1389–1406.</li> <li>3. D. Airehrour, J. Gutierrez and S. K. Ray, (2016), "Secure routing for internet of things: A survey," <i>Journal of Network and Computer Applications</i>, 66, pp. 198–213.</li> <li>4. Reem Abdul Rahman and Babar Shah, (2016), "Security analysis of IoT protocols: A focus in CoAP," <i>2016 3rd MEC International Conference on Big Data and Smart City, ICBDSO 2016</i>, pp. 172–178..</li> <li>5. Flavio Bonomi, Rodolfo Milito, Jiang Zhu and Sateesh Addepalli, (2012), "Fog Computing and Its Role in the Internet of Things," <i>Proceedings of the first edition of the MCC workshop on Mobile cloud computing</i>, pp. 13–16.</li> <li>6. Weisong Shi, Jie Cao, Quan Zhang, Youhuizi Li and Lanyu Xu, (2016), "Edge Computing: Vision and Challenges," <i>IEEE Internet of Things Journal</i>, 3(5), pp. 637–646.</li> <li>7. M. Mukherjee et al., (2017), "Security and Privacy in Fog Computing: Challenges," <i>IEEE Access</i>, 5, pp. 19293–19304.</li> <li>8. Jie Cao, Quan Zhang and Weisong Shi, (2018), "Challenges and opportunities in edge computing," <i>SpringerBriefs in Computer Science</i>, pp. 59–70.</li> <li>9. Martina Marjanovic, Aleksandar Antonic and Ivana Podnar Zarko, (2018), "Edge computing architecture for mobile crowd sensing," <i>IEEE Access</i>, 6, pp. 10662–10674.</li> <li>10. Hesham El-Sayed et al., (2017), "Edge of Things: The Big Picture on the Integration of Edge, IoT and the Cloud in a Distributed Computing Environment," <i>IEEE Access</i>, 6, pp. 1706–1717</li> <li>11. Huaqing Zhang, Yong Xiao, Shengrong Bu, Dusit Niyato, F. Richard Yu and Zhu Han, (2017), "Computing Resource Allocation in Three-Tier IoT Fog Networks: A Joint Optimization Approach Combining Stackelberg Game and Matching," <i>IEEE Internet of Things Journal</i>, 4(5), pp. 1204–1215</li> <li>12. Veeramanikandan M. and Suresh Sankaranarayanan, (2019), "Publish/subscribe based multi-tier edge computational model in Internet of Things for latency reduction," <i>Journal of Parallel and Distributed Computing</i>, 127, pp. 18–27.</li> <li>13. Ashfaq Farooqui, Kristofer Bengtsson, Petter Falkman and Martin Fabian, (2019), "From factory floor to process models: A data gathering approach to generate, transform, and visualize manufacturing processes," <i>CIRP Journal of Manufacturing Science and Technology</i>, 24, pp. 6–16.</li> <li>14. Hongbing Wang, Chao Yu, Lei Wang and Qi Yu, (2018), "Effective BigDataSpace service selection over trust and heterogeneous QoS preferences," <i>IEEE Transactions on Services Computing</i>, 11(4), pp. 644–657.</li> <li>15. Pekka Pääkkönen and Daniel Pakkala, (2015), "Reference Architecture and Classification of Technologies, Products and Services for Big Data Systems," <i>Big Data Research</i>, 2(4), pp. 166–186</li> <li>16. Tom White, (2015), "Hadoop: The Definitive Guide, 4th Edition," O'Reilly Media, Inc., (2015).</li> </ol>	<ol style="list-style-type: none"> <li>17. Team Hortonworks, "Hortonworks," [Online]. Available: <a href="https://hortonworks.com/">https://hortonworks.com/</a>.</li> <li>18. Cloudera, "Cloudera," [Online]. Available: <a href="https://www.cloudera.com/about.html">https://www.cloudera.com/about.html</a>.</li> <li>19. The Apache Software Foundation, "Apache Ni-Fi," [Online]. Available: <a href="https://nifi.apache.org/">https://nifi.apache.org/</a>.</li> <li>20. The Apache Software Foundation, "Apache Kafka," [Online]. Available: <a href="https://kafka.apache.org/">https://kafka.apache.org/</a>.</li> <li>21. The Apache Software Foundation, "Kafka Use cases," [Online]. Available: <a href="https://kafka.apache.org/uses">https://kafka.apache.org/uses</a>.</li> <li>22. The Apache Software Foundation, "Apache Storm," [Online]. Available: <a href="https://storm.apache.org/">https://storm.apache.org/</a>.</li> <li>23. The Apache Software Foundation, "Apache Hive," Apache. [Online]. Available: <a href="https://hive.apache.org/">https://hive.apache.org/</a>.</li> <li>24. The Apache Software Foundation, "Apache Pig," [Online]. Available: <a href="https://pig.apache.org/">https://pig.apache.org/</a>.</li> <li>25. Alan Gates and Daniel Dai, (2016), "Programming Pig: Dataflow Scripting with Hadoop," Shroff/O'Reilly.</li> <li>26. The Apache Software Foundation, "Zookeeper," [Online]. Available: <a href="https://zookeeper.apache.org/">https://zookeeper.apache.org/</a></li> <li>27. Shanguang Wang, Yali Zhao, Jinlinag Xu, Jie Yuan and Ching Hsien Hsu, (2019), "Edge server placement in mobile edge computing," <i>Journal of Parallel and Distributed Computing</i>, 127, pp. 160–168.</li> <li>28. Yuthika, S, Ekta Dagur, Sourabh Mishra, Rijo Jackson Tom, Veeramanikandan, M and Suresh, S, "Intelligent IoT Based Automated Irrigation System", <i>International Journal of Applied Engineering and Research</i>, Vol.12(18), pp.7306-7320, 2017</li> <li>29. Soundarya, P, Parthyusha, V, Niharika, A .V, Karthick, T and Suresh, S, "Intelligent IoT Based Water Quality Monitoring System", <i>International Journal of Applied Engineering and Research</i>, Vol.12(16), pp.5447-5454, 2017</li> <li>30. Manav, M, Sameer, S, Suresh, S, Tom, R J and Veeramanikandan, M, "IoT Based Hydroponics System using Deep Neural Networks", <i>Journal of Computers and Electronics in Agriculture</i>, Vol.155, pp.473-486, 2018, Elsevier Publishing</li> <li>31. Vignesh, M , Lavanya, V, Abhilasha, K, Gunasekhar, A and Suresh, S, "IoT Based Smart Energy Management System", <i>International Journal of Applied Engineering and Research</i>, Vol.12(16), pp.5455-5462, 2017</li> </ol>
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Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember Understand	40 %	-	30 %	-	30 %	-	30 %	-	30%	-
Level 2	Apply Analyze	40 %	-	40 %	-	40 %	-	40 %	-	40%	-
Level 3	Evaluate Create	20 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Total	100 %		100 %		100 %		100 %		100 %	

# CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
<i>Dr.Madan Lakshmanan</i>	<i>Dr.Subra Ganesan</i>	<i>Dr.S.Suresh</i>
<i>Senior Scientist</i>	<i>Professor, Department of Electrical and Computer Engineering</i>	<i>Dr.J. Sujithra</i>
<i>CEERI, CSIR, Chennai (R&amp;D Industry)</i>	<i>Oakland University, USA</i>	

Course Code	18CSE448T	Course Name	ENERGY MANAGEMENT FOR INTERNET OF THINGS DEVICES	Course Category	E	Professional Elective				L	T	P	C
										3	0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil							
Course Offering Department		Computer Science and Engineering		Data Book / Codes/Standards	Nil							

Course Learning Rationale (CLR):		The purpose of learning this course is to:			Learning			Program Learning Outcomes (PLO)																																	
CLR-1 :	Understand the rudiments of energy conservation and IoT			1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15																				
CLR-2 :	Gain the knowledge on various energy conservation schemes in IoT			Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3																				
CLR-3 :	Utilize the conventional and optimization algorithms for conserving energy in IoT devices																					H	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	
CLR-4 :	Understand the various techniques of green IoT and impact of conventional techniques of IoT																					H	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M
CLR-5 :	Gain the knowledge on existing energy efficient architecture for energy conservation and harvesting																					H	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M
CLR-6 :	Gain the knowledge on low energy Bluetooth devices and its importance																					H	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M
Course Learning Outcomes (CLO):		At the end of this course, learners will be able to:																																							
CLO-1 :	Acquire the knowledge on IoT and energy conservation approaches in IoT			2	80	85																																			
CLO-2 :	Identify and choose appropriate energy conservation component for real world problems			2	75	80																																			
CLO-3 :	Design and develop energy conservation algorithms for improving the lifetime of IoT devices			2	85	80																																			
CLO-4 :	Compare and contrast of various green IoT techniques and able to design green IoT for real world problems			2	80	75																																			
CLO-5 :	Design and develop energy efficient architecture for real world problems			2	75	85																																			
CLO-6 :	Design and develop energy efficient architecture for real world problems using low energy Bluetooth devices			2	80	85																																			

Duration (hour)	9		9		9		9		9	
S-1	SLO-1	Introduction to IoT	Energy conservation schemes	Static energy efficient algorithms	Green IoT an Overview	Designing energy efficient IoT based Intelligent Transport System				
	SLO-2	Architecture of IoT	Sleep/wakeup scheme	Exact allocation algorithm	Smart Homes, Smart Cities	Intelligent Transport System				
S-2	SLO-1	Components of IoT	Data driven scheme	Best Fit Heuristic Algorithm	Energy Efficient smart health care	Motivations for IoT in Transportation				
	SLO-2	Applications of IoT	Mobility based scheme	Dynamic energy efficient algorithms	Importance of Green IOT	Communication Technology and Related Power Issues				
S-3	SLO-1	Challenges in IOT	Load balancing	Hardware Level Solution	Taxonomy of green IoT techniques	Information Extraction and Underlying Power Issues				
	SLO-2	Energy Management in IoT	Working of load balancing	Dynamic Voltage Frequency Scaling (DVFS)	Various Approaches to Achieve Green IoT	Energy Efficiency Challenges and Corresponding Solutions, Further Challenges and Opportunities				
S-4	SLO-1	Energy harvesting	Hardware based load balancing	Software Level Solution	software based green IoT techniques	Capacity Estimation of Electric Vehicle Aggregator for Ancillary Services				
	SLO-2	Block diagram of energy harvesting	Software Based Load Balancing	First Fit Decreasing algorithm (FFD)	Hardware based green IoT techniques	Development of Electric Vehicles				
S-5	SLO-1	Various ambient energies	Compare hardware and software based load balancing techniques	Modified Best Fit Decreasing algorithm (MBFD)	Policy based techniques	Motivation for Vehicle to Everything (V2X) and V2G Technology				
	SLO-2	Energy harvesting schemes	Load balancing algorithms	Genetic Algorithm (GA)	Awareness based Approach - Toward Green IoT, Energy Awareness	Electric Vehicles and Solar Power Plants in Smart Grid Environment				

S-6	SLO-1	Harvesting modules		Particle Swarm Optimization (PSO)	IoT Based Smart Metering	Potential of EV to Grid Connection, Capacity Estimation of Aggregator
	SLO-2	Rectenna Model	Static Algorithms, Dynamic Algorithms	Ant Colony Optimization (ACO)	Communication Technology Creating Awareness About Green Information, Promoting Recycling	Battery Management System, Grid Connection and Performance Testing of V2G
S-7	SLO-1	Sensing antenna	Issues of energy conservation in IoT	Simulated Annealing (SA)	Habitual Based Techniques	Weather monitoring using Bluetooth Low Energy (BLE) in warehouses
	SLO-2	DC-DC Converter		Cat Swarm Optimization(CSO)	Comparative analysis of different green IoT approaches	BLE Introduction
S-8	SLO-1	Wireless energy harvesting	Basic model of smart home system	Hybrid Genetic Algorithm and Cat Swarm Optimization (HGACSO)	Case study: impact of smart phones on the environment in present and future trends	BLE importance
	SLO-2	Near Field Communication, Inductive coupling	Energy Conservation in Smart Home and IoT	Hybrid Genetic Algorithm, Particle Swarm Optimization and Simulated annealing(HGAPSOA)	Reduce the environmental impact life cycle assesment of smatphones, smart phone emission and selling rate	
S-9	SLO-1	Paradigmatic view of energy efficient IoT	Automation and Sensors in Smart Home	Comparison of dynamic energy efficient algorithms	Promoting the Usage of Sensor Cloud: a step toward green IoT.	Design weather monitoring using BLE
	SLO-2	Pragmatic energy efficient IoT system architecture	Case study: energy conservation component for smart home.	Compare and contrast static and dynamic energy efficient algorithms	Creating Awareness Through Prototyping: A Green IoT-Based Smart	

Learning Resources	<ol style="list-style-type: none"> <li>1. "Energy Conservation for IoT Devices Concepts, Paradigms and Solutions", Mamta Mittal, Sudeep Tanwar, Basant Agarwal, Lalit Mohan Goyal, Studies in Systems, Decision and Control 206, 2019.</li> <li>2. "IoT projects with Bluetooth Low Energy- Harness the power of connected things", Madhur</li> </ol>	<ol style="list-style-type: none"> <li>3. 1 Green IoT: An Investigation on Energy Saving Practices for 2020 and Beyond, Rushan Arshad, Saman Zahoor, Munam Ali Shah, Abdul Wahid, and Hongnian Yu, special section on future networks: architectures, protocols, and applications, 2017.</li> </ol>
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#### Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#		Theory	Practice
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice		
Level 1	Remember	40 %	-	30 %	-	30 %	-	30 %	-	30%	-
Level 2	Understand	40 %	-	40 %	-	40 %	-	40 %	-	40%	-
	Apply	40 %	-	40 %	-	40 %	-	40 %	-	40%	-
Level 3	Analyze	20 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Evaluate	20 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Create	20 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Total	100 %		100 %		100 %		100 %		100 %	

# CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

#### Course Designers

Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Mr. Anantha Velavan, Principal Validation Engineer, Micro chip	Dr. Divya Udayan J, PhD(S.Korea) MIEEE   MACM   MIDF, Associate Professor, VIT University, Vellore	Dr. T. Sujithra, SRMIST
2. Mr. Ganesh SKandha, Senior Applications Engineer, Micro chip	Dr. Masoodhu Banu, Professor/Head of Bio Medical, Veltech University,	Dr. Kayalvizhi Jayavel, SRMIST
		Mrs. Anitha, SRMIST

Course Code	18CSE367T	Course Name	REQUIREMENTS ENGINEERING	Course Category	E	Professional Elective	L	T	P	C
							3	0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Computer Science and Engineering		Data Book / Codes/Standards	Nil	

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning			Program Learning Outcomes (PLO)														
CLR-1 :	Identify the sources, collect, organize and classify the requirements	1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CLR-2 :	Improve their ability to choose the appropriate Elicitation Techniques for any systems	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3
CLR-3 :	Familiarize with the various requirements documentation and validation techniques																		
CLR-4 :	Familiarize with the various requirements quality drivers, Traceability models and requirements change control techniques																		
CLR-5 :	Expose to the Conflicts, Escalation model , Settlements and Analytics of Cost Benefit analysis																		
CLR-6 :	Expose to the latest requirements engineering tools																		

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Learning			Program Learning Outcomes (PLO)														
CLO-1 :	Acquire the knowledge on identifying the Source, organising and classifying requirements	2	80	85	H	H	L	M	-	L	L	M	H	H	M	L	-	-	-
CLO-2 :	Acquire the ability to identify and Apply the appropriate Elicitation Techniques for any systems	2	75	80	H	H	H	L	-	L	-	L	H	H	H	L	-	-	-
CLO-3 :	Understand the basic ideas about various requirements documentation and validation techniques	2	85	80	H	L	L	L	M	-	-	M	M	M	M	-	-	-	-
CLO-4 :	Apply the knowledge on various requirements quality drivers, Traceability models and requirements change control techniques for any system	2	80	75	H	H	L	M	H	M	-	M	M	L	L	M	-	-	-
CLO-5 :	Appreciate the concepts of Conflict, Escalation model , Settlements and Analytics of Cost Benefit analysis	2	75	85	H	H	-	H	H-	-	-	M	L	M	M	-	-	-	-
CLO-6 :	Appreciate the concepts of latest requirements engineering tools	2	70	70	H	L	L	M	H	-	L	L	L	L	M	M	-	-	-

Duration (hour)	9		9		9		9		9	
S-1	SLO-1	Introduction to Requirements and Requirements Engineering	Requirement Inception	Introduction to Requirement Document, Structure of Document	Business drivers of Quality-components of Integrated Quality approach	Conflict types				
	SLO-2	Requirements Types	sources of requirements							
S-2	SLO-1	Classification of Requirements	Introduction to requirement Elicitation	Vision, Scope and Elicitation notes	Quality improvement techniques, Requirements Quality Assurance	Mastering and using detection of the 5conflicts types on the basis of indication in project				
	SLO-2	Requirements Gathering relevant to Software Life Cycle Models								
S-3	SLO-1	Stakeholders in the requirements process	Classical Elicitation Techniques-Interview, Questionnaire, Social analysis	Requirement Specification techniques	PDCA Cycle	Glas's conflicts escalation model				
	SLO-2									
S-4	SLO-1	Requirements Engineering Process Framework, Requirements Engineering Maturity Model	Modern Elicitation Techniques-Brainstorming,	Introduction to requirement validation-Classical Requirement Validation techniques-Inspection, Simple Check	Introduction to Requirement Management-Requirement Identification-Requirements traceability	Conflicts Settlement techniques				
	SLO-2	Generic Process for requirements Engineering								



S-5	SLO-1	Levels of Requirements Engineering	Modern Elicitation Techniques- Prototyping, Use Centered Design,	Introduction to requirement validation- Classical Requirement Validation techniques-Desk Check, Walkthrough	Requirement Traceability models, Traceability Matrix- Traceability List & Tree	Conflicts Settlement techniques
	SLO-2	System Model for Requirements Engineering				
S-6	SLO-1	Representation of Requirements-Data Flow, ER Diagram	Modern Elicitation Techniques- Walkthrough, Use case Joint Application Development	Format review	Introduction to Requirement Traceability- Requirement traceability methods	Analytic Methods – Mastering and using Consider All Facts (CAF)
	SLO-2	View Point Controlled Requirements				
S-7	SLO-1	Structured Analysis and Design Technique, Viewpoint Oriented Requirements Definition	Requirement reuse	Prototype & Enactments, Functional test Design		Analytic Methods – Plus –Minus- Intresting(PMI)
	SLO-2					
S-8	SLO-1	Object Oriented Methods of Requirements Engineering	Feature Oriented Domain Analysis	Development of User manual	Advance Traceability	Analytic Methods – Cost Benefit Analysis
	SLO-2					
S-9	SLO-1	Case Study : For the given application identify the stakeholders, gather and classify the requirements according to the types	Case Study: For the given application apply various techniques and Elicitation the requirements	Case study. For the given application validate and document the specifications	Requirement Change Control	Case study : Requirement Engineering Tools
	SLO-2					

Learning Resources	1. ElizabethHull, KenJackson, JeremyDick, RequirementsEngineering, Springer, 2013 2. RalphR. Young, "TheRequirmentsENgineeringHandbook", 2004	3. AxelvanLamsweerde, "RequirementsEngineering: FromSystemGoalstoUMLModelstoSoftware Specifications", Wiley, 2014 4. KarlWieggers, JoyBeatty, SoftwareRequirements(DeveloperBestPractices), (3rdEdition), MicrosoftPress, 2014.
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Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember Understand	40%	-	30%	-	30%	-	30%	-	30%	-
Level 2	Apply Analyze	40%	-	40%	-	40%	-	40%	-	40%	-
Level 3	Evaluate Create	20%	-	30%	-	30%	-	30%	-	30%	-
	Total	100 %		100 %		100 %		100 %		100 %	

# CA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Dr. Mariappan Vaithilingam, Engineering Leader Amazon, dr.v.m@ieee.org		1. Mrs. Sasi Rekha Sankar, SRMIST
2. Mr. Badinath, SDET, Amzon, sbadhrinath@gmail.com		2. Mrs. Geetha.G, SRMIST
		3 Dr. S. Thenmalar, SRMIST

Course Code	18CSE368T	Course Name	SOFTWARE ARCHITECTURE AND DESIGN	Course Category	E	Professional Elective	L	T	P	C
							3	0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Computer Science and Engineering		Data Book / Codes/Standards	Nil	

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning			Program Learning Outcomes (PLO)														
CLR-1 :	Classify the essential elements of software architecture	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CLR-2 :	Understand the issues related to architecting a large-scale software system				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CLR-3 :	Understand different software architectures views and styles				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CLR-4 :	Able to use the four-views approach for developing and documenting a software architectures				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CLR-5 :	Understand the implications of different design patterns				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CLR-6 :	working as part of a team, develop, analyze and critique an architecture of a software system				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Learning			Program Learning Outcomes (PLO)														
CLO-1 :	Describe different approaches to design software application	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CLO-2 :	Analyze specifications and identify appropriate design strategies.				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CLO-3 :	Develop an appropriate design for a given set of requirements				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CLO-4 :	Identify applicable design patterns for the solution				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CLO-5 :	Abstract and document reusable design patterns				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CLO-6 :	Evaluate a given design against the specifications				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15

Duration (hour)	9		9		9		9		9	
S-1	SLO-1	Software Architecture –Software Design	Software Architectural Patterns & Styles	Evaluating a Software Architecture	Introduction to Design Process	Introduction to Design Pattern				
	SLO-2	Importance and Need of Software Architecture	Types of Architectural Styles	Why- When -Who evaluate Architecture	Design Strategy	Component of Design Pattern - Types				
S-2	SLO-1	4 +1 View Model	Layered pattern	What Qualities Can We Evaluate an Architecture?	Describing the design process the D-Matrix	Creational Design Patten - Abstract Factory Pattern				
	SLO-2	Activities in Software Architecture	Merits and Demerits of Layered Pattern		Views associated with D-matrix	Factory Method				
S-3	SLO-1	Fundamental design issues	Pipe-Filter pattern	Outputs of an Architecture Evaluation	Design by top-down decomposition	Singleton Pattern				
	SLO-2		Merits and Demerits of Pipe and Filter			Structural design Pattern - Types				
S-4	SLO-1	Understanding quality attributes -	Shared Data Pattern	Evaluating the Architecture - ATAM	Design by composition	Adaptor pattern				
	SLO-2	Six parts of Quality Scenario	Merits and Demerits of Shared Data Pattern	Participants and Outputs of ATAM		Decorator Pattern				
S-5	SLO-1	Design for quality attributes - Availability ( General Scenario, Tactics)	Client Server pattern	Phases of ATAM	Function-oriented design	Proxy Pattern				
	SLO-2		Merits and Demerits of Client Server	CASE Study for ATAM		Behavioral Design Pattern - Types				
S-6	SLO-1	Design for quality attributes - Modifiability ( General Scenario,	Blackboard Architectural Pattern	Evaluating the Architecture - CBAM	Object-oriented design	Observer Pattern				

		Tactics )				
	SLO-2		Merits and Demerits	Decision-Making Context		Strategy Pattern
S-7	SLO-1	Design for quality attributes - Security ( General Scenario, Tactics )	Flight Simulation: A Case Study in an Architecture for Integrability	Basis for the CBAM - Case Study	Aspect Oriented Design	Iterator pattern
	SLO-2		Relationship to the Architecture Business Cycle			Introduction to ADL
S-8	SLO-1	Design for quality attributes - Usability ( General Scenario, Tactics )	Requirements and Qualities related to flight simulation	Evaluating Software Architecture - SAAM	Design Metrics - Need for Metrics	Components of ADL- Example
	SLO-2			SAAM Evaluation Process	WMC -DIT	
S-9	SLO-1	Design for quality attributes - Testability ( General Scenario, Tactics)	Architectural Solution for flight simulation	Evaluating Software Architecture - ARID	NOC - CBC	Future Directions in Architecture
	SLO-2			ARID Evaluation Process	RFC- LCOM	

Learning Resources	1. Len Bass, Paul Clements, & Rick Kazman. <i>Software Architecture in Practice (Third Edition)</i> . Addison- Wesley,2013	4. Paul Clements , Rick Kazman , Mark Klein, <i>Evaluating Software Architectures: Methods and Case Studies</i> . Addison Wesley; 1 edition (22 October2001)
	2. Humberto Cervantes, Rick Kazman , <i>Designing Software Architectures: A Practical Approach</i> . Pearson Education,2016	
	3. Carlos Otero, "SoftwareEngineeringDesign:TheoryandPractice",CRCPress,2012	6. VasudevaVarma, <i>SoftwareArchitecture:ACaseBasedApproach</i> .PearsonEducation,2009.

#### Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#		Theory	Practice
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice		
Level 1	Remember	40 %	-	30 %	-	30 %	-	30 %	-	30%	-
Level 2	Understand	40 %	-	40 %	-	40 %	-	40 %	-	40%	-
	Apply	40 %	-	40 %	-	40 %	-	40 %	-	40%	-
Level 3	Analyze	20 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Evaluate	20 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Create	20 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Total	100 %		100 %		100 %		100 %		100 %	

# CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
		Mr.C.Arun, SRMIST

Course Code	18CSE369T	Course Name	SOFTWARE MODELING AND ANALYSIS	Course Category	E	Professional Elective	L	T	P	C
							3	0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Computer Science and Engineering		Data Book / Codes/Standards	Nil	

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning			Program Learning Outcomes (PLO)																
CLR-1 :	Select a suitable modeling method according to problem area and assignment, and can justify their choice.	1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15		
CLR-2 :	Formulate models of a system to describe the system on different levels of abstraction and from different viewpoints.	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3			
CLR-3 :	Identify the Formal models used in software development																				
CLR-4 :	Define model checking concepts using tools																				
CLR-5 :	Model the software system and analyze its characteristics and correctness.																				

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:																				
CLO-1 :	Implement the appropriate modeling method for the given problem	2	80	85	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-2 :	Explain the system abstraction in different levels	2	75	80	H	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-3 :	Apply the Formal models in the software development	2	85	80	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-4 :	Apply tools to check model checking properties of a system	2	80	75	H	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-5 :	Analyze the characteristics and correctness of software system	2	75	85	H	-	-	H	-	-	-	-	-	-	-	-	-	-	-	-	-

Duration (hour)	9		9		9		9		9	
S-1	SLO-1	Introduction to software modelling	Representing domain concepts by conceptual objects	Modeling system agents, Characterizing agents.	Correctness of Object Oriented Programs Design by Contract, The Class Invariant	Introduction to Kripke Structures				
S-2	SLO-1	Modeling principles	Entities, Association, Attributes	Representing agent models,Refinement of abstract agents	Example - correctness of stack application	Modeling System Design as Kripke Structure				
S-3	SLO-1	Goal features as model annotations,Goal refinement	Built-in associations for structuring object models	Building Agent models	A real-time temporal logic for specifying model annotations	Exercise on Kripke Modelling, Recap to Kripke Structures				
S-4	SLO-1	Representing conflicts among goals,Connecting the goal model with other system views.	Class Diagrams, Heuristic rules for building object models	Modelling system operations, Characterizing system operations	Specifying goals in the goal model.	Exercises on system modeling using kripke structures, Introduction to LTL				
S-5	SLO-1	Modelling alternative options, Goal diagrams as AND/OR graphs.	Object or Attribute Entity, association, agent or event?	Goal Operationalization, Goals, agents, objects and operations	Specifying descriptive properties in the object model	Properties of a system, Liveness and Safety properties , Exercise on specifying properties as LTL formula				
S-6	SLO-1	Documenting goal refinements and assignments with annotations	Attribute of a linked object or of the linking association Specialization and generalizing concepts Avoiding common pitfalls	Representing object models, Building operation models	Specifying operationalization's in the operation model	Introduction to NuSMV tool, Model Checking using NuSMV,Introduction to SPIN CHECKER tool				
S-7	SLO-1	Building goal models: Heuristic rules and reusable patterns	Aggregation or association? Avoiding common pitfalls	Modelling System behaviour, Modelling instance behaviours	Checking goal refinements deriving goal operations	Model Checking using SPIN checker tool				
S-8	SLO-1	Goal obstruction by obstacles	Specialization and generalizing concepts Avoiding common pitfalls	Modelling class behaviours	Generating obstacles for risk analysis Generating anti goals for security analysis	System Property as first order logic formula Proof of correctness using theorem prover				

S-9	SLO-1	Modelling obstacles, Obstacle analysis for a more robust goal model	Case Study	Building behaviour models	Formal conflict analysis. Synthesizing behaviour models for animation and model checking.	Introduction Isabelle tool, Theorem proving using Isabelle
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Learning Resources	<ol style="list-style-type: none"> <li>Axel van Lamsweerde "Requirements Engineering: From System Goals to UML Model to Software Specifications" ISBN: 978-0-470-01270-3 February 9, 2009 Wiley</li> <li><a href="http://www.bowdoin.edu/~allen/courses/cs260/readings/ch12.pdf">http://www.bowdoin.edu/~allen/courses/cs260/readings/ch12.pdf</a></li> </ol>	<ol style="list-style-type: none"> <li>Gerard J. Holzmann, "The SPIN Model Checker: Primer and Reference Manual" ISBN-13: 978-0321773715, AT&amp;T Bell Labs Murray Hill New Jersey ©2004   Addison-Wesley Professional</li> </ol>
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Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember Understand	40 %	-	30 %	-	30 %	-	30 %	-	30%	-
Level 2	Apply Analyze	40 %	-	40 %	-	40 %	-	40 %	-	40%	-
Level 3	Evaluate Create	20 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Total	100 %		100 %		100 %		100 %		100 %	

# CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Ms T Vijayalakshmi Priyadharsini, Senior Manager, Cognizant Technology Solutions, Chennai	1. Dr. Kumudha Padmanaban, Associate Professor, Coimbatore Institute of Technology, <a href="mailto:kumudha@cit.edu.in">kumudha@cit.edu.in</a>	1. Mr Ramraj S, SRMIST
	2. Dr M Sangeetha, Coimbatore Institute of Technology, <a href="mailto:citcsesangi@gmail.com">citcsesangi@gmail.com</a>	2. Ms A NithyaKalyani, SRMIST

Course Code	18CSE370T	Course Name	DESIGN PATTERNS	Course Category	E	Professional Elective	L	T	P	C
							3	0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Computer Science and Engineering		Data Book / Codes/Standards	Nil	

Course Learning Rationale (CLR):	The purpose of learning this course is to:			Learning			Program Learning Outcomes (PLO)																	
CLR-1 :	Conceive the importance of reuse of solution for common problems in software development.			1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15			
CLR-2 :	Identify the appropriate patterns for design problems.			Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3			
CLR-3 :	Implement the various design pattern solution for appropriate scenarios						H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLR-4 :	Refactoring the badly designed program properly using patterns.						H	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
							H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:						H	H	-	-	-	-	-	-	-	-	-	-	-	-	-			
CLO-1 :	To create software designs that are scalable and easily maintainable			2	80	85	H	H	-	-	-	-	-	-	-	-	-	-	-	-	-			
CLO-2 :	Use creational design patterns in software design for class instantiation			2	75	80	H	H	-	-	-	-	-	-	-	-	-	-	-	-	-			
CLO-3 :	Use structural design patterns for better class and object composition			2	85	80	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-			
CLO-4 :	Use behavioral patterns for better organization and Communication between the objects			2	80	75	H	H	-	-	-	-	-	-	-	-	-	-	-	-	-			

Duration (hour)	9	9	9	9	9	
S-1	SLO-1 SLO-2	Basics of UML Class Diagram, Interaction Diagram	Strategy pattern- Intent, Motivation, Applicability, Structure, Participants, collaborations, consequences Strategy pattern- Implementation and sample code	Abstract factory- Intent, Motivation, Applicability, Structure, Participants, collaborations, consequences Abstract factory- Implementation and sample code	Adapter- Intent, Motivation, Applicability, Structure, Participants, collaborations, consequences Adapter- Implementation and sample code	What to Expect from Design Patterns The Pattern Community An Invitation
S-2	SLO-1 SLO-2	Object design, Reuse Concepts, Solution Objects Inheritance & Design Patterns	Mediator - Intent, Motivation, Applicability, Structure, Participants, collaborations, consequences Mediator- Implementation and sample code	Singleton pattern- Intent, Motivation, Applicability, Structure, Participants, collaborations, consequences Singleton pattern Implementation and sample code	Bridge- Intent, Motivation, Applicability, Structure, Participants, collaborations, consequences Bridge- Implementation and sample code	A Parting Thought A Case Study : Designing a Document Editor : Design Problems, Document Structure
S-3	SLO-1 SLO-2	Principle and Strategies Open/Closed principle Designing from context, Encapsulating Variation	Template Method- Intent, Motivation, Applicability, Structure, Participants, collaborations, consequences Template Method- Implementation	Factory method pattern- Intent, Motivation, Applicability, Structure, Participants, collaborations, consequences Factory method pattern Implementation	Decorator, Facade- Intent, Motivation, Applicability, Participants, collaborations, consequences Structure Decorator, Facade- Implementation	A Case Study : Designing a Document Editor : Design Problems, Document Structure Formatting, Embellishing the User Interface
S-4	SLO-1 SLO-2	Abstract classes and Interfaces Design patterns and Architecture	Template Method- sample code Case study: Identify which pattern is applicable for the given case study and justify	Factory method pattern sample code Case study: Identify which pattern is applicable for the given case study and justify	Decorator, Facade- Sample Code Case study: Identify which pattern is applicable for the given case study and justify	Supporting Multiple Look-and-Feel Standards Supporting Multiple Window Systems
S-5	SLO-1 SLO-2	Gand of Four Patterns Basics of UML	Case study: Identify which pattern is applicable for the given case study and justify Strategy pattern- Intent, Motivation, Applicability, Structure, Participants, collaborations, consequences	Case study: Identify which pattern is applicable for the given case study and justify Abstract factory- Intent, Motivation, Applicability, Structure, Participants, collaborations, consequences	Case study: Identify which pattern is applicable for the given case study and justify Adapter- Intent, Motivation, Applicability, Structure, Participants, collaborations, consequences	User Operations Spelling Checking and Hyphenation What to Expect from Design Patterns

S-6	SLO-1	Class Diagram, Interaction Diagram Object design, Reuse Concepts, Solution Objects	Strategy pattern- Implementation and sample code Mediator - Intent, Motivation, Applicability, Structure, Participants, collaborations, consequences	Abstract factory- Implementation and sample code Singleton pattern- Intent, Motivation, Applicability, Structure, Participants, collaborations, consequences	Adapter- Implementation and sample code Bridge- Intent, Motivation, Applicability, Structure, Participants, collaborations, consequences	The Pattern Community An Invitation A Parting Thought
	SLO-2					
S-7	SLO-1	Inheritance & Design Patterns Principle and Strategies Open/Closed principle	Mediator- Implementation and sample code Template Method- Intent, Motivation, Applicability, Structure, Participants, collaborations, consequences	Singleton pattern Implementation and sample code Factory method pattern- Intent, Motivation, Applicability, Structure, Participants, collaborations, consequences	Bridge- Implementation and sample code Decorator, Facade- Intent, Motivation, Applicability, Participants, collaborations, consequences Structure	A Case Study : Designing a Document Editor : Design Problems, Document Structure A Case Study : Designing a Document Editor : Design Problems, Document Structure
	SLO-2					
S-8	SLO-1	Designing from context, Encapsulating Variation Abstract classes and Interfaces	Template Method- Implementation Template Method- sample code	Factory method pattern Implementation Factory method pattern sample code	Decorator, Facade- Implementation Decorator, Facade- Sample Code	Formatting, Embellishing the User Interface Supporting Multiple Look-and-Feel Standards
	SLO-2					
S-9	SLO-1	Design patterns and Architecture	Case study: Identify which pattern is applicable for the given case study and justify	Case study: Identify which pattern is applicable for the given case study and justify	Case study: Identify which pattern is applicable for the given case study and justify	Supporting Multiple Window Systems
	SLO-2					

Learning Resources	<ol style="list-style-type: none"> <li>1. Bruegge, Bernd and Allen H. Dutoit. "Object-Oriented Software Engineering: Using UML, Patterns and Java", Pearson: Prentice Hall Publishers 2004</li> <li>2. Erich Gamma, Richard Helm, "Design Patterns: Elements of Reusable Software Development", Pearson Education, 2005</li> </ol>	<ol style="list-style-type: none"> <li>3. Alan Shalloway, James R Trott "Design pattern explained", Pearson Education, 2005.</li> <li>4. Eric Freeman, Elisabeth Robson, Bert Bates, and Kathy Sierra, "Head First Design Patterns", O'Reilly Publications, 2004.</li> </ol>
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#### Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember Understand	40 %	-	30 %	-	30 %	-	30 %	-	30%	-
Level 2	Apply Analyze	40 %	-	40 %	-	40 %	-	40 %	-	40%	-
Level 3	Evaluate Create	20 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Total	100 %		100 %		100 %		100 %		100 %	

# CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

#### Course Designers

Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Ms T Vijayalakshmi Priyadharsini, Senior Manager, Cognizant Technology Solutions, Chennai	1. Dr. Kumudha Padmanaban, Associate Professor, Coimbatore Institute of Technology, kumudha@cit.edu.in	1. Dr S Sridar SRMIST
	2. Dr M Sangeetha, Coimbatore Institute of Technology, citcsesangi@gmail.com	2. Ramraj S SRMIST

Course Code	18CSE371T	Course Name	USER INTERFACE DESIGN	Course Category	E	Professional Elective	L	T	P	C
							3	0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Computer Science and Engineering		Data Book / Codes/Standards	Nil	

Course Learning Rationale (CLR):	The purpose of learning this course is to:			Learning			Program Learning Outcomes (PLO)																		
CLR-1 :	Understand the concepts of design; Utilize by learning various color models			1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15				
CLR-2 :	Gain knowledge on the basics of various law in UX			Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3				
CLR-3 :	Construct the task for requirement gathering						H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLR-4 :	Gain knowledge on how to Design for various domains or applications						H	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLR-5 :	Introduce tools for designing various applications						H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLR-6 :	Utilised different types of design for real-time programming applications						H	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLR-6 :	Utilised different types of design for real-time programming applications						H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:																								
CLO-1 :	Identify various color models for design			2	80	85																			
CLO-2 :	Create the design as per the design law			2	75	80																			
CLO-3 :	Construct the task for requirement gathering			2	85	80																			
CLO-4 :	Create wire frames and prototypes			2	80	75																			
CLO-5 :	Create the usability constraints and accessibility			2	75	85																			
CLO-6 :	Construct real-time applications using real-time programming applications			2	80	85																			

Duration (hour)	9		9		9		9		9	
S-1	SLO-1	What is typography-type properties, baseline, cap height	Laws of UX designing	Introduction to Interaction Design	Culture in usability	Importance of case studies and guidelines				
	SLO-2	X-height, ascenders	Hicks law	Task analysis	Universal usability	Tracking APP Introduction				
S-2	SLO-1	Descenders and weight	example of hicks law with an application	Data collection for gathering user	Inclusive interaction	Tracking APP Design guidelines				
	SLO-2	Type classification-Serif	Jakob's law	Data for task requirements	Importance of accessibility	Tracking APP demo				
S-3	SLO-1	sans serif fonts	example of jakob's law with an application	Requirements gathering	principles of accessibility	Designing UI				
	SLO-2	monospace	Fitts's Law	Eliciting Qualitative data	Universal design	Redesigning Gmail and making it flash				
S-4	SLO-1	handwriting and Display	example of Fitts's law with an application	analyzing qualitative data	Accessibility design	Design principles				
	SLO-2	Readability, letter spacing	Ockham's Razor	Qualitative metrics	Font weight, color	Redesigning Gmail and making it flash Demo				
S-5	SLO-1	line height with an example	example of Ockham's law with an application	User narratives	Contrast, Screen readers	Introduction of how to Design a new UX concept to reduce driver distraction				
	SLO-2	Paragraph spacing, power of alignment	Pareto Principle	Scenario implementation and its challenges	Alt text using a tool	Designing concepts of Driver distraction				
S-6	SLO-1	Leading and Kerning	example of Pareto principle with an application	Wireframes	Introduction to Multifaceted Users	Demo				
	SLO-2	Fundamentals of color	Weber's law	Example on wireframes	Designing for Multifaceted Users	Importance of User data in UX designing				
S-7	SLO-1	Color Models Introduction	example of Weber's law with an application	Prototypes	Design guidelines	Approach to design without user data				
	SLO-2	RGB, CMYK	Tesler's law	Implementation of Prototypes	Guidelines for helping adults	Designing concept				



S-8	SLO-1	Color harmony: monochromatic, analogous	example of Tesler's law with an application	UX design for mobile application	Application example	Implementation problems without data
	SLO-2	Complementary, triadic, double-complementary	Law of proximity	Application design example	Virtual third eye simulator introduction	Dynamic webpages
S-9	SLO-1	Meaning of colors	example of proximity	Responsive Design	Web accessibility guide	Demo
	SLO-2	The power of Contrast	Law of similarity and human eye	Adaptive design and difference with Responsive design	Virtual third eye simulator web accessibility	Perform UI Case study

Learning Resources	1. Jeff Johnson, Kate Finn- "Designing user Interfaces for an aging population towards Universal design- Morgan Kauffman publishers – Elsevier-2017	3. Andrew Rogerson- "User Experience Design"-Smashmedia2012-Freiburg, Germany
	2. Elvis Canziba- "Hands-on UX Design for Developers"-Packt Birmingham, Mumbai-2018	4. Barbara Ballard, "Designing the mobile user experience" Wiley publications 2007 5. <a href="https://uxdesign.cc/tagged/case-study">https://uxdesign.cc/tagged/case-study</a>

Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	40%	-	30%	-	30%	-	30%	-	30%	-
Level 2	Understand	40%	-	40%	-	40%	-	40%	-	40%	-
	Apply	40%	-	40%	-	40%	-	40%	-	40%	-
Level 3	Analyze	20%	-	30%	-	30%	-	30%	-	30%	-
	Evaluate	20%	-	30%	-	30%	-	30%	-	30%	-
	Create	20%	-	30%	-	30%	-	30%	-	30%	-
	Total	100 %		100 %		100 %		100 %		100 %	

# CA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
		1. Mr.S.Karthick, SRMIST
		2.Mrs.Akilandeswari, SRMIST

Course Code	18CSE372T	Course Name	VISUAL PROGRAMMING	Course Category	E	Professional Elective	L	T	P	C
							3	0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	CSE	Data Book / Codes/Standards	Nil		

Course Learning Rationale (CLR):	The purpose of learning this course is to:			Learning			Program Learning Outcomes (PLO)																	
CLR-1 :	Gain knowledge about basics of C# and .NET framework			1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15			
CLR-2 :	Utilize object-oriented aspects of C# to develop applications			Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3			
CLR-3 :	Utilize forms, menus etc. to design Windows applications						-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLR-4 :	Utilize ActiveX Data Objects to create Database applications						H	-	M	-	H	-	-	-	-	-	-	-	-	H	-	-	-	-
CLR-5 :	Utilize web forms to develop Web based applications						H	H	M	-	H	L	L	-	H	-	H	-	-	H	-	-	-	-
							H	-	M	M	H	L	L	M	H	M	L	H	M	H	M	H	H	

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:			2	80	85	-	-	-	-	H	-	-	-	-	-	-	-	-	-	-	-
CLO-1 :	Understand the basics of C# and .NET framework			2	75	80	H	-	M	-	H	-	-	-	-	-	-	H	-	-	-	
CLO-2 :	Develop applications using object-oriented aspects of C#			2	85	80	H	-	M	M	H	L	L	-	H	-	-	H	-	-	-	
CLO-3 :	Design Windows applications			2	80	75	H	H	M	-	H	L	L	-	H	-	-	H	-	-	-	
CLO-4 :	Create Database applications using ActiveX Data Objects			2	75	85	H	-	M	M	H	L	L	M	H	M	L	H	M	H	H	
CLO-5 :	Develop Web based applications			2	75	85	H	-	M	M	H	L	L	M	H	M	L	H	M	H	H	

Duration (hour)	10	10	9	8	8	
S-1	SLO-1 SLO-2	Introducing C# - Understanding .NET Framework	Class – Objects	Building Windows Application	Accessing data with ADO.NET: DataSet	Programming Web Application with Web Forms
S-2	SLO-1 SLO-2	Overview of C# - Literals – Variables Data Types – Operators – Constants - Expressions	Constructors – Types of Constructors	Examples: Windows Applications	Accessing data with ADO.NET: Typed Dataset	Introduction to ASP.NET,
S-3	SLO-1 SLO-2	Program Control Statements: Branching	Inheritance and its types	Creating Window Forms with Events and Controls	Data Adapter	Working with XML and .NET
S-4	SLO-1 SLO-2	Program Control Statements: Looping	Examples - Inheritance	Examples: Window Forms with Events and Controls	Updating Database using Stored Procedures	Creating Virtual Directory and Web Application
S-5	SLO-1 SLO-2	Casting - Methods	Indexers and Properties	Menu and Toolbar	SQL Server with ADO.NET	Session Management
S-6	SLO-1 SLO-2	Arrays: Array Class	Polymorphism – Operator Overloading	Delegates - Inheriting Window Forms	Handling Exceptions	Web Services – web.config
S-7	SLO-1 SLO-2	Array List	Polymorphism – Method Overloading	SDI Application	Validating Controls	Web Services – Passing Datasets and Returning Datasets from Web Services
S-8	SLO-1 SLO-2	String	Interfaces, Abstract Class	MDI Application	Windows Application Configuration	Transaction Handling, Exception Handling – Returning Exceptions from SQL Server
S-9	SLO-1 SLO-2	String Builder	Event Handling	Dialog Box: Modal and Modeless		
S-10	SLO-1 SLO-2	Structures - Enumerations	Errors and Exception Handling			

Learning Resources	1. Herbert Schildt, "The Complete Reference: C# 4.0", Tata McGraw Hill, 2012.	3. Christian Nagel et al. "Professional C# 2012 with .NET 4.5", Wiley India, 2012.
	2. Andrew Troelsen, Philip Japikse, "C# 6.0 and the .NET 4.6 Framework", Seventh Edition, Apress, 2015	4. Andrew Troelsen, Philip Japikse, "Pro C# 7 with .NET and .NET Core", Eighth Edition, Apress, 2017
		5. Stephen C. Perry, "Core C# and .NET", Prentice Hall, 2005

Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	40%	-	30%	-	30%	-	30%	-	30%	-
	Understand										
Level 2	Apply	40%	-	40%	-	40%	-	40%	-	40%	-
	Analyze										
Level 3	Evaluate	20%	-	30%	-	30%	-	30%	-	30%	-
	Create										
Total		100 %		100 %		100 %		100 %		100 %	

# CA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Mr. Prakas, Associate Consultant, Virtusa, Chennai	1.	1. Dr. M.S. Abirami, SRMIST
2. Mr. S. Padmanabhan, Associate Vice President, Intellect, Chennai	2.	2. Ms. Nagadevi SRMIST 3. Mr. K. Navin

Course Code	18CSE373T	Course Name	PROGRAMMING IN JAVASCRIPT	Course Category	E	Professional Elective	L	T	P	C
							3	0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	CSE	Data Book / Codes/Standards	Nil		

Course Learning Rationale (CLR):	The purpose of learning this course is to:			Learning			Program Learning Outcomes (PLO)																			
CLR-1 :	Understand scripting language basics for web development			1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15					
CLR-2 :	Develop familiarity with the JavaScript language – Arrays, Objects, Functions			Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3					
CLR-3 :	Understand concepts like HTML, CSS , DOM,						H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
CLR-4 :	Acquire knowledge of jQuery , DOM events etc.						H	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLR-5 :	Apply in AJAX and learn the usage of Closures						H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
							H	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:			2	80	85	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			
CLO-1 :	Learn the basics of Scripting language			2	75	80	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			
CLO-2 :	Ability to use Javascript in applications			2	85	80	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			
CLO-3 :	Ability to apply HTML, CSS and DOM			2	80	75	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			
CLO-4 :	Ability to Apply jQuery concepts in applications			2	75	85	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			
CLO-5 :	Understand the AJAX environment and Closure concept			2	75	85	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			

Duration (hour)	9	9	9	9	
S-1	SLO-1 Learn concept of Scripting languages	Arrays. Array insertion and deletion	HTML and CSS and	jQuery , Overview of jQuery	AJAX.
	SLO-2 Compiled vs interpreter a comparison	. Array length	The Document Object Model , Tags	Examples	Asynchronous Communication
S-2	SLO-1 Understand Web development basics	Sparse arrays	Document structure.	Cross-browser compatibility	Callback functions.
	SLO-2 Acquire basic knowledge on Server side programming	Multidimensional arrays	Elements. Text, forms, images, blocks and frames.	The \$ function object	The get and post formats.
S-3	SLO-1 Understand concept of dynamic interactive web pages.	Objects as unordered maps. Object creation,	Selectors	Element selectors.	Same-origin policy.
	SLO-2 Overview of JavaScript , Brief history	modification and lookup syntax. Nested objects. Object methods.	Cascading and inheritance	Tree traversal.	Cross-origin requests with JSONP
S-4	SLO-1 Common use-cases. Runtime environments, Overview of language features.	The delete keyword.	Text and color tyles.	Node creation, insertion, modification and deletion.	AJAX polling.
	SLO-2 Running JavaScriptDebugging JavaScript in the browser. The console and REPL in the browser and at the command line	The for... in statement, and the hasOwnProperty method.	The box model.	Getting and setting attributes,	Context Object method invocation as method passing
S-5	SLO-1 Values and literals. Primitive types. Numbers. Integer and floating point as a single type Rounding errors.	The global window object. Object references	Layout.	styles and class.	The this variable as an implicit parameter variable.
	SLO-2 . Special floating point numbers.	Aliasing. Pass-by-reference-copy	The DOM as an document API. Browser	Wrapping and unwrapping DOM raw	Problems with methods in event handlers

			<i>semantics.</i>	<i>information</i>	<i>objects.</i>	<i>and callbacks</i>
S-6	SLO-1	<i>The Math library. Strings. Immutability of strings.</i>	<i>Functions :Function declaration and invocation syntax.</i>	<i>The setTimeout and setInterval</i>		<i>Usage of call and apply</i>
	SLO-2	<i>+ and [] operators Common string utilities</i>	<i>Anonymous functions.</i>	<i>Element lookup</i>	<i>The chaining pattern</i>	<i>Binding context.</i>
S-7	SLO-1	<i>Booleans. Ternary operator.</i>	<i>Functions as data.</i>	<i>Tree traversal.</i>	<i>Event handling.</i>	<i>The new keyword.</i>
	SLO-2	<i>Regular expressions. Truth-y and False-y values. null and undefined.</i>	<i>The arguments object.</i>	<i>Attribute getting and setting</i>	<i>bind and unbind.</i>	<i>Closures Lexical scope. Inner functions</i>
S-8	SLO-1	<i>Dynamic typing. Weak typing. The typeof operator.</i>	<i>Variadic functions. Optional parameters.</i>	<i>Creating and deleting nodes.</i>	<i>Keyboard and mouse events.</i>	<i>Closure scope. Examining closure scope in the debugger</i>
	SLO-2	<i>The === and !== operators.</i>	<i>Named parameters. Function overloading.</i>	<i>Events.</i>	<i>Event delegation and bubbling.</i>	<i>Functors.</i>
S-9	SLO-1	<i>Control statements.</i>	<i>Duck typing.</i>	<i>Case studies</i>	<i>Animation.</i>	<i>Simulation of private object properties.</i>
	SLO-2	<i>Examples</i>	<i>Examples</i>	<i>Case Studies</i>	<i>Examples</i>	<i>Simulation of namespaces.</i>

Learning Resources	1. Don Gosselin , <i>JavaScript Fifth Edition, Thomson Learning., Web Technology Series</i>	3. Laura Lemay, Rafe Colburn, Jennifer Kymin, " <i>Mastering HTML, CSS &amp; Javascript</i> ", <i>Web Publishing, 2016</i>
	2. Nicholas C Zakas, <i>Professional JavaScript for Web Developers , Wrox Professional Guide, 2012</i>	

Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	40%	-	30%	-	30%	-	30%	-	30%	-
	Understand										
Level 2	Apply	40%	-	40%	-	40%	-	40%	-	40%	-
	Analyze										
Level 3	Evaluate	20%	-	30%	-	30%	-	30%	-	30%	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

# CA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
	1.	1. Prof.S.S.Sridhar, SRMIST

Course Code	18CSE374T	Course Name	SOFTWARE ENGINEERING TOOLS	Course Category	E	Professional Elective	L	T	P	C
							3	0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	CSE	Data Book / Codes/Standards	Nil		

Course Learning Rationale (CLR):		The purpose of learning this course is to:			Learning			Program Learning Outcomes (PLO)															
CLR-1 :	CLR-2 :	CLR-3 :	CLR-4 :	CLR-5 :	CLR-6 :	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Understand the software engineering process and the tools used to support this process to deliver the quality software product	Know the process, tools and methods used for software requirements modeling and the designing process	Study the various software development approaches, tools and to install and use some software development tools	Know about different web application development technologies and tools used to support the quick development process	Understand the software testing process used in the industry and various test related tools used for the different task in the testing	Study the functionalities of different testing tools used in the software maintenance and engineering process				Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3
CLO-1 :	Use automated tools to develop the quality software product in by following engineering process	2	80	85	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-2 :	Design the specification of software using various techniques and tools	2	75	80	H	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-3 :	Create application using latest tools, code generators and IDEs	2	85	80	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-4 :	Apply the various web technologies and tools to develop the web application	2	80	75	H	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-5 :	Know the various testing tools and apply it during the software testing process	2	75	85	H	-	-	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-6 :	Use the tools for process management and to gain the knowledge of various tools used for different task in maintenance activities	2	80	85	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Duration (hour)	9		9		9		9		9	
S-1	SLO-1	Introduction to Software Engineering Process	Software Construction Tools	Web Application Development Tools	Software Testing Process	Software Engineering Process Tools				
	SLO-2	Need of Tools in the Software Engineering Process	Program editors	Tools for Front End Developers	Software Testing Tools	Process modeling tools				
S-2	SLO-1	Requirement Engineering Process	Compilers	TypeScript	Need for Automated Testing Tools	Process management tools				
	SLO-2	Software Requirements Tools	Compiler types	Installing TypeScript	Taxonomy of Testing Tools	Integrated CASE environments				
S-3	SLO-1	Requirements modeling tools	code generators	AngularJS	Functional/Regression Testing Tools	Process-centered software engineering environments				
	SLO-2	Traceability tools	Tools for JAVA code generator	AngularJS Architecture and Features	Performance Testing Tools	Software Configuration Management Tools				
S-4	SLO-1	Desirable Features of Requirement Management Tools	Comparison of code generation tools	Tools for Back End Developers	Testing Management Tools	Defect, enhancement, issue and problem tracking tools				
	SLO-2	Some Requirement Management Tools Available	Interpreters	PHP	Source Code Testing Tools	Version management tools				

S-5	SLO-1	Tools Description	Difference between Compiler and Interpreters	Ruby on Rails	How to Select a Testing Tool?	Software Engineering Management Tools
	SLO-2	Software Design Process	Debuggers	Laravel	Test execution frameworks	Project planning and tracking tools
S-6	SLO-1	Steps in Software Design	Integrated Development Environment	Overview of Content Management System (CMS)	Re-engineering tools	Risk management tools
	SLO-2	Software Modeling Languages	Comparison of IDE	WordPress	WinRunner	Infrastructure Support Tools
S-7	SLO-1	Unified Modeling Language	ATOM Tool	WordPress - Features	Overview of WinRunner	Interpersonal Communication tools
	SLO-2	Behavior Trees	Features of ATOM Tool	WordPress – Installation	LoadRunne - Overview	Information retrieval tools
S-8	SLO-1	C-K theory	Installing Atom	Joomla - Overview	QTP - Overview	System administration and support tools
	SLO-2	IDEF, Object-Role Modeling	NetBeans	Joomla – Features	Junit - Overview	Miscellaneous Tool Issues
S-9	SLO-1	Petri nets	Features of NetBeans	Joomla – Installation	Testing Java Code using Junit	Tool integration techniques
	SLO-2	Software Design Tools	Cloud Based Development tools	Drupal – Overview and Architecture	Examples	Tool evaluation

Learning Resources	1. RogerSPressman, "SoftwareEngineering–APractitioner'sApproach", 7thedition, TataMcGrawHill Education, 2014.	4. SwapnaKishoreandRajeshNaik, "SoftwareRequirementsandEstimation", TataMcGrawHill, 2003
	2. IanSomerville"SoftwareEngineering", 9thedition, PearsonEducation, 2010. <a href="https://atom.io/">https://atom.io/</a>	5. K.V.K.K.Prasad, "SoftwareTestingTools", DreamtechPress, 2010 <a href="https://www.w3schools.com">https://www.w3schools.com</a> <a href="https://www.joomla.org/">https://www.joomla.org/</a>

#### Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#		Theory	Practice
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice		
Level 1	Remember Understand	40%	-	30%	-	30%	-	30%	-	30%	-
Level 2	Apply Analyze	40%	-	40%	-	40%	-	40%	-	40%	-
Level 3	Evaluate Create	20%	-	30%	-	30%	-	30%	-	30%	-
	Total	100 %		100 %		100 %		100 %		100 %	

# CA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. R.Tamilanban, Senior Software Engineer, Altimetrik India Pvt. Ltd.	1.	1. S.KALIRAJ, SRMIST
2.	2.	2. R.ANITA, SRMIST

Course Code	18CSE466T	Course Name	SOFTWARE VERIFICATION AND VALIDATION	Course Category	E	Professional Elective	L	T	P	C
							3	0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Computer Science and Engineering		Data Book / Codes/Standards	Nil	

Course Learning Rationale (CLR):		The purpose of learning this course is to:			Learning			Program Learning Outcomes (PLO)																	
					1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15			
CLR-1 :	Provide an understanding of concepts and techniques for testing software				Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3			
CLR-2 :	Prepare test plan based on the requirement document, design test plans and document test plans							H	H	H	H	H	M	M	H	H	H	H	H	M	H	H	H	H	H
CLR-3 :	Design test cases suitable for a software development in various domains							H	H	H	H	M	M	M	H	H	M	M	H	M	H	H	H	H	H
CLR-4 :	Validate and document test cases, assuring software component or system satisfies its requirements and meets stakeholder expectations							H	H	H	M	M	-	M	H	H	M	H	H	M	H	H	H	H	H
CLR-5 :	Use of automation testing tools							H	M	H	H	M	M	M	H	H	M	H	M	H	H	H	H	H	H
Course Learning Outcomes (CLO):		At the end of this course, learners will be able to:																							
CLO-1 :	Identify, design different types of test cases for software development in any domain				2	80	85	H	H	H	H	M	M	H	H	H	M	H	H	H	H	H			
CLO-2 :	Design, develop, implement, validate and document test plans at various levels				3	80	80	H	H	H	H	M	M	M	H	H	H	M	H	H	H	H			
CLO-3 :	Develop Test cases for a given Software/System Specification				2	90	85	H	H	H	M	M	-	M	H	H	M	M	H	H	H	H			
CLO-4 :	Validate Test Cases with the Requirement Specifications				2	80	80	H	H	H	M	M	-	M	H	H	M	H	H	H	H	H			
CLO-5 :	Use various automation tools to implement test cases				3	75	80	H	M	H	H	M	M	H	H	M	H	H	H	H	H	H			

Duration (hour)	8		10		8		9		10	
S-1	SLO-1	Fundamentals of Testing: Necessity of Testing-Case Studies on "Impact of Software bugs"	Test Case Design Strategies: Introduction to basic design strategies	White Box Strategies - Peer Reviews, Inspections, Walkthrough	The need for levels of testing, Unit Testing: Planning, Test Harness	Test Management: Choice of Standards		Software Test Automation: Skills and Scope Design		
	SLO-2	Objectives of Testing, Basics Definitions			Running the tests Recording Results	Infrastructure Management, Test People Management				
S-2	SLO-1	Testing Principles-Illustrations	Comparative Analysis	Integration Testing: Goals, Design and Plan	Test Plan Components		Architecture for Automation			
	SLO-2				Test Plan Attachments					
S-3	SLO-1	Fundamental Test Process, The tester's role in a software development organization	Static Analysis Tools: Coding Standards, Code Metrics, Code Structure	System Testing goals, Types of System Testing: Functional Testing	Locating Test Items, Managing Issues		Requirements for a test tool, Process Model for Automation, Selecting the test tool			
	SLO-2	Test planning			Performance Testing, Stress Testing	Addressing Perception, Taking team together				
S-4	SLO-1	Establishing Test Policy, Structured approach to testing Test Factors	Coverage and Control Flow Graphs	Configuration Testing	Documentation uses		Demonstration of a Functional Testing Tool			
	SLO-2	Eleven Step software testing process			Security Testing	Documentation Types				
S-5	SLO-1	Origin of Defects, Defect Repository and Test Design	Paths Code Complexity	Recovery Testing, Reliability Testing	Test Analysis report Documentation,		Demonstration of a Web Testing Tool			



	SLO-2	Developer/Tester support of developing a defect repository	Activity: Calculate Path Code Complexity for a given source code	Usability Testing	Analyze reports and Problem tracking,	
S-6	SLO-1	Defect Examples, Case Studies – “Identify the defect”	Evaluating test adequacy criteria, Case Studies- “Applying the suitable White Box Strategy”	Regression Testing	Controlling and Monitoring Test Progress	Démonstration of an Unit Testing Tool
	SLO-2			Alpha, Beta and Acceptance Testing	Test Metrics and measurements: Role, need and types	
S-7	SLO-1	Defect Analysis and Prevention Strategies	Black Box Testing Strategies: Requirements Based Testing, Random Testing	Role of use cases in testing	Project Metrics with Practice	Demonstration of an Defect Tracking Tool
	SLO-2			Applying Testing Skills: Compatibility testing, Internationalization testing		
S-8	SLO-1	Developing adhoc test cases for a case study	Black Box Testing Strategies: Boundary Value Analysis, Equivalence Class Partitioning, Activity: Designing test cases for the given requirement specification using Boundary value analysis and Equivalence Class Partitioning	Testing Documentation plan	Progress Metrics with Practice	Demonstration of an Test Management Tool
	SLO-2			Recording test cases, Reporting and Measurement of Success		
S-9	SLO-1		Black Box Testing Strategies: Cause Effect graphing Activity: Designing test cases for the given requirement specification using cause effect graphing and developing decision tables		Productivity Metrics with Practice	Challenges in Automation
	SLO-2					
S-10	SLO1 SLO2		Evaluating test adequacy criteria, Case Studies- “Applying the suitable Black Box Strategy”			The Future: Software Quality Assurance

Learning Resources	1. Srinivasan Desikan and Gopalaswamy Ramesh, “Software Testing – Principles and Practices”, Pearson Education, 2006	3. Ilene Burnstein, “Practical Software Testing”, Springer International Edition, 2003.
	2. Ron Patton, “Software Testing”, Second Edition, Sams Publishing, Pearson Education, 2007.	4. Aditya P. Mathur, “Foundations of Software Testing _ Fundamental Algorithms and Techniques”, Dorling Kindersley (India) Pvt. Ltd., Pearson Education, 2008 5. RenuRajani, Pradeep Oak, “Software Testing-Effective Methods, Tools and Techniques”, Tata McGraw Hill Education, 2011.

Learning Assessment											
	Bloom’s Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#		Theory	Practice
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice		
Level 1	Remember Understand	40 %	-	30 %	-	30 %	-	30 %	-	30%	-
Level 2	Apply Analyze	40 %	-	40 %	-	40 %	-	40 %	-	40%	-
Level 3	Evaluate Create	20 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Total	100 %		100 %		100 %		100 %		100 %	

# CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Mr. ShrikantSatyanarayan, Technical Manager LDRA Technology PVT LTD	1. Dr. N. Bhalaji, Associate Professor, SSN Institutions	1. Mrs. Anupama.C.G, SRMIST
2. Mr. Girish Raghavan, Senior DMTS Manager, Wipro Technologies		2. Mr. Selvin Paul Peter, SRMIST

Course Code	18CSE467T	Course Name	SOFTWARE QUALITY ASSURANCE	Course Category	E	Professional Elective	L	T	P	C
							3	0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	CSE	Data Book / Codes/Standards	Nil		

Course Learning Rationale (CLR):	The purpose of learning this course is to:			Learning			Program Learning Outcomes (PLO)																	
CLR-1 :	Understand the importance of software quality			1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15			
CLR-2 :	Gain knowledge about the components of software quality assurance system			Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3			
CLR-3 :	Gain knowledge on conducting reviews walk through and inspection						H	H	-	-	-	-	-	-	-	-	-	-	-	M	-	H	-	-
CLR-4 :	Understand the importance of SCM, procedures, policies in SQA						H	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	H	H
CLR-5 :	Recognize the significance of human components						-	-	-	-	-	-	-	M	H	-	-	-	-	-	-	-	-	-
CLR-6 :	Gain Knowledge on measurements and standards						H	-	H	-	M	-	-	-	-	-	H	-	H	-	-	-	-	-
Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:						2	80	85	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-1 :	Acquire the knowledge on software quality			2	75	80	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			
CLO-2 :	Acquire the ability to identify the dimension of a software project			2	85	80	H	H	-	-	-	-	-	-	-	-	-	-	-	H	H			
CLO-3 :	Apply different quality component in different phase of life cycle			2	80	75	-	-	-	-	-	-	M	H	-	-	-	-	-	-	-			
CLO-4 :	Follow procedures, processes, policies and work instructions in software development			2	75	85	H	-	H	-	M	-	-	-	-	H	-	-	-	-	-			
CLO-5 :	Manage risks and handle human components effectively			2	80	85	-	H	-	H	-	-	-	H	-	-	-	H	-	-	-			
CLO-6 :	Apply different measurements and follow standards			2	80	85	-	-	H	-	H	-	-	-	H	-	-	H	-	-	-			

Duration (hour)	9		9		9		9		9	
S-1	SLO-1	Introduction to software Quality	Software Quality Assurance System Architecture	Check lists	Introduction to Risk management	Importance of Measurement				
	SLO-2	Defining software quality and software quality Assurance	Components of Software Quality Assurance System	Verification and validation	Risk management according to the standards and models	Measurement according to ISO 9001				
S-2	SLO-1	Software error, defects and failures	Contract Review process and its stages Contract Review objectives	Verification and validation	Risk management according to the standards and models	The practical software and systems measurement method				
	SLO-2	Software error, defects and failures	Implementation of Contract Review, Contract review for internal projects	Basics of Software Configuration Management , Benefits of Good configuration Management	Risk management according to the standards and models	The practical software and systems measurement method				
S-3	SLO-1	Cost of quality	Development plan	Activity: Test the functionalities of the given project using any functional testing tool	Roles, Measurements	Measurement According to the CMMI Model				
	SLO-2	Cost of quality	Quality Plan	Activity: Test the functionalities of the given project using any functional testing tool	Human factors and risk management	Measurement According to the CMMI Model				
S-4	SLO-1	Quality culture	Reviews, Personal review and desk check review	SCM Activities, Baselines	Introduction to supplier management, Supplier requirements	Survey as a measurement tool				
	SLO-2	Five dimensions of a software project	Walk through	Software Repository and its branches,	Agreement Processes, Supplier	Survey as a measurement tool				

				Configuration Control	agreement management according to the CMMI	
S-5	SLO-1	Software Engineering code of Ethics	Review standards and Models	Configuration Status Accounting	Managing suppliers	Implementing a measurement program
	SLO-2	Software Engineering code of Ethics	Review standards and Models	Software Configuration Audit, Implementing SCM in very small entities with ISO/IEC29110	Software Acquisition life cycle	Standards, cost of quality and business models
S-6	SLO-1	Software quality models- McCall	Inspection	Policies	Software Contract Types	ISO 9000 family
	SLO-2	Software quality models- McCall	Project Launch reviews and project assessments	Process	Software Contract Reviews	IEEE 730 standard for SQA processes
S-7	SLO-1	Software quality models -IEEE 1061	Agile Meetings	Procedures and work instructions	Case Study: Prepare Contract Review Document for a project	IEEE 730 standard for SQA processes
	SLO-2	Software quality models -EEE 1061	Measures	Organizational standards	Case Study: Prepare Contract Review Document for a project	Process Maturity models of the SEI
S-8	SLO-1	Software quality models -ISO-25000 set of standards	Selecting the type of review, Tools	Graphical representation of process and procedures	Staff Training and Certification	Software Quality Assurance Plan
	SLO-2	Software quality models -ISO-25000 set of standards	Audits, Types, Audits according to the IEEE 1028 standard	Graphical representation of process and procedures	Staff Training and Certifications	Software Quality Assurance Plan
S-9	SLO-1	Case Study: Analyzing quality factors involved in a project	Case Study: Prepare a development plan for a project.	Preventive and corrective actions	Management and its Role in Quality Assurance	Case study: Prepare a Software Quality Assurance Plan for –interested project
	SLO-2	Case Study: Analyzing quality factors involved in a project.	Case Study: Prepare a development plan for a project	Document control	Management and its Role in Quality Assurance	Case study: Prepare a Software Quality Assurance Plan for –interested project

Learning Resources	1. Claude Y.Laporte, Alain April, Software quality Assurance, First edition , IEEE computer Society and Wiley,2018. 2. Daniel Galin, "SoftwareQualityAssurancefromtheorytoimplementation", Pearson,2016	3. G.GordonSchulmeyer, "Hand book of Software Quality Assurance", 4 <sup>th</sup> edition, ARTECH HOUSE INC,2008 4. Allen Gilles, "Software quality: Theory and management" - International Thomson - Computer press, 2011
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Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#		Theory	Practice
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice		
Level 1	Remember Understand	40 %	-	30 %	-	30 %	-	30 %	-	30%	-
Level 2	Apply Analyze	40 %	-	40 %	-	40 %	-	40 %	-	40%	-
Level 3	Evaluate Create	20 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Total	100 %		100 %		100 %		100 %		100 %	

# CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1.Mr. Benet Zacharias, Senior Consultant, Wipro Consulting Services, Chennai	1. Dr. A. Amuthan, Professor, Dept. of CSE, Pondicherry Engg. College, Pondicherry.	1. Dr. T.S.Shiny Angel, Assistant Professor, SRMIST
		2. Dr. A. Jeyasekar, Associate Professor, SRMIST

Course Code	18CSE468T	Course Name	SOFTWARE MEASUREMENTS AND METRICS	Course Category	E	Professional Elective	L	T	P	C
							3	0	0	3

Pre-requisite Courses	18CSE466T	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Computer Science and Engineering		Data Book / Codes/Standards	Nil	

Course Learning Rationale (CLR):	The purpose of learning this course is to:			Learning			Program Learning Outcomes (PLO)															
CLR-1 :	Familiarize with different metrics used in different process levels			1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
CLR-2 :	Apply metrics knowledge to measure Engineering problems.			Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3	
CLR-3 :	Improve their ability in making decisions via continuous practice like assessment and usage of metrics.						L	H	-	H	L	-	-	-	L	L	-	H	-	-	-	
CLR-4 :	Design, implement and change metrics based on industry practice						M	M	L	M	L	-	-	-	M	L	-	H	-	-	-	
Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:						M	M	M	H	L	-	-	-	M	L	-	H	-	-	-	
CLO-1 :	Understand and measure the software features			3			M	H	M	H	L	-	-	M	M	L	-	H	-	-	-	
CLO-2 :	Understand the need of software quality			3																		
CLO-3 :	Will be able to understand the software development tools			3																		
CLO-4 :	Evalaute the stages of process improvement and its necessities in Development Life Cycle			3																		

Duration (hour)	9		9		9		9		9	
S-1	SLO-1	Software Sizing Metrics	Complexity Metrics and Models	Customer Satisfaction Surveys: Methods of survey data collection	Software Quality - Five steps to software quality control	Conducting In-Process Quality Assessments				
	SLO-2	Fundamentals in Measurement		Sampling Methods	Product Quality Metrics with practice	The Preparation Phase				
S-2	SLO-1	Basic Measures	Lines of Code	Analyzig Satisfaction with practise	In-Process Quality Metrics	The Evaluation Phase				
	SLO-2	Reliability and Validity	Halstead's Software Science	Satisfaction with Company terms	Metrics for Software Maintenance	The Summarization Phase				
S-3	SLO-1	Measurement Errors	Cyclomatic Complexity			Recommendations and Risk Mitigation				
	SLO-2	Assessing Reliability	Syntactic Constructs			Conducting Software Project Assessments				
S-4	SLO-1	Evolution in software Metrics	Structure Metrics	Metrics for Object-Oriented Projects with tools	Ishikawa's Seven Basic Tools with practice	Audit and Assessment				
	SLO-2			Case Study for the usage of complexity metrics with tools	Defect removal Effectiveness	Software Process Maturity Assessment and Software Project Assessment				
S-5	SLO-1	Functional Size Measurements	Testing Metrics :Test Progress S Curve	Concepts and Constructs	The Rayleigh Model	Software Process Assessment Cycle				
	SLO-2			Design and Complexity Metrics		Measures and metrics of industry leaders				
S-6	SLO-1	Cost of counting function point metrics	Testing Defect Arrivals Over Time	Lorenz Metrics and Rules of Thumb	Reliability Growth Models - Jelinski-Moranda Model	Measures and metrics of industry leaders				
	SLO-2			Product Size Over Time		Measures, Metrics, Innovation				
S-7	SLO-1	Software measures and metrics not based on function points	CPU Utilization	CK OO Metrics Suite	Goel-Okumoto Model	Measurements, Metrics and outsource Litigation				
	SLO-2			Effort/Outcome Model		Measurements, Metrics and outsource and Behavioral changes				
S-8	SLO-1	Future Technical Developments in Functional Metrics	Effort/Outcome Model	Productivity Metrics		Software Process Improvement				
	SLO-2									

S-9	SLO-1	Case Study to Measure software size	Case Study to apply Testing metrics	Case Study for the usage of Object oriented metrics with tools	Musa-Okumoto Model	Sequences
	SLO-2	using various size Metrics				Measuring Process Maturity Measuring Proecess Capability

Learning Resources	<ol style="list-style-type: none"> <li>Stephen H. Kan, "Metrics and Models in Software Quality Engineering", Addison Wesley, Second Edition, 2017.</li> <li>Caper Jones, "Applied Software Measurement: Global Analysis of Productivity and Quality", Third Edition, McGraw Hill Companies, 2008</li> </ol>	<ol style="list-style-type: none"> <li>Mark Lorenz, Jeff Kidd, "Object-Oriented Software Metrics", Prentice Hall, 2000</li> <li>Naresh Chauhan, "Software Testing Principles and Practices", Oxford University Press, 2010.</li> <li>Ravindranath Pandian C, "Software Metrics A Guide to Planning, Analysis, and Application", Auerbach, First Indian Reprint, 2011</li> </ol>
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Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	40 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Understand										
Level 2	Apply	40 %	-	40 %	-	40 %	-	40 %	-	40%	-
	Analyze										
Level 3	Evaluate	20 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

# CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Bijoymon Soman Sr. Test Analyst UST Global, Philadelphia, PA, USA	1. Dr. Arun kumar M N, FISAT, Kerala, amrakmar.mn11@gmail.com	1. Mrs. B. Jothi, SRMIST
		2. Ms Aswathy, SRMIST

Course Code	18CSE469T	Course Name	SOFTWARE PROCESS AND AGILE PRACTICES	Course Category	E	Professional Elective	L	T	P	C
							3	0	0	3

re-requisite Courses	Nil	o-requisite Courses	Nil	ogressive Courses	Nil
Course Offering Department	Computer Science and Engineering		Data Book / Codes/Standards	Nil	

Course Learning Rationale (CLR):	The purpose of learning this course is to:			Learning			Program Learning Outcomes (PLO)																		
CLR-1 :	Understand the basic concepts of Software process and Agile manifesto			1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15				
CLR-2 :	Comprehend various Agile principles			Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3				
CLR-3 :	Gain knowledge on Agile Methodologies						H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLR-4 :	Acquire Knowledge on Agile project management and Environment						H	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLR-5 :	Understand the concepts of Test driven development and Feature driven development						H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLR-6 :	Understand the Agile approach to Quality assurance						H	-	-	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:			2	80	85	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-1 :	Acquire the knowledge of best practices involved in Software process			2	75	80	H	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-2 :	Acquire the ability to identify the agile principles for software development			2	85	80	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-3 :	Understand work products, roles and practices of Scrum, XP, UP and EVO			2	80	75	H	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-4 :	Apply the knowledge of Agile methodologies in various projects			2	75	85	H	-	-	H	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-5 :	Apply the knowledge of Agile project management and practices			2	80	85	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-6 :	Acquire the knowledge of Agile quality assurance			2	80	85	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Duration (hour)	9		9		9		9		9			
S-1	SLO-1	The nature of Software	Agile And Its Significance	Agile methodology	Agile Project management	Agile Quality assurance	SLO-1	The Software Process	Evolutionary delivery, Scrum Demo	Life cycle phases	Pipelining activities across Iterations	Feature Driven Development roles
	SLO-2	Defining Software	Agile Story	Extreme Programming: Method Overview	Multi-team and multi-site development	Feature Driven Development	S-2	SLO-2	Software Engineering practice	Work products	Rolling Wave adaptive and predictive planning	Feature Driven Development process
S-2	SLO-1	Agile Development	Agile Motivation	Roles and practices	Benefits of rolling wave adaptive planning	Class Ownership	S-3	SLO-1	Agility and the cost of change	Challenges With The Waterfall	Agile requirements	Reporting
	SLO-2	Agile Process	Research Evidence	Process mixtures	Agile modeling	Test Driven Development (TDD)	S-4	SLO-1	Agile Manifesto & Principles	Scrum: Method Overview	Defining and keeping the vision	Test Driven Development roles
S-3	SLO-1	Software is new product development	Life cycle phases	Unified process: Method Overview	Evolutionary Requirements workshop	TDD benefits	S-5	SLO-1	Predictable vs. Inventive Projects	Work products	Gathering requirements	TDD Limitations
	SLO-2	Iterative and Evolutionary methods	Roles and practices	Roles and practices	Tracking requirement across iterations, Direct user involvement	Agile approach to Quality Assurance	S-6	SLO-1	Risk driven and client driven planning	Core practices	Brainstorming and Brain writing	Unscheduled and Scheduled project reviews
S-4	SLO-1	Time boxed Iterative development	Values of Scrum meeting	EVO: Method Overview	Mind maps, Team rotation writing	Status meeting	S-7	SLO-1	Evolutionary and Adaptive development	Other practices and values	Agile environment	Automated unit tests and Acceptance tests
	SLO-2	Adaptive Development	Common mistakes and	Work products	Continuous Integration	Exploratory Testing	S-8	SLO-1	Adaptive Development	Common mistakes and	Continuous Integration	Exploratory Testing

			<i>misunderstandings</i>			
	SLO-2	<i>Incremental Delivery, Evolutionary delivery</i>	<i>Sample projects</i>	<i>Roles and practices</i>	<i>Project Wiki webs, Case tools</i>	<i>Code review and code metrics</i>
S-9	SLO-1	<i>Specific Iterative methods</i>	<i>Process mixtures</i>	<i>Core practices</i>	<i>Caves and common rooms</i>	<i>Continuous Integration</i>
	SLO-2	<i>Evolutionary methods</i>	<i>Strengths and Weakness of Scrum</i>	<i>Process mixtures</i>	<i>Reverse engineering</i>	<i>Informative Workspaces</i>

Learning Resources	1. Bruce R. Maxim Roger S. Pressman, "Software Engineering: A Practitioner's Approach", McGraw Hill Education; Eighth edition, 2019	3. Elisabeth Hendrickson Quality Tree Software Inc, "Agile Testing" 2008
	2. Craig Larman, "Agile and Iterative Development – A Manager's Guide", Pearson Education – 2010	4. Chetankumar Patel, Muthu Ramachandran, Story Card Maturity Model (SMM): A Process Improvement Framework for Agile Requirements Engineering Practices, Journal of Software, Academy Publishers, Vol 4, No 5 (2009), 422-435, Jul 2009.

Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	40 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Understand										
Level 2	Apply	40 %	-	40 %	-	40 %	-	40 %	-	40%	-
	Analyze										
Level 3	Evaluate	20 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

# CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
Mr. Harihara prasath venkatraman ,Agile Coach, Renault Nissan Technology & Business Centre India , Hariharaprasath.Venkataraman@mtbci.com	Dr.N.Prakash ,Associate professor , B.S.A. Crescent Institute of Science and Technology	Mr.G.Senthil Kumar, Asst.prof (S.G), SRMIST
	Dr.K.Kumar, Associate professor, Vellore Institute of technology	Mr.Gouthaman, Asst.Prof., SRMIST

Course Code	18CSE470T	Course Name	SOTWARE SECURITY	Course Category	E	Professional Elective	L	T	P	C
							3	0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Computer Science and Engineering		Data Book / Codes/Standards	Nil	

Course Learning Rationale (CLR):	The purpose of learning this course is to:			Learning			Program Learning Outcomes (PLO)																	
CLR-1 :	Understand the need for Software Security and the threats to software security			1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15			
CLR-2 :	Incorporate security principles to software development lifecycle			Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3			
CLR-3 :	Understand Secure software architecture design and coding						H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLR-4 :	Gain basic knowledge on web security principles						H	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLR-5 :	Learn risk management and mitigation of risk in software development						H	-	-	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLR-6 :	Learn testing types and strategies for secure software						H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:						2	80	85	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-1 :	Identify security threats and issues in software			2	75	80	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			
CLO-2 :	Gather security related requirements during requirement elicitation			2	85	80	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			
CLO-3 :	Design software by incorporating security principles			2	80	75	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			
CLO-4 :	Understand the issues in web and database security			2	75	85	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			
CLO-5 :	Apply risk management strategies and risk mitigation strategies in software development			2	80	85	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			
CLO-6 :	Apply testing strategies for secure software development			2	80	85	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			

Duration (hour)	9		9		9		9		9	
S-1	SLO-1	Introduction to software Security	Secure software architecture and design	Browser Security Principles	Risk Management Framework	Software security testing				
	SLO-2	Software assurance and software security	Software security practices for architecture and design	Defining the same-origin policy	Five stages of activity	Contrasting software testing and software security testing				
S-2	SLO-1	Threats to Software security	Software security knowledge for architecture and design	Client-side vs. server-side	Applying the RMF	Functional testing				
	SLO-2	Sources of Software Insecurity	Software characterization	Exceptions to the same origin policy	Understanding the business context	Risk-based testing				
S-3	SLO-1	Benefits of detecting software security defects early	Threat analysis	Cross-site scripting	Gathering the artifacts, conducting project research	Penetration Testing				
	SLO-2	Managing Secure software development	Architectural vulnerability assessment	Reflected, POST-based reflected, stored and local XSS	Identifying the business and technical risk	Security testing consideration throughout the SDLC				
S-4	SLO-1	Risk Management framework for Software security	Risk likelihood determination	XSS defense	Developing risk questionnaires, interviewing the target project team	Unit testing				
	SLO-2	Software security practices in the development lifecycle	Risk Impact Determination	Cross-site request forgery	Analyzing the research and interview data	Testing Libraries				
S-5	SLO-1	Properties of secure software	Risk Mitigation Planning	CSRF defense	Uncovering technical risks	Testing Executable files				
	SLO-2	Influencing security properties of software	Security principles	Prevent XSS	Analyzing software artifacts	Integration testing				
S-6	SLO-1	Building a security assurance case	Security guidelines and attack patterns	SQL Injection	Synthesizing and ranking the risk	System Testing				
	SLO-2	Incorporating assurance cases into SDLC	Secure coding and testing	SQL Injection effects	Reviewing the risk data	Security Failures				



S-7	SLO-1	Importance of requirements engineering	Code analysis	Blind SQL Injection	Conducting the business and technical peer review	Categories of Errors
	SLO-2	Security Requirements Engineering	common software code vulnerabilities	Setting Database Permissions	Defining the risk mitigation strategy	Attacker Behaviour
S-8	SLO-1	The SQUARE Process model	Source code review	Stored Procedure Security	The importance of measurement	Functional and attacker perspectives for Security Analysis
	SLO-2	SQUARE sample outputs	Coding practices	SQL Injection in stored procedures	Measurement and metrics in the RMF	Identity Management and Software development
S-9	SLO-1	Requirements elicitation	Sources of additional information on secure coding	Insecure direct object references	The Cigital Workbench	System Complexity drivers and security
	SLO-2	Requirements prioritization	Best practices for secure coding	Pre and post authorization checks	Risk Management is a framework for Software security	Deep Technical Problem Complexity

Learning Resources	1. Gary McGraw, Software Security – A Guide for Project Managers, Addison-Wesley Professional, 2008, ISBN-13:978-0321509178	2. James M. Helfrich, Security for Software Engineers, CRC Press, Taylor and Francis Group 2019	3. James Ransome, Anmol Misra, Core Software Security, CRC Press, Taylor and Francis Group 2014.
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Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#		Theory	Practice
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice		
Level 1	Remember Understand	40 %	-	30 %	-	30 %	-	30 %	-	30%	-
Level 2	Apply Analyze	40 %	-	40 %	-	40 %	-	40 %	-	40%	-
Level 3	Evaluate Create	20 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Total	100 %		100 %		100 %		100 %		100 %	

# CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1.Mr.PrasannaKumar, InfosysPrasanna_kumar11@infosys.com	1.Dr.Emma, Anna University Chennai, umaramesh@aunist.net	1.Dr.G.Usha, SRMIST
2.Mr.Mithun, Cognizant, Mithun.SS@cognizant.com	2.Dr.KunvarSingh, NIT Trichy, kunwar@nitt.edu	2.Dr.Usha Krithikka, SRMIST

Course Code	18CSE471T	Course Name	SOFTWARE MAINTENANCE AND ADMINISTRATION	Course Category	E	Professional Elective	L	T	P	C
							3	0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	
Course Offering Department	Computer Science and Engineering		Data Book / Codes/Standards	Nil	

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning			Program Learning Outcomes (PLO)														
CLR-1 :	Understand the factors that make change of existing systems both technically challenging and risky, and the processes required to control change.	1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CLR-2 :	Acquire a knowledge and understanding of the specific problems inherent in the reengineering and evolution of legacy software systems, and be able to apply some of the techniques that can be of use in comprehending and changing them	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3
CLR-3 :	Identify the specific challenges that inherent in the reengineering and evolution of data-intensive systems that are able to apply some of the techniques that can be of use in comprehending and changing them																		
CLR-4 :	Evaluate and understand the specific problems inherent in the reengineering and evolution of package-based software systems, and be able to apply techniques for designing change-resistant systems from pre-packaged code.																		
CLR-5 :	Analyze and apply numerous administration tools and technical concepts that relate to software administration																		

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Learning			Program Learning Outcomes (PLO)														
CLO-1 :	Explain terms used in make change of existing systems both technically challenging and risky, and the processes	3	80	70	H	H	H	H	H	-	-	-	H	H	-	H	-	-	-
CLO-2 :	Incorporate a knowledge and understanding of the specific problems inherent in the reengineering and evolution of	3	85	75	M	H	H	M	H	-	-	-	M	H	-	H	-	-	-
CLO-3 :	Identify challenges that inherent in the reengineering and evolution of data-intensive systems that are able to apply some of the techniques	3	75	70	M	H	M	H	H	-	-	-	M	H	-	H	-	-	-
CLO-4 :	Apply techniques for designing change-resistant systems from pre-packaged code.	3	85	80	M	H	M	H	H	-	-	-	M	H	-	H	-	-	-
CLO-5 :	Apply numerous administration tools and technical concepts that relate to software administration	3	85	75	H	H	M	H	H	-	-	-	M	H	-	H	-	-	-

Duration (hour)	9		9		9		9		9	
S-1	SLO-1	Meaning of software maintenance, software change, ongoing support, economic implications of modifying software, the nomenclature and image problem	Definition, purposes and objectives	Definition for configuration management, change control,	Quality Assurance,	Analyzing system logs, operating system updates,				
S-2	SLO-2	Software maintenance framework,				levels of reverse Engineering,	documentation	fourth generation languages,	patches, configuration changes	
S-3	SLO-1	Potential solutions to maintenance problem.	supports techniques, benefits	Management and organizational issues	object oriented paradigms	Performing backups. Installing				
S-4	SLO-2	Maintenance process models				Reuse and reusability: Definitions,	Management responsibilities	Maintenance tools	Configuring new hardware and software.	
S-5	SLO-1	Definition of critical appraisal of traditional process models,	objective and benefit of reuse	Enhancing maintenance productivity	Criteria for selecting tools,	Adding,				
S-6	SLO-2	Maintenance process models.				approach to reuse,	maintenance teams	taxonomy of tools,	removing,	
S-6	SLO-1	Program understanding: Aims of program comprehension,	approach to reuse,	maintenance teams	taxonomy of tools,	resetting passwords, System performance tuning				
S-6	SLO-2	Program understanding: Aims of program comprehension,				approach to reuse,	maintenance teams	taxonomy of tools,	updating user account information,	

S-7	SLO-1	<i>maintainers and their information needs</i>	<i>Domain Analysis,</i>	<i>Personnel Education and Training</i>	<i>Program understanding and reverse engineering testing,</i>	<i>Performing routine audits of systems and software</i>
	SLO-2	<i>comprehension process models</i>	<i>Components engineering,</i>			
S-8	SLO-1	<i>Mental models, program comprehension strategies,</i>	<i>reuse process model,</i>	<i>Personnel Education and Training</i>	<i>Configuration management, and other tasks.</i>	<i>Performing routine audits of software</i>
	SLO-2	<i>factors that affect understanding,</i>	<i>Factors that impact upon reuse.</i>			
S-9	SLO-2	<i>implications of comprehension theories and studies</i>	<i>Maintenance measures, Definitions, objectives of software measurement, example measures, guidelines for selecting maintenance measures</i>	<i>Organization modes</i>	<i>Past, present and future of software maintenance</i>	<i>Performing routine audits of systems and software</i>

Learning Resources	1. <i>Armstrong A Takang and Penny A.Grubb, "Software Maintenance: concepts and Practice", International Thomson Computer press, London,2015</i>	2. <i>Roger S Pressman, "Software Engineering", 6th edition, Tata McGraw-Hill, 2004</i>
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Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	40 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Understand										
Level 2	Apply	40 %	-	40 %	-	40 %	-	40 %	-	40%	-
	Analyze										
Level 3	Evaluate	20 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

# CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
		1. <i>Mr.S.Selvakumara Samy., SRMIST</i>
		2., <i>Ms.D.Hema,SRMIST</i>

# ACADEMIC CURRICULA

**Open Elective Courses**

**Regulations - 2018**

**SRM INSTITUTE OF SCIENCE AND TECHNOLOGY**

**(Deemed to be University u/s 3 of UGC Act, 1956)**

Kattankulathur, Kancheepuram, Tamil Nadu, India

Course Code	18ASO101T	Course Name	ELEMENTS OF AERONAUTICS	Course Category	O	Open Elective	L	T	P	C
							3	0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Aerospace Engineering		Data Book / Codes/Standards	Nil	

Course Learning Rationale (CLR):	The purpose of learning this course is to:			Learning			Program Learning Outcomes (PLO)																																		
CLR-1 :	Understand the art of flying			1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15																				
CLR-2 :	Understand variation of pressure, temperature, density in the layers of atmosphere and their effect on the flying objects			Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3																				
CLR-3 :	Identify the types of construction of aircrafts and the working of Engines																					H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
CLR-4 :	Know functions of various components of flying objects and the operating mechanisms																					H	H	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLR-5 :	Know the working of various types of rockets and satellites																					H	-	H	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLR-6 :	Get a bird's eye view of Aerospace Engineering																					H	H	H	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:																					2	85	75	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-1 :	Describe the evolution of aircrafts and their types			2	85	75	H	H	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-																		
CLO-2 :	Describe about the atmosphere and variation in properties, aircraft flight and different speed regimes			2	85	75	H	H	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-																		
CLO-3 :	Explain the basics of aircraft structures, power plants			2	85	75	H	-	H	H	-	-	-	-	-	-	-	-	-	-	-	-	-																		
CLO-4 :	Explain the basics of aircraft controls and instruments			2	85	75	H	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-																		
CLO-5 :	Describe the basic Space Technology concepts			2	85	75	H	-	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-																		
CLO-6 :	Identify the various components and systems in aircraft and describe its working mechanism			2	85	75	H	H	H	H	-	-	-	-	-	-	-	-	-	-	-	-	-																		

Duration (hour)	9		9		9		9		9	
S-1	SLO-1	History of Aviation	International Standard Atmosphere	Introduction to aircraft construction	Aircraft controls	Basic principle of rocket propulsion				
	SLO-2	Imitation of birds, Ornithopters	Hydrostatic equation	History of Aircraft Construction	Functions of aileron, elevator and rudder.	Applications of Rockets				
S-2	SLO-1	Lighter than air vehicles	Temperature, pressure and altitude relationships	Truss and Monocoque construction	Secondary flight controls	Types of Rockets				
	SLO-2	Hot air balloons	Gradient and isothermal region	Semi-monocoque construction.	High lift devices	Solid propulsion rockets				
S-3	SLO-1	George Cayley's contribution	Bernoulli's equation for incompressible flow	Typical wing Structures	Types of control systems	Liquid propulsion rockets Working				
	SLO-2	Otto Lilienthal Contribution	Application	Fuselage Structures	History of Control system evolution	Liquid propulsion rockets Advantages and Disadvantages				
S-4	SLO-1	Wright Brothers contribution	Forces acting on aircraft	Materials used in Aircraft	Mechanical control systems	Hybrid and cryogenic rockets				
	SLO-2	History	Moments acting on aircraft	Explanation with examples	Powered control systems	Hybrid and cryogenic rockets Advantages and Disadvantages				
S-5	SLO-1	Effects of 1 <sup>st</sup> world war	How does an aircraft wing generate lift?	Types of power plants	Fly by wire control systems	History of ISRO				
	SLO-2	Effect of 2 <sup>nd</sup> world war	Preliminary explanation	Fundamental Classification	Basic Operation	Establishment of ISRO				

S-6	SLO-1	Classification of airplanes	Basic characteristics of airfoils	An insight into air breathing engines	Basic instruments for flying	Launch vehicles designed and developed by ISRO
	SLO-2	Detailed classification	NACA nomenclature	Piston Engines	Pitot static instruments	Examples explanation
S-7	SLO-1	Components of a simple conventional aircraft	Introduction to high speed flight	Gas turbine engines	Altimeter	Principle of Satellite Operation
	SLO-2	Functions of each component of a simple conventional aircraft	propagation of sound, Mach number	Types of Gas turbine engines	ASI, VSI	Types of Satellites
S-8	SLO-1	Introduction to Unmanned aerial vehicles	Subsonic and transonic flows	Relative merits of piston-prop, turboprop, and jet engines	Gyroscopic instruments	Satellite applications
	SLO-2	Applications of UAV	Supersonic and hypersonic flows	Comparison based on performance characteristics	Turn and slip indicator Artificial horizon.	Space Debris
S-9	SLO-1	Aviation for society	Supersonic flows	Relative merits of jet engine	Turn and slip indicator	Case study-1 on successful launches
	SLO-2	Aviation for socio economic development	Hypersonic flows	Comparison based on performance characteristics	Artificial horizon	Case study-2 on launch failures

Learning Resources	1. Charles Harrington Kermode, A.C., <i>Flight Without Formulae</i> , 5 <sup>th</sup> ed., Pearson Education, 1970	4. Shevell R.S., <i>Fundamentals of flights</i> , 2 <sup>nd</sup> ed., Pearson education 2004
	2. Anderson, J.D., <i>Introduction to Flight</i> , 8 <sup>th</sup> ed., Tata McGraw Hill, 1996	5. Kermode, A.C., <i>Mechanics of Flight</i> , 12 <sup>th</sup> ed. Pearson Education 1972
	3. Clancy L.J., <i>Aerodynamics</i> , 2 <sup>nd</sup> ed., Sterling book house 1975	6. McKinley, J.L., R.D. Bent, <i>Aircraft Power Plants</i> , McGraw Hill 1993

Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#		Theory	Practice
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice		
Level 1	Remember Understand	40 %	-	30 %	-	30 %	-	30 %	-	30%	-
Level 2	Apply Analyze	40 %	-	40 %	-	40 %	-	40 %	-	40%	-
Level 3	Evaluate Create	20 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Total	100 %		100 %		100 %		100 %		100 %	

# CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Dr. S. Raja, National Aerospace Laboratories, Bangalore, raja@nal.res.in	1. Dr. K. M. Parammasivam, Madras Institute of Technology, Chennai, mparams@mitindia.edu	1. Mr. Abdur Rasheed, SRMIST
2. Dr. A. Sakthivel, CEMILAC, Bangalore, asakthironika@gmail.com	2. Dr. A.P. Haran, Park College of Engineering & Technology, email: ap_haran@rediffmail.com	2. Mr. S. Chandra Sekhar, SRMIST

Course Code	18ASO102T	Course Name	CREATIVITY, INNOVATION AND NEW PRODUCT DEVELOPMENT	Course Category	O	Open Elective	L	T	P	C
							3	0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Aerospace Engineering		Data Book / Codes/Standards	Nil	

Course Learning Rationale (CLR):	The purpose of learning this course is to:			Learning			Program Learning Outcomes (PLO)																																		
CLR-1 :	Improve creativity and problem solving methods			1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15																				
CLR-2 :	Improve the knowledge in finding innovative approach to issues			Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3																				
CLR-3 :	Equip students the skills of project selection																					H	H	-	-	-	H	H	H	-	H	-	H	-	H	-	-	-			
CLR-4 :	Understand patent laws and international practices																					H	H	-	-	-	H	H	H	-	H	-	H	-	H	-	-	-			
CLR-5 :	Have expose to design, testing of an engineering product																					H	-	H	-	-	H	H	H	-	H	-	H	-	H	-	-	-			
CLR-6 :	Set the quality standards in developing a prototype of any engineering product																					H	H	H	H	-	H	H	H	-	H	-	H	-	H	-	-	-			
Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:																																								
CLO-1 :	Understand the importance of thinking ability in the field of engineering			2	85	80	H	H	-	-	-	H	H	H	-	H	-	H	-	-	-																				
CLO-2 :	Update the skills to solve engineering problems			2	85	80	H	H	-	-	-	H	H	H	-	H	-	H	-	-	-																				
CLO-3 :	Undertake better projects which will be helpful for nation development			2	85	80	H	-	-	H	-	H	H	H	-	H	-	H	-	-	-																				
CLO-4 :	Perform better research			2	85	80	H	H	-	-	-	H	H	H	-	H	-	H	-	-	-																				
CLO-5 :	Study and analyze the case studies in the technical way			2	85	80	H	-	H	-	-	H	H	H	-	H	-	H	-	-	-																				
CLO-6 :	Support for the design of quality products and services			2	85	80	H	H	H	H	-	H	H	H	-	H	-	H	-	-	-																				

Duration (hour)	9		9		9		9		9	
S-1	SLO-1	Introduction	Collection of ideas	Introduction to project evaluation	Evaluation of IPR	Design of product prototype				
	SLO-2	The process of technological innovation	Categories of ideas	Preliminary methods	4 traditional forms	Factors of design				
S-2	SLO-1	Factors contributing to successful technological innovation	Different routes for collecting ideas	Screening methods	Definition of IPR	Requirement of design				
	SLO-2	Examples for the factors	Examples	Examples	Development of 7 types of IPR	Design process				
S-3	SLO-1	Technological milestones	Taking different views, Combining the unusual	Product life cycle	Need for IPR in India	Functional design				
	SLO-2	Technological evolution	Examples	Different organizations	Patentable innovation	Functional margins				
S-4	SLO-1	The need for creativity for individual and nation	Adapt, adopt & improve	Product Evaluation profile	Obligations	Test and Qualification				
	SLO-2	The need for innovation for individual and nation	Breaking the rules.	Stability factors	Enforcement measures	Types of tests and their significance				
S-5	SLO-1	Creativity -Obstacles	Challenge the assumptions	Growth factors	Patent search and its advantages	Test plan				

	SLO-2	Problem solving-Obstacles	Asking searching questions	Marketability factors	IP Council	Issues in concluding a test
S-6	SLO-1	Creativity -keys and questions	Increasing the yield	Research factors	International Treaties	Quality standards
	SLO-2	Problem solving-keys and questions	Implementation methods	Development factors	Conventions	Product Strategy
S-7	SLO-1	Brain Storming	Purpose and types, Indian National Technology Missions	Position factors	WIPO	Six-sigma Practice Procedure
	SLO-2	Examples	Detailed explanation	Production factors	TRIPS	Implementation
S-8	SLO-1	Different techniques for creative intelligence	Project selection criteria	Value Engineering	WTO	Marketing- methods
	SLO-2	Detailed explanation with examples	Analysis methods	Need for value engineering	PCT	Marketing- research
S-9	SLO-1	Case Study-1on technology innovation	Case Study-2 on project selection	Case Study-3 on project evaluation	Case Study-4 on IPR	Case Study -5 on product development
	SLO-2	Example	Example	Example	Example	Example

Learning Resources	<ol style="list-style-type: none"> <li>Keelen A.L., <i>New Product Planning and Development</i>, International Correspondence Schools Division, Scraton, Pennsylvania, 1969</li> <li>Paul Sloane, <i>The Leader's Guide to Lateral Thinking Skills</i>, 2<sup>nd</sup> ed., Kogan Page India, New Delhi, 2008</li> <li>Department of Space: <i>IPR Manual</i>, Bangalore, 2007</li> <li>Osho, <i>Creativity – Unleashing the Forces Within</i>, St Martin's Griffin, New York, March, 2007</li> </ol>	<ol style="list-style-type: none"> <li>Abdul Kalam.A.P.J., Arun Tiwari, "Wings of Fire", Universities Press, Hyderabad,1999</li> <li>Edward de Bono, <i>How to have a beautiful mind</i>, Vermilon, London, 2004</li> <li>Khandwalla, R.N., <i>Fourth Eye (Excellence through creativity)</i>, Wheeler Publishing, Allahabad, 1992.</li> <li>Rajiv.V.Dharaskar, <i>Innovation-Growth Engine for Nation. Nice Buzzword but often Misunderstood</i>, www.dharaskar.com</li> <li>Annamalai.N., www.creativitysphere</li> </ol>
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Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#		Theory	Practice
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice		
Level 1	Remember	40 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Understand										
Level 2	Apply	40 %	-	40 %	-	40 %	-	40 %	-	40%	-
	Analyze										
Level 3	Evaluate	20 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

# CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Dr. S. Raja, National Aerospace Laboratories, Bangalore, raja@nal.res.in	1. Dr. K. M. Parammasivam, Madras Institute of Technology, Chennai, mparams@mitindia.edu	1. Mr.Abdur Rasheed, SRMIST
2. Dr. A. Sakthivel, CEMILAC, Bangalore, asakthironika@gmail.com	2. Dr.A.P.Haran, Park College of Engineering & Technology, email: ap_haran@rediffmail.com	2. Mr. S. Chandra Sekhar, SRMIST



Course Code	18ASO103T	Course Name	AVIATION AND AIRLINE MAINTENANCE MANAGEMENT	Course Category	O	Open Elective	L	T	P	C
							3	0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Aerospace Engineering		Data Book / Codes/Standards	Nil	

Course Learning Rationale (CLR):	The purpose of learning this course is to:			Learning			Program Learning Outcomes (PLO)														
CLR-1 :	Create insights to the concepts of Air transportation and Airline management			1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CLR-2 :	Familiarize the concept of Airline forecasting and fleet planning			Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3
CLR-3 :	Identify the significance of airline scheduling and equipment maintenance																				
CLR-4 :	Create insights to the concepts of Aircraft reliability and aging aircraft maintenance																				
CLR-5 :	Familiarize the aviation supporting organization and state regulatory																				
CLR-6 :	Familiarize with aviation maintenance and management																				
Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:																				
CLO-1 :	Identify and understand the organization details in air-transportation			2	85	75	H	-	L	L	M	M	M	H	M	M	L	L	M	M	H
CLO-2 :	Identify the forecasting methods in airline			2	85	75	H	-	L	M	L	L	L	M	M	L	L	M	M	H	
CLO-3 :	Understand the scheduling process and maintenance of aircraft			2	85	75	M	-	-	L	M	M	M	M	M	L	L	H	M	M	
CLO-4 :	Understand the aging aircraft maintenance			2	85	75	H	-	L	M	M	M	L	M	M	M	M	M	M	H	
CLO-5 :	Understand the aviation supporting organizations and state regulatory			2	85	75	H	-	L	L	H	M	M	M	M	H	M	M	M	M	
CLO-6 :	Understand the concept of aviation maintenance and management			2	85	75	H	-	L	L	M	M	M	M	M	L	L	M	M	H	

Duration (hour)	9		9		9		9		9	
S-1	SLO-1	Air Transportation	Airline Economics	Introduction to airline scheduling	Aircraft reliability	Aviation supporting organisations				
	SLO-2	Development of Air Transportation	Airline Forecasting	Mission of Airline scheduling	Parameters to monitor	World trade organisation				
S-2	SLO-1	Comparison of Air Transportation with other Modes of Transport	Fleet Planning	Equipment maintenance	Maintenance schedule	World tourism organisation				
	SLO-2	International Aviation Association	Aircraft Selection Process	Maintenance system of a jet aircraft	Maintenance program	State regulatory				
S-3	SLO-1	ICAO	Operating Cost	Flight operations and crew scheduling	Schedule determination	Responsibilities and functions of CAA				
	SLO-2	IATA	Passenger Capacity	Objective of ground service	Condition monitoring maintenance	Responsibilities and functions of FAA				
S-4	SLO-1	Aviation Classification	Load Factor	Ground operations and facility limitations	ETOPS and EROPS	DGCA				
	SLO-2	Factors Affecting General Aviation Industry	Passenger Fare and Tariffs	Schedule planning and coordination	Aircraft depressurization	functions of DGCA				
S-5	SLO-1	Aircraft Uses	Influence of Geographical, Economic and Political Factors	Traffic flow	Aging Aircraft	Turbine engine monitoring				
	SLO-2	airport classification	On Routes And Route Selection	Schedule salability	Maintenance in aging aircraft	Turbine engine vibration monitoring				

S-6	SLO-1	Airline Management	Fleet Commonality	Schedule Adjustment	Operating cost associated with maintenance	Onboard maintenance system
	SLO-2	Levels of Management	Factors Affecting Fleet Choice	Chain reaction effect	Helicopter maintenance	Life usage monitoring
S-7	SLO-1	Functions of management	Valuation and Depreciation	Load factor leverage	Maintenance schedule	Technology in aircraft maintenance
	SLO-2	Management by Objective	Budgeting	Equipment's and types of schedule	Current Capabilities of NDT	Airline financing
S-8	SLO-1	Principle of organization planning	Cost planning	Preparing flight plans	Applications of NDT in maintenance	Sources of fund
	SLO-2	Organizational Chart	Aircrew Analysis	Aircraft scheduling in line with aircraft maintenance practice	Equipment and tools for maintenance	Globalization
S-9	SLO-1	Line management	Route Analysis	Hub and spoke scheduling	Spare maintenance	Globalization of airlines
	SLO-2	Staff Management	Aircraft evaluation	Advantages and Disadvantages	Future aircraft maintenance	Future Challenges

Learning Resources	1. John G Wensveen, Air Transportation – A Management Perspective, Ashgate Publications, 8 <sup>th</sup> ed., 2015	3. Indian Aircraft Manual, DGCA, sterling book House, Mumbai, reprint 2014
	2. Friend C.H., Aircraft Maintenance Management, Longman aviation technology. 2 <sup>nd</sup> ed., 1992	4. PS Senguttuvan, Fundamentals of air transport management, excel books, reprint 2010

#### Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#		Theory	Practice
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice		
Level 1	Remember Understand	40 %	-	30 %	-	30 %	-	30 %	-	30%	-
Level 2	Apply Analyze	40 %	-	40 %	-	40 %	-	40 %	-	40%	-
Level 3	Evaluate Create	20 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Total	100 %		100 %		100 %		100 %		100 %	

# CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

#### Course Designers

Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Wg .Cdr K. Manoharan (Retd), Blue Dart Aviation Ltd., manoharank@bluedart.com	1. Mr. D. Balaji, Professor, KPRIET, Coimbatore, dbalajideva@gmail.com	1. K.lynthezhuthon, SRMIST
2. Dr. Raja S, CSIR-NAL, Bangalore, raja@nal.res.in	2. Dr. K. M. Parammasivam, Madras Institute of Technology, Chennai, mparams@mitindia.edu	2. Mr .G. Mahendra Perumal, SRMIST

Course Code	18ASO104T	Course Name	AIRCRAFT GENERAL ENGINEERING AND MAINTENANCE PRACTICES	Course Category	O	Open Elective	L	T	P	C
							3	0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Aerospace Engineering		Data Book / Codes/Standards	Nil	

Course Learning Rationale (CLR):	The purpose of learning this course is to:			Learning			Program Learning Outcomes (PLO)																																
CLR-1 :	Identify ground handling tools and equipments to perform ground handling operation of aircraft			1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15																		
CLR-2 :	Maintain the aircraft ground servicing units			Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3																		
CLR-3 :	Upkeep the safety aspects and improve the human relations in working environment.																					H	-	L	L	M	M	M	M	M	M	M	M	M	L	L	M	M	H
CLR-4 :	Work in the planning process environment of maintenance industry.																					H	-	L	L	M	L	L	L	L	M	M	M	M	L	L	M	M	H
CLR-5 :	Maintain the tools, accessories, components ,minor & major assemblies																					M	-	-	-	L	M	M	M	M	M	M	M	M	L	L	H	M	M
CLR-6 :	Utilize the knowledge acquired to work as an efficient maintenance engineer.																					H	L	L	M	M	M	L	M	M	M	M	M	M	M	M	M	M	H
Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:																					2	85	75	H	L	L	L	H	M	M	M	M	M	H	M	M	M	M
CLO-1 :	Understand the operation of various ground handling equipments & procedures			2	85	75	H	L	L	L	H	M	M	M	M	M	H	M	M	M	M																		
CLO-2 :	Acquire knowledge on utility of aircraft ground servicing units and their maintenance			2	85	75	H	L	L	L	H	M	M	M	M	M	H	M	M	M	M																		
CLO-3 :	Know the safety aspects of usage of fluids & the human performance factors			2	85	75	H	L	L	L	H	M	M	M	M	M	H	M	M	M	M																		
CLO-4 :	Acquire knowledge on different maintenance operational procedures			2	85	75	H	L	L	L	H	M	M	M	M	M	H	M	M	M	M																		
CLO-5 :	Acquire knowledge on various maintenance practices.			2	85	75	H	L	L	L	H	M	M	M	M	M	H	M	M	M	M																		
CLO-6 :	Acquire comprehensive knowledge about ground handling & operational procedure of aircraft & its servicing units.			2	85	75	H	L	L	L	M	M	M	M	M	M	L	L	M	M	H																		

Duration (hour)	9		9		9		9		9	
S-1	SLO-1	Introduction to Aircraft Ground Handling Procedures.	Introduction to Maintenance and handling of ground equipment	Safety aspects when working with electricity	Introduction to Maintenance Procedure	Hand Tools				
	SLO-2	Aircraft Taxing Procedure	Maintenance and handling of Compressor	Safety aspects when working with oil, gases, oxygen and chemicals	Maintenance Planning	Care of Tools				
S-2	SLO-1	Aircraft Towing Operations	Maintenance of Portable Hydraulic Test Stand.	Remedial action during an incident	Modification Procedure	Calibration of tools and equipment				
	SLO-2	Safety Precautions during Towing Operations	Handling of Portable Hydraulic Test Stand	Remedial action during an accident.	Stores Procedure	Calibration standards				
S-3	SLO-1	Aircraft Jacking Procedure	Maintenance of Electric power supply equipment	Human Factors	Certification Procedure	Control Cables				
	SLO-2	Safety Precautions during Jacking Procedure	Handling of Electric power supply equipment	Human Error, Murphy's Law	Release Procedure	Pipes and Unions				
S-4	SLO-1	Chocking & Mooring Operations	Maintenance of Charging Trolley	Human performance and limitations – Vision & Hearing	Interface with aircraft operation	Transmissions				
	SLO-2	Safety Precautions during Chocking & Mooring Operations	Handling of Charging Trolley	Information Processing	Maintenance, Inspection	Bearing & Hoses				
S-5	SLO-1	Aircraft Storage Methods	Maintenance of Air-conditioning and Heating Unit	Attention & Perception	Quality control	Springs				

	SLO-2	Storage of Rotables	Handling of Air-conditioning and Heating Unit	Memory & Physical Access	Quality assurance	NDT Techniques
S-6	SLO-1	Refueling Procedures	Maintenance of Ground Support Air Starter Unit	Claustrophobia	Publications	Engineering drawing diagrams
	SLO-2	Defueling Procedures	Handling of Ground Support Air Starter Unit	Factors affecting human performance – Workload	Bulletins	Standards
S-7	SLO-1	Aircraft Deicing Procedures	Maintenance of Oil Pressure Unit	Stress	Airworthiness Directives	Fits and Clearance
	SLO-2	Aircraft Anti-icing Procedures	Handling of Oil Pressure Unit	Time Pressure & Deadlines	Structural Repair Manual	Welding & Swaging
S-8	SLO-1	Effect of environmental condition on aircraft handling and operation	Maintenance of Fire extinguishers	Medication	Overhaul Manual	Brazing & Soldering
	SLO-2	Aircraft cleaning and Maintaining	Handling of Fire extinguishers	Noise & Fumes	Log Books	Bondings
S-9	SLO-1	Ground signaling, Marshaling of aircraft in day time	Maintenance of Jacks, Cranes, Ladders, Platforms, Trestles & Chocks	Climate & Temperature	Introduction to ATA	Corrosion and its removal
	SLO-2	Ground signaling, Marshaling of aircraft in night time.	Handling of Jacks, Cranes, Ladders, Platforms, Trestles & Chocks	Working Environment	ATA Specifications	Trouble shooting techniques.

Learning Resources	<ol style="list-style-type: none"> <li>1. Airframe and Power plant Mechanics, General Hand Book, Federal Aviation Administration, AC65 – 9A</li> <li>2. Airframe and Power plant Mechanics, Airframe Hand Book, Federal Aviation Administration, AC65 – 15A</li> <li>3. Civil Aviation Inspection(CAP 459) Part – II</li> <li>4. Acceptable Methods, Techniques &amp; Practices (FAA) – EA-AC43.13-1A &amp; 2A</li> </ol>	<ol style="list-style-type: none"> <li>5. Michael J.Kroes, William A.Watkins ad Frank Delp, Aircraft Maintenance and Repair, 7<sup>th</sup> ed., Tata McGraw Hill, New Delhi, 2013</li> <li>6. CAP 715 – An Introduction to Aircraft Maintenance Engineering Human Factors for JAR 66, Civil Aviation Authority, UK</li> </ol>
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Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#		Theory	Practice
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice		
Level 1	Remember Understand	40 %	-	30 %	-	30 %	-	30 %	-	30%	-
Level 2	Apply Analyze	40 %	-	40 %	-	40 %	-	40 %	-	40%	-
Level 3	Evaluate Create	20 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Total	100 %		100 %		100 %		100 %		100 %	

# CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Wg .Cdr K. Manoharan (Retd), Blue Dart Aviation Ltd., manoharank@bluedart.com	1. Dr.A.P.Haran, Park College of Engineering & Technology, email: ap_haran@rediffmail.com	1. Dr. S. Sivakumar, SRMIST
2. Dr. Raja S, CSIR-NAL, Bangalore, raja@nal.res.in	2. Dr. K. M. Parammasivam, Madras Institute of Technology, Chennai, mparams@mitindia.edu	2. Mr .G. Mahendra Perumal, SRMIST

Course Code	18ASO105T	Course Name	FLOW VISUALIZATION TECHNIQUES	Course Category	O	Open Elective	L	T	P	C
							3	0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Aerospace Engineering		Data Book / Codes/Standards	Nil	

Course Learning Rationale (CLR):	The purpose of learning this course is to:			Learning			Program Learning Outcomes (PLO)																																		
CLR-1 :	Identify the type of flow visualization used in air flow			1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15																				
CLR-2 :	Identify the type of flow visualization used in water flow			Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3																				
CLR-3 :	Identify the type of flow visualization for compressible flow																					H	-	H	L	-	-	M	-	-	-	-	-	-	-	-	-	H	M	M	
CLR-4 :	Assess the need of image-based measurement like Particle Image Velocimetry																					H	-	H	L	-	-	-	-	-	-	-	-	-	-	-	-	-	M	M	M
CLR-5 :	Understand the operation of various other flow visualization techniques																					H	-	H	L	H	-	-	-	-	-	-	-	-	-	-	-	H	H	H	
CLR-6 :	Utilize the knowledge acquired about various flow visualization for improving the aerodynamics																					H	-	H	L	M	-	-	-	-	-	-	-	-	-	-	M	M	M		
Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:																					2	80	70	H	-	M	L	-	-	M	-	-	-	-	-	-	M	M	M	
CLO-1 :	Understand Flow Visualization requirements and applications			2	80	70	H	-	H	L	-	-	M	-	-	-	-	-	-	H	M	M																			
CLO-2 :	Acquire knowledge on Flow Visualization using air and water			2	80	70	H	-	H	L	-	-	-	-	-	-	-	-	-	-	M	M																			
CLO-3 :	Learn the working principles of compressible flow visualization techniques			2	80	70	H	-	H	L	-	-	-	-	-	-	-	-	-	-	M	M																			
CLO-4 :	Appreciate the usefulness of Particle Image Velocimetry, setup, working and its applications			2	80	70	H	-	H	L	H	-	-	-	-	-	-	-	-	H	H	H																			
CLO-5 :	Gain knowledge on various other visualization techniques			2	80	70	H	-	H	L	M	-	-	-	-	-	-	-	-	M	M	M																			
CLO-6 :	Acquire comprehensive understanding of various flow visualization techniques and their applications			2	80	70	H	-	M	L	-	-	M	-	-	-	-	-	-	M	M	M																			

Duration (hour)	9		9		9		9		9	
S-1	SLO-1	Introduction to Flow Visualization	Safety requirements	Skin Friction Visualization	Holographic Interferometer	Tracer Methods				
	SLO-2	Need for Flow Visualization	Safety procedures	Requirements for Skin Friction	Applications of Holographic Interferometer	Hydrogen Bubble Method				
S-2	SLO-1	Applications of Flow Visualization	Chemical Safety	Interferometer	Particle Image Velocimetry (PIV)	Dye Injection				
	SLO-2	Types of Flow Visualization	Human Safety	Fringe Imaging	PIV and its Types	Types of dye				
S-3	SLO-1	Flow Visualization in Water	Surface Visualization	Compressible Flow Visualization	PIV Setup	Spark Tracer Technique				
	SLO-2	Laminar Flow Visualization	Need for Surface Visualization	Gladstone Dale Relation	PIV Procedure	Spark Tracer Setup				
S-4	SLO-1	Hele-Shaw Apparatus	Surface Visualization versus Surface Measurements	Requirements for Optics	Pulse Signals	Molecular Tagging Velocimetry (MTV)				
	SLO-2	Dye Injection Method	Advantages of Surface Visualization	Optics and Setup procedures	Synchronizer	Setup for MTV				
S-5	SLO-1	Flow Visualization in Air	Wall Shear Stress	Shadowgraph	Imaging for PIV	Thermometry				
	SLO-2	Usage of Tufts	Need for Wall Shear Stress Study	Shadowgraph procedure	Image Correlation	Devices for Thermometry				

S-6	SLO-1	Smoke Generators	Surface Pressure Visualization	Schlieren	Video Recording	Low density flow visualization
	SLO-2	Smoke Injection Methods	Pressure Sensitive Paints (PSP)	Schlieren procedure	Video Imaging	Challenges for low density flow study
S-7	SLO-1	Light Sources	Application of PSP on Surfaces	Mach Zehnder Interferometer	Postprocessing PIV data	Electron Beam Flow visualization
	SLO-2	Light Diffuser	Time resolved PSP	Mach Zehnder Interferometer Setup	Post processing PIV software	Glow Discharge visualization
S-8	SLO-1	Laser Sources	Surface Flow Visualization	Fresnel Equation	Error Sources in PIV	Surface Temperature Visualization
	SLO-2	Laser Sheet for smoke visualization	Shear Sensitivity	Applications of Mach Zehnder Interferometer	Applications of PIV	Temperature Sensitive Paints (TSP)
S-9	SLO-1	Photographic Equipment	Liquid Crystal Coating	Holography	3D PIV	3D Imaging
	SLO-2	Photographic Techniques	Choice of Liquid Crystals	Holography setup	Setup for 3D PIV	3D Image processing

Learning Resources	<ol style="list-style-type: none"> <li>Alexander J Smits, TT Lim, <i>Flow Visualization: Techniques and Examples</i>, 2<sup>nd</sup> ed., Imperial College Press, 2012</li> <li>Rathakrishnan E, <i>Instrumentation, Measurements, and Experiments in Fluids</i>, 1<sup>st</sup> ed., CRC Press, 2007</li> <li>Settles G S, <i>Schlieren and Shadowgraph Techniques: Visualizing Phenomena in Transparent Media</i>, 1<sup>st</sup> ed., Springer, 2001</li> </ol>	<ol style="list-style-type: none"> <li>Merzkirch W (Ed Gersten K), <i>Techniques of flow visualization</i>, AGARDograph No. 302, 1984</li> <li><i>Journal of Visualization</i>, Springer</li> <li><i>Journal of Visualization and Image processing</i>, Begell House</li> </ol>
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Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#		Theory	Practice
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice		
Level 1	Remember	40 %	-	30 %	-	30 %	-	30 %	-	30%	-
Level 2	Understand	40 %	-	40 %	-	40 %	-	40 %	-	40%	-
	Apply	40 %	-	40 %	-	40 %	-	40 %	-	40%	-
Level 3	Analyze	20 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Evaluate	20 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Create	20 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Total	100 %		100 %		100 %		100 %		100 %	

# CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Dr. R. Kalimuthu, VSSC,ISRO, r_kalimuthu@iprc.gov.in	1. Dr. Arun Kumar Perumal, Mechanical Eng, IIT Jammu, arun.perumal@iitjammu.ac.in	1. Mr. S Senthil Kumar, SRMIST
2. Dr. Raja S, CSIR-NAL, email: raja@nal.res.in	2. Dr. Parammasivam K M, MIT, Chennai, email: mparams@mitindia.edu	2. Dr. Kannan B T, SRMIST

Course Code	18ASO106T	Course Name	AIRPORT ENGINEERING	Course Category	O	Open Elective	L	T	P	C
							3	0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Aerospace Engineering		Data Book / Codes/Standards	Nil	

Course Learning Rationale (CLR):	The purpose of learning this course is to:			Learning			Program Learning Outcomes (PLO)																		
CLR-1 :	Familiarize about airports and surveys			1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15				
CLR-2 :	Understand about airport planning and forecasting			Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3				
CLR-3 :	Understand and design runway and taxiways						H	-	L	L	M	M	M	M	M	M	M	M	M	L	L	M	M	H	
CLR-4 :	Understand about air traffic control tower and terminal areas						H	-	L	L	M	L	L	M	M	M	M	M	M	L	L	M	M	H	
CLR-5 :	Understand about helipads and STOL ports						M	-	-	-	L	M	M	M	M	M	M	M	M	L	L	H	M	M	
CLR-6 :	Utilize the knowledge acquired to work as an airport engineer						H	L	L	M	M	M	L	M	M	M	M	M	M	M	M	M	M	M	H
							H	L	L	L	M	M	M	M	M	M	M	M	M	L	L	M	M	H	
Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:																								
CLO-1 :	Identify airports and surveys involved			2	85	75																			
CLO-2 :	Identify airport planning and forecasting			2	85	75																			
CLO-3 :	Understand and design runway and taxiways			2	85	75																			
CLO-4 :	Understand about air traffic control tower and terminal areas			2	85	75																			
CLO-5 :	Understand about helipads and STOL ports			2	85	75																			
CLO-6 :	Acquire comprehensive knowledge about airport and the utilities.			2	85	75																			

Duration (hour)	9		9		9		9		9	
S-1	SLO-1	International airport authority of India	Airport Planning	Runway design	Planning and design of terminal area	Heliport				
	SLO-2	Civil aviation department	Improvement of existing Airport	Runway orientation	Terminal building	Advantages of helicopter				
S-2	SLO-1	Airport Authority of India	Airport site selection	Change in direction of runway	Passenger Flow	Characteristics of helicopter				
	SLO-2	Open sky policy	Factors influence location	Basic runway length	Sequence of activity	Planning of heliport				
S-3	SLO-1	Airport terminology	Airport size	Corrections to basic runway length	Size of apron	Site Selection				
	SLO-2	Aircraft Classification	Factors affecting size of airport	Runway patterns	Hangars	Obstruction clearance requirements				
S-4	SLO-1	Components parts of Aeroplane	Aviation Forecasting	Comparison of runway patterns	Typical airport layout	Elevated heliport				
	SLO-2	Aircraft Characteristics	Important aspects	Taxiway design	Air Traffic Control	Marking and lighting of heliport				
S-5	SLO-1	Jet Aircraft Characteristics	Airport obstructions	Layout of taxiways	Significance of ATC	Heliport in airport				
	SLO-2	Civil and military aircrafts	Imaginary surface	Geometric standards for taxiway	Flight Rules	STOL ports				

S-6	SLO-1	Classification of aerodrome	Objects with actual height	Exit taxiways	ATC Network	Characteristics of STOL Aircraft
	SLO-2	Classification of airports	Clear Zone	Location of exit taxiway	ATC Aids	Advantages of STOL Aircraft
S-7	SLO-1	Flying Activities	Turning zone	Design of exit taxiways	Classification	Planning of STOL Port
	SLO-2	Scheduled and non-scheduled flights	Zoning Laws	Loading aprons	Automation in ATC Aids	Aspects of the planning
S-8	SLO-1	Airport Survey	Environmental considerations	Holding Aprons	GPS ATC	Obstruction clearance requirements
	SLO-2	Objectives and types of survey	Factors influenced by airport activity	Fillets	Free Flight ATC	Runway and taxiway of STOL port
S-9	SLO-1	Drawings to be Prepared	Pollution factor	Separation Clearance	Free flight types	Lighting of STOL Port
	SLO-2	Types of plan	Social factor	Bypass or turnaround taxiway	Approaches of free flight	Marking of STOL Port

Learning Resources	1. Rangwala. Airport Engineering, Charotar Publishing House Pvt., 15 <sup>th</sup> ed., 2015	2. Norman J. Ashford, Saleh A. Mumayiz, Paul H. Wright. Airport Engineering: Planning, Design and Development of 21 <sup>st</sup> Century Airports, 4 <sup>th</sup> ed., CBS Publishers & Distributors. April 2011
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Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#		Theory	Practice
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice		
Level 1	Remember Understand	40 %	-	30 %	-	30 %	-	30 %	-	30%	-
Level 2	Apply Analyze	40 %	-	40 %	-	40 %	-	40 %	-	40%	-
Level 3	Evaluate Create	20 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Total	100 %		100 %		100 %		100 %		100 %	

# CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Wg.Cdr K.Manoharan (Retd), Blue Dart Aviation Ltd, email: manoharank@bluedart.com	1. Mr. D. Balaji, KPRIET, Coimbatore, email: dbalaji.deva@gmail.com	1. K. Lynthezhuthon, SRMIST
2. Dr. Raja S, CSIR-NAL, Bangalore, raja@nal.res.in	2. Dr. K. M. Parammasivam, Madras Institute of Technology, Chennai, mparams@mitindia.edu	2. Mr .G. Mahendra Perumal, SRMIST



Course Code	18ASO107T	Course Name	MOLECULAR GAS DYNAMICS	Course Category	O	Open Elective	L	T	P	C
							3	0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Aerospace Engineering		Data Book / Codes/Standards	Nil	

Course Learning Rationale (CLR):	The purpose of learning this course is to:			Learning			Program Learning Outcomes (PLO)																																				
CLR-1 :	Understand need for molecular description of fluid flow			1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15																						
CLR-2 :	Know the importance of binary collision and the Boltzmann equation			Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3																						
CLR-3 :	Understand the significance of elastic and inelastic collision																					H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	M	M	M		
CLR-4 :	Demonstrate the chemical reactions and thermal radiation with respect to engineering problem																					H	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	L	H	L	
CLR-5 :	Know importance of collisionless flow																					H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	M	M	M
CLR-6 :	Understand the numerical technique for microscopic and mesoscopic method																					H	H	-	L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	M	H	M
																						H	H	-	L	M	-	-	-	-	-	-	-	-	-	-	-	-	-	L	H	L	
Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:																																										
CLO-1 :	Explain the importance of molecular perspective fluid flow			2	85	80																																					
CLO-2 :	Describe the binary collision and need for Boltzmann equation			2	80	75																																					
CLO-3 :	Explain the difference between inelastic and elastic collision and its significance			2	85	80																																					
CLO-4 :	Explain the role of bimolecular reactions and termolecular reactions in chemical reaction			2	80	75																																					
CLO-5 :	Describe the significance of collisionless flow			2	80	75																																					
CLO-6 :	Explain the need for mesoscopic and microscopic numerical technique for fluid flow			2	80	75																																					

Duration (hour)	9		9		9		9		9	
S-1	SLO-1	Introduction to kinetic theory	The Boltzmann equation: The evaluation of phase-space distribution function	Collision theory for bimolecular reactions	Bimodal distributions	Computational technique for mesoscopic method: The Direct Simulation Monte Carlo (DSMC) method, Lattice Boltzmann Method (LBM)				
	SLO-2	Hydrostatics, hydrodynamics								
S-2	SLO-1	Gas kinetic theory	The Boltzmann collision integral	Reaction cross-sections for given reaction rates	Molecular effusion and transpiration	DSMC algorithm				
	SLO-2		The H-theorem							
S-3	SLO-1	Molecular model: need for a molecular description of fluid flow	BGK approximation	Extension to termolecular reactions	One dimensional steady flows	DSMC working principle, advances in DSMC method				
	SLO-2		Nonequilibrium solutions of Boltzmann equation							
S-4	SLO-1	The simple dilute gas, real gas effects	Elastic collision: collision cross-section, collision dynamics	Chemical equilibrium	One-dimensional unsteady flows	Lattice gas automata (LGA)				
	SLO-2									
S-5	SLO-1	Macroscopic properties in a simple gas	The inverse power law model, hard sphere model	The equilibrium collision theory	Transfer of normal, tangential momentum, transfer of translational energy	LGA to lattice Boltzmann equation				
	SLO-2									

S-6	SLO-1	Distribution function, Phase space distributions	Variable hard sphere model	The dissociation reaction, recombination reaction	Free molecular heat transfer, recovery temperature	LBM algorithm, boundary and initial conditions
	SLO-2	The Maxwell-Boltzmann distribution	Variable soft sphere model			
S-7	SLO-1	Maxwell assumption, Distribution of molecular speeds	Generalized hard sphere model, Maxwell model	The exchange and ionization reactions	Stanton number and thermal recovery factor	Computational technique for microscopic method: Molecular Dynamics (MD)
	SLO-2					
S-8	SLO-1	Mixture of gases	Larsen-Borgnakke model in a simple gas and gas mixture	Classical model for rotation radiation	Thermophoresis, flow with multiple reaction	Description of MD method, the force calculation
	SLO-2					
S-9	SLO-1	Moments of Maxwell-Boltzmann distribution	Vibrational and electronic energy, gas-surface interaction	Bound-bound radiation	Test-particle Monte Carlo method	Integrating equations of motion and solution methods.
	SLO-2					

Learning Resources	<ol style="list-style-type: none"> <li>Gombosi, Tamas I., and Atmo Gombosi. <i>Gaskinetic theory</i>. No. 9. Cambridge University Press, 1994.</li> <li>Bird, Graeme A., and J. M. Brady. <i>Molecular gas dynamics and the direct simulation of gas flows</i>. Vol. 5. Oxford: Clarendon press, 1994.</li> <li>Kruger, Ch H., and W. G. Vincenti. <i>Introduction to physical gas dynamics</i>. John Wiley &amp; Sons (1965).</li> </ol>	<ol style="list-style-type: none"> <li>Frenkel, Daan, et al. "Understanding molecular simulation." <i>Computers in Physics</i> 11.4 (1997): 351-354.</li> <li>Anderson, John David. <i>Modern compressible flow: with historical perspective</i>. Vol. 12. New York: McGraw-Hill, 1990.</li> </ol>
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Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#		Theory	Practice
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice		
Level 1	Remember Understand	40 %	-	30 %	-	30 %	-	30 %	-	30%	-
Level 2	Apply Analyze	40 %	-	40 %	-	40 %	-	40 %	-	40%	-
Level 3	Evaluate Create	20 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Total	100 %		100 %		100 %		100 %		100 %	

# CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Expert
Mr. Amit Palankar, GE aviation, Bangalore, palankr.amit@gmail.com	Dr.Arun Kumar P, Indian Institute of Technology Jammu, email: arun.perumal@iitjammu.ac.in	Dr. Malaikannan G, SRMIST

Course Code	18BTO101T	Course Name	HUMAN HEALTH AND DISEASES	Course Category	O	Open Elective	L	T	P	C
							3	0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Biotechnology		Data Book / Codes/Standards	Nil	

Course Learning Rationale (CLR):	The purpose of learning this course is to:			Learning			Program Learning Outcomes (PLO)																														
CLR-1 :	State the basic structural organization of human health system			1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15																
CLR-2 :	Summarize the etiology of human infectious diseases			Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3																
CLR-3 :	Describe immune system of human body and immune disorders																					-	-	-	L	-	M	-	-	-	H	-	H	-	L	H	
CLR-4 :	Impart information about genetic disease																					-	-	-	L	-	M	-	-	-	H	-	H	-	L	H	
CLR-5 :	Indicate the high risk diseases associated with modern society																					-	-	-	L	-	M	-	-	-	H	-	H	-	L	H	
CLR-6 :	State about disease diagnosis and treatment strategies																					-	-	-	L	-	M	-	M	-	H	-	H	-	H	H	H
CLR-6 :	State about disease diagnosis and treatment strategies																					-	-	-	L	-	M	-	H	-	H	-	H	-	H	-	H

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:			Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3
CLO-1 :	Recall basic human biology at the genetic, cellular, and physiological levels			2	80	70	-	-	-	L	-	M	-	-	-	H	-	H	-	L	H
CLO-2 :	Interpret how the human body maintains a healthy balance, and how disturbances of this balance underlie diseases			2	85	75	-	-	-	L	-	M	-	-	-	H	-	H	-	L	H
CLO-3 :	Discuss about infectious organism and understand defense mechanism of our human body			2	75	70	-	-	-	L	-	M	-	-	-	H	-	H	-	L	H
CLO-4 :	Describe disease causing agents			2	85	80	-	-	-	L	-	M	-	-	-	H	-	H	-	L	H
CLO-5 :	Familiarize with modern biomedical scientific approaches to treat disease.			2	85	75	-	-	-	L	-	M	-	M	-	H	-	H	H	H	H
CLO-6 :	Demonstrates the importance of taking responsibility for one's own health			2	80	70	-	-	-	L	-	M	-	H	-	H	-	H	-	H	H

Duration (hour)	9		9		9		9		9	
S-1	SLO-1	Introduction to human health	Concepts of human disease	Immune system	Mendelian genetics	Disease Diagnosis				
	SLO-2	Anatomy and physiology	Disease Disorder and syndrome	Physical chemical and cellular barrier	Genetics of simple and complex traits	Treatment strategy				
S-2	SLO-1	Respiratory system	Pathology of disease	Types of Immune cell	Hereditary disease	Biomedical Instruments				
	SLO-2	Circulatory system	Mechanism of disease	Humoral and cell mediated immunity	Karyotype preparation and analysis Chromosome abnormality	Biosensors				
S-3	SLO-1	Digestive system	Infectious disease	Cells Involved in inflammation	Thalassemia	Drug designing and development				
	SLO-2	Excretory system	Causative agents Bacteria, virus and parasites	Inflammatory Process	Cystic fibrosis	Computer aided drug designing				
S-4	SLO-1	Reproductive system	Bacteria: Introduction Pathogenesis	Immune disorders	Duchene Muscular dystrophy	Drug metabolism				
	SLO-2	Fertilization and embryogenesis	Bacterial toxins	Abscesses, ulcer, cellulitis And Allergy	Sickle cell anemia	ADME property of a drug				
S-5	SLO-1	Cell structure	virulence of bacterial infection	Autoimmunity	Indian genetic disease database	Sources of drug- plants and microbes				
	SLO-2	Tissue types	Antibiotic resistance strains	Immunodeficiency	Human gene mutation database	Route of administration				

S-6	SLO-1	How body gets energy	Virus: An overview of replication cycle of virus	High risk disease of modern society	Principle class of metabolic disorders	Bulk Drugs and processing
	SLO-2	ATP Synthesis	Effect of virus infection in the host cell	Obesity, Hypertension and diabetics	Inherited Metabolic disorders	Active pharmaceutical ingredient
S-7	SLO-1	Cell metabolism	Epidemiology	Neoplasm	Metabolic syndrome	Vaccines types, Recommendation by age
	SLO-2	Cell cycle	Roots of spreading, Emerging and reemerging virus	Oncogenes and tumor suppressor genes	Risk factors	Vaccines – Recent advancement
S-8	SLO-1	Checkpoints in cell division	Parasitosis, common parasites of human	Types of cancer	Lysozyme storage disease: Molecular basis	Immunotherapy
	SLO-2	Cell division -Mitosis and Meiosis	Plasmodium – life cycle and disease	Stages of cancer	List of proteins involved in LSD	Immunotherapeutic approaches currently in use
S-9	SLO-1	Growth factors- overview	Fungal Infections	Cancer in future	Balanced nutrition and Malnutrition	Stem cell therapy
	SLO-2	Types and function	Endemic mycoses in immunocompromised patients	Life style and cancer risk	Deficiency disease	Gene therapy

Learning Resources	1. Goodenough and McGuire, <i>Biology of Humans: Concepts, Applications and issues</i> , 4 <sup>th</sup> ed., Benjamin Cummins/Pearson Publisher, 2011	2. Marianne Neighbors, Ruth Tannehil, <i>Human Diseases</i> , 4 <sup>th</sup> ed., Jones Cengage learning, 2015
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Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#		Theory	Practice
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice		
Level 1	Remember	40 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Understand										
Level 2	Apply	40 %	-	40 %	-	40 %	-	40 %	-	40%	-
	Analyze										
Level 3	Evaluate	20 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

# CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Dr. C. N. Ramchand, Saksin Life sciences Pvt Ltd, Chennai, ramchand@saksinlife.com	1. Prof. K Subramaniam, IITM, Chennai, subbu@iitm.ac.in	1. Dr. Lilly M Saleena, SRMIST
2. Dr. Karthik Periyasamy, Aurobindo Pharma Limited, Hyderabad, karthikmpk@gmail.com	2. Prof. R. B. Narayanan, SVCE, Chennai, rbn@svce.ac.in	2. Dr. Priya Swaminathan, SRMIST

Course Code	18BTO102T	Course Name	MODELLING OF BIOMOLECULES	Course Category	O	Open Elective	L	T	P	C
							3	0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Biotechnology		Data Book / Codes/Standards	Nil	

Course Learning Rationale (CLR):	The purpose of learning this course is to:			Learning			Program Learning Outcomes (PLO)																														
CLR-1 :	State the basic structural organization of human health system			1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15																
CLR-2 :	Summarize the etiology of human infectious diseases			Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3																
CLR-3 :	Describe immune system of human body and immune disorders																					-	-	-	L	-	M	-	-	-	H	-	H	-	L	H	
CLR-4 :	Impart information about genetic disease																					-	-	-	L	-	M	-	-	-	H	-	H	-	L	H	
CLR-5 :	Indicate the high risk diseases associated with modern society																					-	-	-	L	-	M	-	-	-	H	-	H	-	L	H	
CLR-6 :	State about disease diagnosis and treatment strategies																					-	-	-	L	-	M	-	M	-	H	-	H	-	H	H	H
CLR-6 :	State about disease diagnosis and treatment strategies																					-	-	-	L	-	M	-	H	-	H	-	H	-	H	-	H
Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:			2	80	70	-	-	-	L	-	M	-	-	-	H	-	H	-	L	H																
CLO-1 :	Recall basic human biology at the genetic, cellular, and physiological levels			2	85	75	-	-	-	L	-	M	-	-	-	H	-	H	-	L	H																
CLO-2 :	Interpret how the human body maintains a healthy balance, and how disturbances of this balance underlie diseases			2	75	70	-	-	-	L	-	M	-	-	-	H	-	H	-	L	H																
CLO-3 :	Discuss about infectious organism and understand defense mechanism of our human body			2	85	80	-	-	-	L	-	M	-	-	-	H	-	H	-	L	H																
CLO-4 :	Describe disease causing agents			2	85	75	-	-	-	L	-	M	-	M	-	H	-	H	H	H	H																
CLO-5 :	Familiarize with modern biomedical scientific approaches to treat disease.			2	80	70	-	-	-	L	-	M	-	H	-	H	-	H	-	H	H																
CLO-6 :	Demonstrates the importance of taking responsibility for one's own health			2	80	70	-	-	-	L	-	M	-	H	-	H	-	H	-	H	H																

Duration (hour)	9		9		9		9		9	
S-1	SLO-1	Introduction to human health	Concepts of human disease	Immune system	Mendelian genetics	Disease Diagnosis				
	SLO-2	Anatomy and physiology	Disease Disorder and syndrome	Physical chemical and cellular barrier	Genetics of simple and complex traits	Treatment strategy				
S-2	SLO-1	Respiratory system	Pathology of disease	Types of Immune cell	Hereditary disease	Biomedical Instruments				
	SLO-2	Circulatory system	Mechanism of disease	Humoral and cell mediated immunity	Karyotype preparation and analysis Chromosome abnormality	Biosensors				
S-3	SLO-1	Digestive system	Infectious disease	Cells Involved in inflammation	Thalassemia	Drug designing and development				
	SLO-2	Excretory system	Causative agents Bacteria, virus and parasites	Inflammatory Process	Cystic fibrosis	Computer aided drug designing				
S-4	SLO-1	Reproductive system	Bacteria: Introduction Pathogenesis	Immune disorders	Duchene Muscular dystrophy	Drug metabolism				
	SLO-2	Fertilization and embryogenesis	Bacterial toxins	Abscesses, ulcer, cellulitis And Allergy	Sickle cell anemia	ADME property of a drug				
S-5	SLO-1	Cell structure	virulence of bacterial infection	Autoimmunity	Indian genetic disease database	Sources of drug- plants and microbes				
	SLO-2	Tissue types	Antibiotic resistance strains	Immunodeficiency	Human gene mutation database	Route of administration				

S-6	SLO-1	How body gets energy	Virus: An overview of replication cycle of virus	High risk disease of modern society	Principle class of metabolic disorders	Bulk Drugs and processing
	SLO-2	ATP Synthesis	Effect of virus infection in the host cell	Obesity, Hypertension and diabetics	Inherited Metabolic disorders	Active pharmaceutical ingredient
S-7	SLO-1	Cell metabolism	Epidemiology	Neoplasm	Metabolic syndrome	Vaccines types, Recommendation by age
	SLO-2	Cell cycle	Roots of spreading, Emerging and reemerging virus	Oncogenes and tumor suppressor genes	Risk factors	Vaccines – Recent advancement
S-8	SLO-1	Checkpoints in cell division	Parasitosis, common parasites of human	Types of cancer	Lysozyme storage disease: Molecular basis	Immunotherapy
	SLO-2	Cell division -Mitosis and Meiosis	Plasmodium – life cycle and disease	Stages of cancer	List of proteins involved in LSD	Immunotherapeutic approaches currently in use
S-9	SLO-1	Growth factors- overview	Fungal Infections	Cancer in future	Balanced nutrition and Malnutrition	Stem cell therapy
	SLO-2	Types and function	Endemic mycoses in immunocompromised patients	Life style and cancer risk	Deficiency disease	Gene therapy

Learning Resources	1. Goodenough and McGuire, <i>Biology of Humans: Concepts, Applications and issues, 4th ed., Benjamin Cummins/Pearson Publisher, 2011</i>	2. Marianne Neighbors, Ruth Tannehil, <i>Human Diseases, 4th ed., Jones Cengage learning, 2015</i>
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Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#		Theory	Practice
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice		
Level 1	Remember	40 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Understand										
Level 2	Apply	40 %	-	40 %	-	40 %	-	40 %	-	40%	-
	Analyze										
Level 3	Evaluate	20 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

# CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Dr. C. N. Ramchand, Saksin Life sciences Pvt Ltd, Chennai, ramchand@saksinlife.com	1. Prof. K Subramaniam, IITM, Chennai, subbu@iitm.ac.in	1. Dr. Lilly M Saleena, SRMIST
2. Dr. Karthik Periyasamy, Aurobindo Pharma Limited, Hyderabad, karthikmpk@gmail.com	2. Prof. R. B. Narayanan, SVCE, Chennai, rbn@svce.ac.in	2. Dr. Priya Swaminathan, SRMIST

Course Code	18BTO103T	Course Name	ACTIVATED CARBON TECHNOLOGY	Course Category	O	Open Elective	L	T	P	C
							3	0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Biotechnology		Data Book / Codes/Standards	Nil	

Course Learning Rationale (CLR):	The purpose of learning this course is to:			Learning			Program Learning Outcomes (PLO)														
CLR-1 :	State a basic understanding of activated carbon and its industrial applications.			1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CLR-2 :	Demonstrate the preparation of the material from different sources of waste			Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3
CLR-3 :	Apply the engineering aspects of the adsorbents																				
CLR-4 :	Prepare the adsorbents for the waste water treatment plants																				
CLR-5 :	Analyze the problems of the industrial effluents that are hazardous to the environment																				
CLR-6 :	Apply a solution to solve the industrial effluent problems																				

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:			Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3	
CLO-1 :	Discuss about the activated carbon from different sources and subsequent knowledge to apply industrially			1	80	80	H	H	H	H	-	M	L	H	H	H	H	H	H	H	H	H
CLO-2 :	Prepare the activated carbon from different sources			2	85	75	H	H	H	H	-	-	M	H	H	H	H	H	H	H	H	H
CLO-3 :	Explain the kinetics on the adsorption of heavy metals, dyes and toxic substances			2	75	80	M	H	M	H	M	M	-	M	H	H	H	H	H	H	H	H
CLO-4 :	Evaluate mechanism of activated carbon that is ultimately responsible for removing the toxic substance from the effluent			2	85	80	H	H	H	H	-	-	H	L	H	H	H	H	H	H	H	H
CLO-5 :	Design an alternative adsorption process and present the solution to adsorption problems.			3	85	75	H	H	H	H	-	M	H	H	H	L	H	H	H	H	H	H
CLO-6 :	Formulate the activated carbon for better environment			2	80	80	H	H	H	H	L	M	M	M	H	H	H	H	H	H	H	H

Duration (hour)	9		9		9		9		9	
S-1	SLO-1	Activated Carbon and Its Surface Structure	Principle of Adsorption Kinetics	Activated adsorption from solutions	Principle of AAS and its applications	Application of activated adsorption technology in the waste water treatment				
	SLO-2	Basics of activated carbon	Effect of contact time on the adsorption characteristics	Types of isotherms for solution phase	AAS analysis of dyes adsorption by activated carbon	Application of Activated Carbon in Environmental Pollution				
S-2	SLO-1	Historical Perspective of Activated Carbon Adsorption and its Integration with Biological Processes	Effect of pH on the adsorption characteristics	Types of adsorption isotherm sorbent selection	Characterizing the pore structure of the carbon by SEM	Integration of Activated Carbon Adsorption with Biological Processes in Wastewater and Water Treatment				
	SLO-2	Activated carbon-crystalline structure, porous structure and chemical structure	Effect of agitation and adsorbent dosage on the adsorption characteristics	Regeneration of activated carbon	Proximate analysis of activated carbon prepared from various raw materials	Industrial waste water treatment using natural material as an adsorbent				
S-3	SLO-1	Types of materials from different sources	Thermodynamic parameters like change in free energy, enthalpy and entropy for the process of removal	Batch adsorption kinetics	Principles of FTIR analysis for the prepared activated carbon	AC on the removal of hazardous organic and inorganic compounds from industrial waste water				
	SLO-2	Preparation of granulated and powder activated carbon	Contact Oxidation Process Followed by Activated Carbon	Factors influencing adsorption from binary solution	X-ray refractive diffraction (XRD) studies for activated carbon	AC on the removal of hazardous gases and vapors from industrial flue gases				
S-4	SLO-1	Influence of carbon-oxygen surface groups of adsorption properties	Models, and types of adsorption	Transport processes in adsorption from liquid phase on activated carbon	X-ray photoelectron spectroscopy (XPS) studies for activated carbon	Application of activated adsorption technology in pharmaceutical industries				
	SLO-2	Influence of other surface groups of adsorption properties	Influencing factors for adsorption properties	Capillary transport in adsorption from liquid phase on activated carbon	Interpretation of results	Application of activated adsorption technology in leather industries				

S-5	SLO-1	Chemical activation using acids	Influencing factors for the Adsorption equilibrium	Adsorption behaviour of Low-Bio-degradable Organics on Activated Carbon Surfaces	X-ray absorption spectroscopy (XAS) studies for activated carbon	Application of activated adsorption technology in food industries
	SLO-2	Chemical activation using alkalis	Development of adsorption isotherms	Adsorption behaviour of Non-Bio-degradable Organics on Activated Carbon Surfaces	Interpretation of analysis	Application of activated adsorption technology in paint industries
S-6	SLO-1	Preparation of carbon from agricultural wastes	Linear, Freundlich, Langmuir adsorption isotherms	Design for packed columns	BET Principle and analysis	Adsorption for Textile Wastewater Treatment
	SLO-2	Preparation of activated carbon from agricultural waste using chemical agents	Temkin and Dubinin–Radushkevich isotherm models	Process design factors of fixed-bed adsorption columns	Interpretation of BET analysis	Improved Control of Pollutants through Integrated Adsorption and Biological Treatment
S-7	SLO-1	Preparation of activated carbon from lower cost materials	Adsorption Equilibria of the Light Hydrocarbon Gases on the Activated Carbon and Silica Gel	Phenol wastewater treatment by a two-step adsorption–oxidation process on activated carbon	Analysis and design of GAC and PAC Contactors	Application of activated adsorption technology in plating industries
	SLO-2	Effect of activating agents	Adsorption Equilibria of the heavy Hydrocarbon Gases on the Activated Carbon and Silica Gel	Hydrocarbon wastewater treatment process on activated carbon	Interpretation of results	Application of activated adsorption technology in dye industries
S-8	SLO-1	Activated carbon from e-waste such as PCB, Metallic and non-metallic components	Simulated Binary Isothermal Adsorption on Activated Carbon in Periodic Countercurrent Column Operation	Scale-up laboratory adsorption column	Thermal analysis of prepared activated carbon	Application of activated adsorption technology in drug industries
	SLO-2	Using physical and chemical methods for the preparation of AC from e waste	Solving problems	Criteria for scale up	Interpretation of results	Application of activated adsorption technology in brewing industries
S-9	SLO-1	pH, solubility and Iodine number of activated carbon	A Liquid-Phase Adsorption and rate of diffusion of phenol from aqueous solution into Activated Carbon	Adsorption of phenols onto granular activated carbon in a liquid–solid fluidized bed	Differential Scanning Calorimetry for the analysis of activated carbon	Adsorption of Normal Paraffins and Sulfur Compounds on Activated Carbon
	SLO-2	Different types of carbon Nano-materials: CNT, CNF, CNB, their structure	Solving problems	Desorption of phenols onto granular activated carbon in a liquid–solid fluidized bed	Interpretation of results	Application of activated adsorption technology in dairy industries

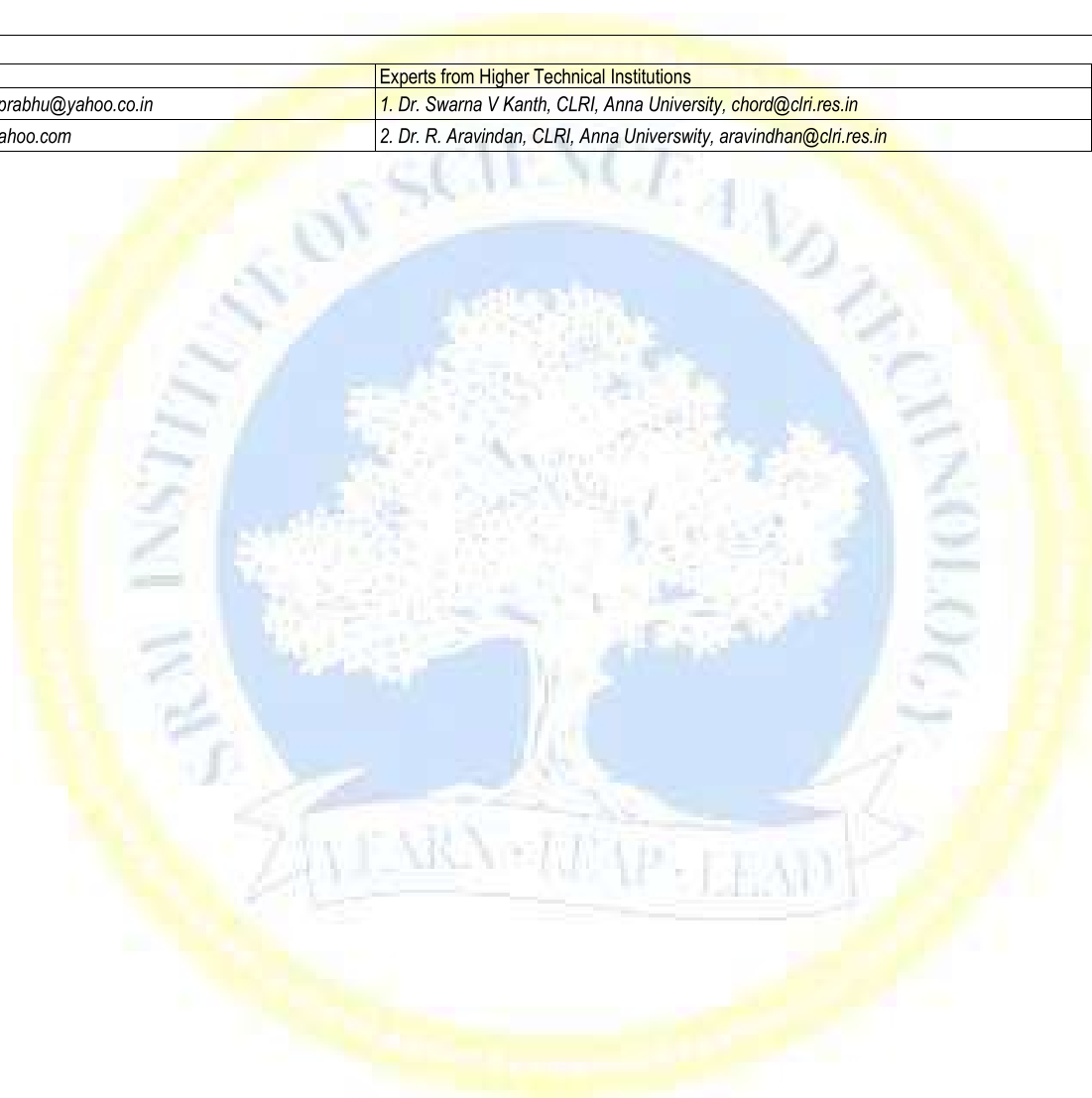
Learning Resources	1. Bansal, R.C. and M. Goyal, <i>Activated Carbon Adsorption</i> , Boca Raton, FL: CRC Press, 2013	4. Jean Rouquerol, Francoise Rouquerol, Kenneth S.W. Sing, <i>Adsorption by Powders and Porous Solids: Principles, Methodology and Applications</i> , Academic Press, 1998
	2. Harry Marsh Francisco Rodriguez Reinoso, <i>Activated Carbon</i> , 1 Edition, Elsevier Science, June 2006	
	3. Douglas M. Ruthven, <i>Principles of Adsorption and Adsorption Processes</i> , Wiley, 1984	5. Richard I. Masel, <i>Principles of Adsorption and Reaction on Solid Surfaces</i> , Wiley, 1996

Learning Assessment											
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		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#		Theory	Practice
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice		
Level 1	Remember	40 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Understand										
Level 2	Apply	40 %	-	40 %	-	40 %	-	40 %	-	40%	-
	Analyze										
Level 3	Evaluate	20 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

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Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Mr. Prabhakaran M, CK & Industries, ck_prabhu@yahoo.co.in	1. Dr. Swarna V Kanth, CLRI, Anna University, chord@clri.res.in	1. Dr. M. Pandimadevi, SRMIST
2. Mr. Vinod Kanth, Consultant,svkuvk71@yahoo.com	2. Dr. R. Aravindan, CLRI, Anna University, aravindhan@clri.res.in	2. Dr. B.Samuel Jacob, SRMIST



Course Code	18BTO104T	Course Name	DEFENCE FORCES IN OUR BODY	Course Category	O	Open Elective	L	T	P	C
							3	0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Biotechnology		Data Book / Codes/Standards	Nil	

Course Learning Rationale (CLR):	The purpose of learning this course is to:			Learning			Program Learning Outcomes (PLO)																																		
CLR-1 :	Analyze the various components of the immune system			1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15																				
CLR-2 :	Discuss the innate immune cells and their role in fighting against pathogens			Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3																				
CLR-3 :	Demonstrate the adoptive immune system and their function																					H	H	H	H	H	H	H	M	L	H	H	H	H	H	H	H	H	H	H	
CLR-4 :	Illustrate the methods and techniques used in immunology																					2	85	75	M	H	M	M	M	M	M	H	H	H	H	H	H	H	H	H	H
CLR-5 :	Discuss how the human body respond to pathogens																					2	75	80	H	H	M	M	M	M	M	H	L	H	H	H	H	H	H	H	H
CLR-6 :	Apply immunotherapy																					2	85	80	H	H	H	H	H	H	H	H	H	H	L	H	H	H	H	H	H
CLR-6 :	Apply immunotherapy																					2	80	80	H	H	H	H	L	M	M	M	M	H	H	H	H	H	H	H	H
Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:																																								
CLO-1 :	Explain about the basic concept of immune system			1	80	80	H	H	H	H																															
CLO-2 :	Describe the different type of immune cells and organs			2	85	75	H	H	H	H			M	H	H	H	H	H	H	H	H	H	H																		
CLO-3 :	Analyse how the body respond to pathogens			2	75	80	M	H	M	H	M	M		M	H	H	H	H	H	H	H	H	H																		
CLO-4 :	Discuss about the immunotechniques used to assess immune functions			2	85	80	H	H	H	H			H	L	H	H	H	H	H	H	H	H	H																		
CLO-5 :	Evaluate immunity to infections			2	85	75	H	H	H	H		M	H	H	H	L	H	H	H	H	H	H	H																		
CLO-6 :	Describe immunotherapy			2	80	80	H	H	H	H	L	M	M	M	H	H	H	H	H	H	H	H	H																		

Duration (hour)	9		9		9		9		9	
S-1	SLO-1	Introduction to the immune system	Introduction to innate immune system	Introduction to adaptive immune system	Antigen –antibody interaction	What is an infection?				
	SLO-2	History of modern immunology	Components of the innate immune system	Components of the adaptive immune system	Forces in antigen-antibody interaction	Human infectious agents				
S-2	SLO-1	What is immunity?	Anatomical barriers- Chemical and mechanical	Types of adaptive response	Affinity and avidity	Bacterial diseases				
	SLO-2	Concept of self and non-self	Anatomical barriers- Biological	Innate versus adaptive immune response	Cross-reactivity and specificity	Immunity to bacteria				
S-3	SLO-1	Primary lymphoid organ Blood marrow	Humoral components-complements	Antibody mediated immune response	Antibody as Immunoassays	Viral diseases				
	SLO-2	Primary lymphoid organ Thymus	Humoral components-coagulation factors	What are antibodies and antigens?	Agglutination	Immunity to viruses				
S-4	SLO-1	Hematopoietic stem cell	Cytokines	Immunoglobulin structure	Blood typing	Fungi and human diseases				
	SLO-2	Development of blood cell lineage	Properties and functions of cytokines	Role of antibodies	Immuno electrophoresis	Immunity to fungi				
S-5	SLO-1	Red blood cells and platelets	Phagocytosis and macrophages	Effect of antigen-antibody binding	Principle of ELISA Clinical utility	Protozoan and worms				
	SLO-2	White Blood cells	Neutrophil granules and killing	Types of antibodies	Types of ELISA	Immunity to protozoan				

S-6	SLO-1	The myeloid cells- granulocytic	NK cell cytotoxicity	Cell mediated immunity- T cells	Western Blot and confirmation	Vaccination-how does it work?
	SLO-2	The myeloid cells- monocytic	Dendritic cells and its action	Different types of T cells and their functions	ELISPOT- detection of virus	Different types of vaccination
S-7	SLO-1	The lymphoid cells- T and B cells	Pathogen recognition	T cell receptor	Tissue sectioning	Immunodeficiency
	SLO-2	The lymphoid cells- NK cells	Innate immune receptors	How does a T cell recognize antigen?	Immunohistochemistry	Autoimmune diseases
S-8	SLO-1	Secondary lymphoid organs-Spleen	Inflammation and its process	Antigen presenting cells	Fluorescence and its utility in immunoassays	Introduction to cancer
	SLO-2	Secondary lymphoid organs-Lymph nodes	Signs of inflammation	Interaction of APC with the T cells	Flow cytometry	Immunity to cancer
S-9	SLO-1	The lymph	Mechanism of inflammation	Clonal selection	Isolation of immune cells	Strategies of cancer treatment
	SLO-2	The lymphatic system	Role of inflammation in diseases	Primary and secondary immune response	Activation of immune cells	Immunotherapy

Learning Resources	<ol style="list-style-type: none"> <li>1. A.K. Chakravarty, <i>Immunology and Immunotechnology</i>, Oxford University Press, 2006</li> <li>2. Peter Wood, <i>Understanding Immunology</i>, 2<sup>nd</sup> ed., Pearson Education, 2006</li> </ol>	<ol style="list-style-type: none"> <li>3. Sudha Gangal, Shubhangi Sontakke, <i>Textbook of basic and clinical immunology</i>, Universities Press, 2013</li> <li>4. Richard Coico, Geoffrey Sunshine, <i>Immunology: A short course</i>, 6<sup>th</sup> ed., Wiley-Blackwell, 2009</li> </ol>
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Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#		Theory	Practice
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice		
Level 1	Remember	40 %	-	30 %	-	30 %	-	30 %	-	30%	-
Level 2	Understand	40 %	-	40 %	-	40 %	-	40 %	-	40%	-
Level 3	Apply	20 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Analyze										
	Evaluate										
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

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Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
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2. Dr. Karthik Periyasamy, Aurobindo Pharma Limited, Hyderabad, karthikmpk@gmail.com	2. Prof. R. B. Narayanan, SVCE, Chennai, rbn@svce.ac.in	2. Dr.Oindrilla.M, SRMIST

Course Code	18BTO105T	Course Name	ANIMAL MODELS FOR RESEARCH	Course Category	O	Open Elective	L	T	P	C
							3	0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Biotechnology		Data Book / Codes/Standards	Nil	

Course Learning Rationale (CLR):	The purpose of learning this course is to:			Learning			Program Learning Outcomes (PLO)														
CLR-1 :	Learn the basics of animal experiments			1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CLR-2 :	Apply the concept of living model organism and selection of appropriate model			Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3
CLR-3 :	Use of various animal models available																				
CLR-4 :	Analyze the different alternatives and ethical issues																				
CLR-5 :	Use pilot experiments to evaluate their working/living environment																				
CLR-6 :	Analyze animal experiment data and correlate with human case reports																				

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:			1	85	80	L	M	H	H	H	L	M	H	H	M	H	H	H	H	H	H
CLO-1 :	Describe about the fundamentals of animal experiments			2	85	70	M	M	H	H	H	M	M	H		M	H	H	M	L	M	M
CLO-2 :	Recognize the similarities between animal models and humans			2	80	75	M	H	M	H	H	L	L	H		L	H	H	H	M	L	L
CLO-3 :	Discuss the knowledge on different animal models available			2	75	80	M	H	H	H	H		H	H		L	H	H	M	M	M	M
CLO-4 :	Explain the functions that can be studied in animal models			3	85	75	H	M	H	H	H		H	H	L	H	H	H	H	L	M	M
CLO-5 :	Analyze the animal alternatives and ethical issues			3	80	80	H	H	H	H	H	M	M	M	L	H	H	H	H	M	M	H
CLO-6 :	Interpret pilot experiments to study animal model experiment																					

Duration (hour)	9		9		9		9		9	
S-1	SLO-1	Introduction to biology of animals	Selection of animal models	Transgenesis and transgenic animal models	Drugs and compound administration	Animals in laboratory environment				
	SLO-2	Structure and organs	Mammals, bovine, aquatic, insect	Knockout, Knockin, Mutation models	Need for animal models to test new compounds prior clinical study	Light cycle, temperature and humidity				
S-2	SLO-1	Classification of animals	Mammal biology – life cycle	CRISPR cas 9	Oral administration	Pathogen free environment lab				
	SLO-2	Vertebrate and Invertebrate	Rats, mice, sheep and bovine	UAS gal 4 systems	Nasal dosage	Precautions and protective gear to be followed by researchers				
S-3	SLO-1	Human evolution	Rats – types of rats	Animal models for cataracts and retinitis pigmentosa	Inhalation	Housing and Animal husbandry				
	SLO-2	Darwinism theory	Genetic background among different sub species	Animal models for Atherosclerosis and myocardial infarction	Inhalation related experiment animal models	Animal husbandry training				
S-4	SLO-1	Human diseases	Mice – types of mice	Animal models for cardiac and cardiovascular disease	Inhalation related experiment animal models and issues that can be replicated	3 R's and Alternative for animal models				
	SLO-2	Need for animal models	Genetic background among different sub species	Animal models for metabolic syndrome	Invasive administrations – intravenous	Tissue culture – cell lines				
S-5	SLO-1	Experimental animal models	Sheep and cow as animal models	Animal models for diabetes and obesity	Invasive administrations – intravenous and intra-peritoneal	Primary tissue culture				

	SLO-2	Monkey, rat, rabbit - living animals models	Disease research on sheep and cow	Animal models for liver diseases	Invasive administrations – intraocular	3D cell culture reconstructing and replacing organs
S-6	SLO-1	Chicken, pig tissues – non living animal models	Aquatic animals models	Animal models for skin disorders and regeneration	Invasive administrations – intraocular and intramuscular	Limitation and ethical issues in research on humans
	SLO-2	Pig heart as cardiovascular model	Life cycle of zebra fish and Japanese rice fish and research	Animal models for stroke, olfactory and neuromuscular dysfunction	Invasive administrations – Subcutaneous	Lower order animal models
S-7	SLO-1	Classical animal models used – squid	Hydra as an aquatic animal model	Animal models for schizophrenia	Invasive administrations – Subcutaneous	Ethical issues in using humans samples
	SLO-2	Nervous system in squid and early evidences	Life cycle and environmental toxin researches	Animal models for Alzheimer's and Huntington disease	Non invasive drug administration	Ethical issues in using experiments animals
S-8	SLO-1	Classical animal models used – cats	Non vertebrate insect models – Drosophila and C. elegans	Animal models for Parkinson and multiple sclerosis.	Skin adsorption	Computer science – simulations and animal models
	SLO-2	Visuals tracks in cats and early evidences	Life cycle of C. elegans and research	Animal models for Mood disorders	Selecting appropriate drug administration route	Heart diseases and simulation
S-9	SLO-1	Classical animal models – primates	Life cycle of Drosophila as evolution models	Animal disorder for mania	Understand route of exposure in toxicity cases	Computational models
	SLO-2	Behavioral assays in primates.	Drosophila genetics	Animal disorder for stress coping and resilience.	Human-animal equivalent dose calculation and problems	Computational models to repalce animal cognition

Learning Resources	1. Hau J, Van Hoosier GL Jr, Handbook of Laboratory Animal Science, Volume I: Essential Principles and Practices" 2 <sup>nd</sup> ed., CRC Press: Boca Raton, FL, 2003	2. Micheal Conn P, Animal Models for the Study of Human Disease, 2 <sup>nd</sup> ed., Academic Press, 2017 3. Jerome Y Yager, Animal Models of Neuro-developmental Disorders, Human Press, 2015
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Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#		Theory	Practice
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice		
Level 1	Remember	40 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Understand										
Level 2	Apply	40 %	-	40 %	-	40 %	-	40 %	-	40%	-
	Analyze										
Level 3	Evaluate	20 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

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Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Dr. C. N. Ramchand, Saksin Life sciences Pvt Ltd, Chennai, ramchand@saksinlife.com	1. Prof. K Subramaniam, IITM, Chennai, subbu@iitm.ac.in	1. Dr. S. Sahabudeen, SRMIST
2. Dr. Karthik Periyasamy, Aurobindo Pharma Limited, Hyderabad, karthikmpk@gmail.com	2. Prof. R. B. Narayanan, SVCE, Chennai, rbn@svce.ac.in	2. Dr.R.A. Nazeer, SRMIST

Course Code	18BTO106T	Course Name	WASTE TO WEALTH TO WHEELS	Course Category	O	Open Elective	L	T	P	C
							3	0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Biotechnology		Data Book / Codes/Standards	Nil	

Course Learning Rationale (CLR):	The purpose of learning this course is to:			Learning			Program Learning Outcomes (PLO)																																		
CLR-1 :	Identify the applications of engineering concepts for sustainable waste management			1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15																				
CLR-2 :	Identify the applications of energy conversion technology			Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3																				
CLR-3 :	Identify the significance of eco-friendly process																					H	M	M	H	M	M	H	H	H	H	M	H	M	H	M	H	H			
CLR-4 :	Create insights to the concepts of zero-waste process																					H	M	M	H	M	M	H	H	H	H	M	H	M	H	M	H	H			
CLR-5 :	Analyze the important fuel properties of wastes and biomass																					H	M	M	H	M	M	H	H	H	H	M	H	M	H	M	H	H			
CLR-6 :	Utilize the concepts basic engineering calculations (mass and heat balances) for biomass based energy systems																					H	M	M	H	M	M	H	H	H	H	M	H	M	H	M	H	H			
Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:																					1	80	70	H	M	M	M	H	H	H	H	M	H	M	H	M	H			
CLO-1 :	Formulate the methodology for waste segregation based on international policy			2	85	75	H	M	M	M	H	H	H	M	L	H	M	H	M	H																					
CLO-2 :	Analyze calorific parameters of wastes and biomass			2	75	70	H	H	M	M	H	H	H	H	M	H	H	H	M	H																					
CLO-3 :	Apply thermo-chemical conversion process for waste to energy conversion			2	85	80	H	H	M	M	H	H	H	H	M	H	H	H	H	H																					
CLO-4 :	Apply bioprocessing techniques to convert waste to biofuel and value added chemicals			2	85	75	H	H	M	M	H	H	H	M	H	M	H	H	H	H																					
CLO-5 :	Identify the applications of mass and energy balance for making commercially viable Waste to wealth process			1	80	70	H	M	M	M	H	H	H	H	M	H	M	H	H	M																					
CLO-6 :	Describe the National policy towards biofuel production and Energy security						H	M	M	M	H	H	H	M	H	M	H	H	M	H																					

Duration (hour)	9		9		9		9		9	
S-1	SLO-1	Sources of industrial wastes	Thermal processing of wastes: Combustion, Co-generation/co-firing	Catalytic depolymerization of biomass-derived oxygenated feedstocks	Treatment based on aerobic and anaerobic waste bioprocessing	Energy content estimation of wastes and products by bomb (solid and liquid)(ASTM)				
	SLO-2	Sources of agro and MSW wastes	Pyrolysis and torrefecation	Biosynthetic pathway for lignin synthesis	Vermi-composting of solid wastes for bio-fertilizer; Vermi-wash	For gaseous fuel (ASTM)				
S-2	SLO-1	Impact of wastes on biodiversity	Hydrolysis and plasma treatment for waste to energy conversion	Hydrolysis of cellulose from lignocellulosic wastes over novel solid acids	Production of hydrocarbons (bioalkanes) from lignocelluloses	Process calculations for energy and mass balance of waste and by product recovery				
	SLO-2	Effect on food chain/food web	Catalytic conversion process	Inhibitory compounds of lignin degradation that impedes bioprocessing	Quality comparison between conventional and bio-based chemicals	Software hands on training for mass and energy balance				
S-3	SLO-1	Waste segregation methodologies	Syngas production	Synthesis of polyols by hydrogenation / hydrogenolysis of cellulose and sugar	Production of biodiesel (Oil seeds/Algae)	Case : non-conventional transportation fuels and their manufacturers obtained by processing of wastes				
	SLO-2	Hazardous and non-hazardous wastes	Flue gas filters and value addition from particulate matter	Role of green solvents and ionic liquids in fuel production	Whole crop biorefinery approach	Municipal leachate processing and value product development				
S-4	SLO-1	Recalcitrant and non-recalcitrant wastes	Waste heat recovery	Hybrid energy system using biological routes	Oleaginous organisms (Fungi and yeast)	Management of post-energy recovery residues (bottom ash, fly ash, digestate)				
	SLO-2	Xenobiotics and Rationale for bioprocessing	Hydrothermal electricity production	Clean coal technologies bioleaching and biosorption	Enzymatic transesterification Vs. Chemical methods	Bioenergy-Biochar energy cycle				

S-5	SLO-1	Waste characterization	Bio refinery demonstration projects on ethanol	Unified oils and biodiesel from oil seeds and algae by chemical catalysis	Biobutanol, ABE synthesis, bioalkanes	R& D scope in WWW Gas to liquids (GTL) technology
	SLO-2	Calorific value estimation: Bomb and Junker's calorimeter	Case study on India's potential on second generation bioethanol	Case study on India's potential on second generation biodiesel from Jatropha	Biopolymers and plastics (PHA, PHB and PLA)	CO <sub>2</sub> sequestration by biological modes
S-6	SLO-1	Point source collection and non-point source wastes collection	Distillation technology for bioethanol	Fischer-Tropsch process – Gas to liquid fuels	Gaseous fuels: Biomethane	Landfill fill emission control
	SLO-2	Role of smart dustbins	Adsorption technology for ethanol fractionation	Comparison of fuel quality standards from FT and fossil fuel	Energy conversion strategies from biogas	Land fill and flue gas recovery for its commercial application
S-7	SLO-1	Energy crops – Terrestrial	Bio refinery demonstration projects on Biodiesel	3 <sup>rd</sup> generation biofuel: For transportation	Biohydrogen and Gas to liquid fuel technologies	Current and Emerging Challenges to Renewable Energy Development
	SLO-2	Energy crops – Aquatic	Case study of implementation of Biodiesel project by Indian Railways	3 <sup>rd</sup> generation biofuel: For value added hydrocarbons	ABE biosynthesis (Acetone Butanol and Ethanol)	Government policies for energy security
S-8	SLO-1	Potential Benefits of Replacing Fossil Fuels with Biofuel, Biomass and Biogas	Transesterification and distillation	Genetically modified (GM) organisms for improved fuel production	Metabolic pathway engineering for ABE biosynthesis	Community Participation in Renewable Energy Development
	SLO-2	Implication of fossil fuel on National economy, environment and energy security	Refining technologies for biodiesel	GM bioenergy crops and its implication for developing countries	Aircraft liquid biofuel from biomass feedstocks	Contract farming strategy for non-edible feedstock production
S-9	SLO-1	Political Drivers for Biofuel Development	By product processing of biodiesel production	Algal based technologies for biofuel and value added chemical preparation	Bio-alkanes and alkenes from waste biomass to be used as jet engines fuels	Combined industrial waste treatment for energy recovery
	SLO-2	Activities of MNRE, Government of India and International Energy Agency	Conversion of de-oiled cake into value added products	GM algae and its regulatory issues	New energy research Projects pertaining to transportation fuels in Global context	Urban and rural integration system for sustainable waste utilization for value added product generation

Learning Resources	<ol style="list-style-type: none"> <li>David M. Mousdale, <i>Biofuels: Biotechnology, Chemistry, and Sustainable Development</i>, CRC Press, 2008</li> <li>Roland A. Jansen, <i>Second Generation Biofuels and Biomass</i>, Wiley, 2013</li> </ol>	<ol style="list-style-type: none"> <li>A.H.Scragg, <i>Biofuels, Production, Application and Development</i>, CAB International, 2009</li> <li>Robert C. Brown, Tristan R. Brown, <i>Biorenewable Resources: Engineering New Products from Agriculture</i>, 2<sup>nd</sup> ed., Wiley, 2014</li> </ol>
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Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#		Theory	Practice
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice		
Level 1	Remember Understand	40 %	-	30 %	-	30 %	-	30 %	-	30%	-
Level 2	Apply Analyze	40 %	-	40 %	-	40 %	-	40 %	-	40%	-
Level 3	Evaluate Create	20 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Total	100 %		100 %		100 %		100 %		100 %	

# CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Dr. C. N. Ramchand, Saksin Life sciences Pvt Ltd, Chennai, ramchand@saksinlife.com	1. Prof. K Subramaniam, IITM, Chennai, subbu@iitm.ac.in	1. Dr. Samuel Jacob, SRMIST
2. Dr. Karthik Periyasamy, Aurobindo Pharma Limited, Hyderabad, karthikmpk@gmail.com	2. Prof. R. B. Narayanan, SVCE, Chennai, rbn@svce.ac.in	2. Dr. K.Ramani, SRMIST

Course Code	18BTO107T	Course Name	FUNDAMENTAL NEUROBIOLOGY	Course Category	O	Open Elective	L	T	P	C
							3	0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Biotechnology	Data Book / Codes/Standards	Nil		

Course Learning Rationale (CLR):	The purpose of learning this course is to:			Learning			Program Learning Outcomes (PLO)														
CLR-1 :	Recall the brain function from its organization			1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CLR-2 :	Discuss Molecular signaling in neurons			Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3
CLR-3 :	Compare Neural basis of senses																				
CLR-4 :	Explain different methods for studying neuro-immune functions																				
CLR-5 :	Analyze genetic variations in brain development																				
CLR-6 :	Analyze genetic variation and inheritance pertaining to nervous system disorders																				
Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:																				
CLO-1 :	Describe the fundamental organization of brain and its functions			2	85	75	M	H	H	M	-	-	M	H	L	H	H	L	H	H	
CLO-2 :	Explain the concepts and experiments in the neurotransmitters			2	75	80	M	H	M	H	M	M	-	M	H	H	H	L	H	H	
CLO-3 :	Recognize the pattern of brain energy metabolism			2	85	80	L	H	H	H	-	-	H	L	L	H	H	M	H	H	
CLO-4 :	Discuss the different methods in the neuroendocrine and immune interactions			3	85	75	L	H	H	M	-	M	H	H	L	H	H	H	H	H	
CLO-5 :	Analyze the role of genes in brain development and functions			2	80	80	M	H	H	H	L	H	M	M	H	H	H	H	H	H	
CLO-6 :	Explain the concepts of nervous system disorder and the diseases associated with it																				

Duration (hour)	9		9		9		9		9	
S-1	SLO-1	Basics of Neurobiology	Membrane potential	Brain energy metabolism at the cellular level	Nature of central systems	Disorders of the nervous system				
	SLO-2	Understanding brain function	Action potential	Sensory systems	Survey methods	Developmental disorder:				
S-2	SLO-1	Orientation of Central nervous system	Resting potential	Receptors to perceptions	Neuroendocrine circuits	Autism, Dyslexia, ADHD				
	SLO-2	Peripheral nervous system	Electrochemical basis of nerve function	Chemical and somatic senses	Functions of neuroendocrine system	Mental Disorder				
S-3	SLO-1	Levels of Neural organization	Electrical and Thermodynamic Forces in Passive Distribution of Ions	Molecular and neural basis of visual perception	Neuroendocrine tumors	Schizophrenia				
	SLO-2	Concept of functional units	Hyperpolarization or Depolarization	Organization of autonomic nervous system and functions	Global epidemiology of neuroendocrine tumors	Degenerative disorders				
S-4	SLO-1	Cellular basis of Neurobiology	Chemical basis for neuronal communication	Nature of motor system and its functions	Neuro-immune circuits	Alzheimer's disease				
	SLO-2	Clinical issues in neurobiology	Ion pumps and Ion gradients	Reflexes and fixed motor responses	Neuro-immune functions	Parkinson's disease				
S-5	SLO-1	Neuron terminology	Ion channels	Locomotion	Neuroendocrine-immune interactions in neurological disorders	Psychiatric disorder				



	SLO-2	Cell biology of neurons and glia	Hyperpolarization-Activated Ionic Currents	Food intake and metabolism	Neuroendocrine-immune interactions in autoimmune diseases	Depression and anxiety
S-6	SLO-1	Differentiation of axon and dendrite	Neurotransmitters	Water intake and body fluids	Developmental genetics of the brain.	Vascular disorders
	SLO-2	Structural neuroscience methods: A brief history	Neuropeptides	Sleep, dreaming and wakefulness	Genes for human brain development	Stroke
S-7	SLO-1	Sensorimotor, autonomic and enteric divisions	Receptors of neurotransmitters	Reward and motivation	Genes in neurological disorders.	Other disorders
	SLO-2	Synapses and spines	Non-classical neurotransmitters	Emotion and addiction	Epigenetics of the brain.	Epilepsy
S-8	SLO-1	Inhibitory circuit neurons	Synthesis of neurotransmitters and neuropeptides	Cognitive development and aging	Epigenetics in brain disorders	Drug addiction
	SLO-2	Inhibitory projection neurons	Release and metabolism of neurotransmitters	Cognitive impairment	Role of Environmental factors in neurodevelopment.	Neural Plasticity, Goat Brain Dissection
S-9	SLO-1	Excitatory neurons	Molecular mechanisms nerve terminal	Learning and memory	Exposure of lead and methyl mercury in neurodevelopmental disorders.	Understanding brain by Artificial Intelligence
	SLO-2	Neuroglia and glial sheaths	Molecular signaling in neurons	Language, communication and consciousness	Neurotoxins	Neural network for analyzing brains network

Learning Resources	1. Larry Squire, Darwin Berg, Floyd E. Bloom, Sascha du Lac, Anirvan Ghosh, Nicholas C. Spitzer, <i>Fundamental Neuroscience, 4th ed., Academic Press, 2012</i>	2. Michael Aschner, Lucio G. Costa, <i>Environmental factors in Neurodevelopmental and neurodegenerative disorders, Academic Press, 2015</i>
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Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#		Theory	Practice
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice		
Level 1	Remember	40 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Understand										
Level 2	Apply	40 %	-	40 %	-	40 %	-	40 %	-	40%	-
	Analyze										
Level 3	Evaluate	20 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

# CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Dr. C. N. Ramchand, Saksin Life sciences Pvt Ltd, Chennai, ramchand@saksinlife.com	1. Prof. K Subramaniam, IITM, Chennai, subbu@iitm.ac.in	1. Dr. S. ThyagaRajan, SRMIST
2. Dr. Karthik Periyasamy, Aurobindo Pharma Limited, Hyderabad, karthikmpk@gmail.com	2. Prof. R. B. Narayanan, SVCE, Chennai, rbn@svce.ac.in	2. Dr. R. VasanthaRekha, SRMIST

Course Code	18ECO106J	Course Name	PCB DESIGN AND MANUFACTURING			Course Category	O	Open Elective					L	T	P	C											
												2	0	2	3												
Pre-requisite Courses	Nil			Co-requisite Courses	Nil			Progressive Courses	Nil																		
Course Offering Department	Electronics and Communication			Data Book / Codes/Standards	Nil																						
Course Learning Rationale (CLR):	The purpose of learning this course is to:						Learning			Program Learning Outcomes (PLO)																	
CLR-1 :	Explore the terminologies of PCB design and Electronic components						1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15			
CLR-2 :	Design consideration involved in PCB design						Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3			
CLR-3 :	Utilize the PCB design consideration for special application circuits									H	-	-	L	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLR-4 :	Design a PCB layout using CAD tool									M	-	L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLR-5 :	Explore various PCB manufacturing techniques									M	-	-	L	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLR-6 :	Equip the learners to explore and understand PCB design technology, design constraints and manufacturing technique									L	-	-	-	H	-	-	-	-	-	-	-	-	-	-	-	-	-
Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:									1	80	70	H	-	L	L	H	-	-	-	-	-	-	-	-	-	-
CLO-1 :	Identify the various types of PCB and electronics components packaging						2	80	70	M	-	-	-	-	-	-	-	-	-	-	-	-	-	-			
CLO-2 :	Select suitable design and consider appropriate parameters involved in PCB design						3	80	70	M	-	L	-	-	-	-	-	-	-	-	-	-	-	-			
CLO-3 :	Apply the appropriate design rules in designing PCB for special application circuits						2	80	70	M	-	-	L	-	-	-	-	-	-	-	-	-	-	-			
CLO-4 :	Design and develop a PCB layout using CAD tool						3	80	70	M	-	-	M	H	-	-	-	-	-	-	-	-	-	-			
CLO-5 :	Identify and select the required PCB manufacturing technology						3	80	70	L	-	-	-	H	-	-	-	-	-	-	-	-	-	-			
CLO-6 :	Develop PCB layout using PCB design CAD (Computer Aided Design) tool and proficiency in PCB fabrication						1	80	70	H	-	L	L	H	-	-	-	-	-	-	-	-	-	-			
Duration (hour)	12		12		12		12		12																		
S-1	SLO-1	Nomenclature of a Printed Circuit Board	PCB Design Considerations - Important Design Elements	Design Rules for Analog Circuits	Schematic Capture - Introduction schematic capture tool	Image Transfer Techniques- Screen Printing, Pattern Transferring Techniques																					
	SLO-2	Classification of Printed Circuit Boards	PCB Design Considerations - Important Performance Parameters	Design Rules for Analog Circuits																							
S-2	SLO-1	Manufacturing of basic PCB - Single-and Double-sided Plated Through-holes	PCB Design Considerations - Mechanical Design Considerations	Design Rules for Digital Circuits	Schematic Capture - Simulation of simple electronic circuit	Image Transfer Techniques- Printing Inks, Photo Printing, Laser Direct Imaging (LDI)																					
	SLO-2	Manufacturing of Multi-Layer Boards - Flexible Boards, Challenges in modern PCB Design and Manufacture, Standards	PCB Design Considerations - Mechanical Design Considerations	Design Rules for Digital Circuits	Schematic Capture - Schematic to layout transfer	Copper Clad Laminates - Properties of Laminates, Types of Laminates, Evaluation of Laminates																					
S-3-4	SLO-1	Study of electronic components- Passive electronic components	Design and analysis of RL and RC time constants. Schematic in CAD tool	Schematic and PCB Layout in CAD tool. Regulated power supply design. - Full wave rectifier circuit design with fixed voltage regulator	PCB Layout Design of single digit pulse counter using PCB design tool.	Mini Project - PCB Layout Design of electronic turn ON/OFF timer using IC555 using PCB design tool.																					
	SLO-2																										
S-5	SLO-1	Types, Symbols, Packaging shapes and terminal details of Electronic Components -Resistors, Thermistors Capacitors, Inductors	PCB Design Considerations - Electrical Design Considerations	Design Rules for High Frequency Circuits	PCB Layout Design - Conception Level Introduction	Etching Techniques – wet Etching chemicals																					
	SLO-2	Diodes, Light Emitting Diodes (LED), Photodiode,	PCB Design Considerations - Conductor Patterns	Design Rules for Fast Pulse Circuits	PCB Layout Design - Specifying Parts, Packages and Pin Names, Libraries	Etching Techniques - Mechanical Etching																					

S-6	SLO-1	Transistors, Field-effect Transistors, Insulated Gate Bipolar Transistor (IGBT), Thyristor	Component Placement Rules	Design Rules for Microwave Circuits	PCB Layout Design - Checking foot prints of the components, Part list, Net list, Making Net list Files	PCB Assembly Process
	SLO-2	Integrated Circuits (ICs), Three-terminal Voltage Regulator	Fabrication and Assembly Considerations	Design Rules for Microwave Circuits	PCB Layout Design – Placing Parts, Routing Traces, Modifying Traces	Through-hole
S 7-8	SLO-1	Study of electronic components- active devices, analog and digital integrated circuits (IC)	Design and analysis of RLC circuits. Schematic in CAD tool	Schematic and PCB Layout in CAD tool. Regulated power supply design. -Full wave rectifier circuit design with fixed voltage regulator	PCB Design of single digit pulse counter: Schematic and PCB layout using PCB design tool.	Mini Project - Manufacture the PCB for electronic turn ON/OFF timer using IC555and construct and test the designed circuit.
	SLO-2					
S-9	SLO-1	Digital Integrated Circuits, Random Access Memory	Environmental Factors	Design Rules for High-density Interconnection Structures	PCB Layout Design - Mounting Holes	PCB Assembly Process
	SLO-2	Read Only Memory	Cooling Requirements	Design Rules for High-density Interconnection Structures	Adding Text, PCB Layout	Surface Mount, Mixed Technologies
S-10	SLO-1	Microcontrollers, Surface Mount Devices	Packaging Density	Electromagnetic Interference (EMI)	PCB Layout Design - DRC,	PCB Assembly Process
	SLO-2	Transformer, Relays, Connectors	Layout Design	Electromagnetic Compatibility (EMC)	Pattern Transfer, Layout printing	Soldering
S 11-12	SLO-1	Study of testing and measuring Instruments: Logic analyzer, spectrum analyzer, IC tester (Analog and Digital), LCR meters	PCB Layout Design - of RL, RC and RLC circuits	Schematic and PCB Layout in CAD tool. Regulated power supply design. Full wave rectifier circuit design with fixed voltage regulator	Mini Project - PCB Layout Design of electronic turn ON/OFF timer using IC555 using PCB design tool.	Mini Project - Manufacture the PCB for electronic turn ON/OFF timer using IC555and construct and test the designed circuit.
	SLO-2					

Learning Resources	1. Raghubir Singh Khandpur, Printed Circuit Boards: Design, Fabrication, and Assembly, McGraw-Hill Electronic Engineering, 2006	5. Douglas Brooks, Signal Integrity Issues and Printed Circuit Board Design, Prentice Hall PTR, 2003
	2. Charles A. Harpe, High Performance Printed Circuit Boards, McGraw Hill Professional, 2000	6. Mark I. Montrose, Printed Circuit Board Design Techniques for EMC Compliance: A handbook for designers, 2 <sup>nd</sup> ed., Wiley, 2015
	3. Bruce R. Archambeault, James Drewniak, PCB Design for Real-World EMI Control, Volume 696 of The Springer International Series in Engineering and Computer Science, Springer Science & Business Media, 2013	7. Esim open source tool: <a href="http://esim.fossee.in/">http://esim.fossee.in/</a>
	4. Kraig Mitzner, Complete PCB Design Using OrCAD Capture and PCB Editor, Newnes / Elsevier, 2009	8. TINA/OrCAD User manual

Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#		Theory	Practice
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice		
Level 1	Remember	20%	20%	15%	15%	15%	15%	15%	15%	15%	15%
	Understand										
Level 2	Apply	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%
	Analyze										
Level 3	Evaluate	10%	10%	15%	15%	15%	15%	15%	15%	15%	15%
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

# CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Mr. Anuj Kumar, Bombardier Transportation, Ahmedabad, kumaranj.anii@gmail.com	1. Dr. Meenakshi, Professor of ECE, CEG, Anna University, meena68@annauniv.edu	1. Dr. P. Eswaran, SRMIST
2. Mr. Hariharasudhan - Johnson Controls, Pune, hariharasudhan.v@jci.com	2. Dr. Venkatesan, Sr. Scientist, NIOT, Chennai, venkat@niot.res.in	2. Dr. D. Malathi, SRMIST

Course Code	18ECO108J	Course Name	EMBEDDED SYSTEM DESIGN USING ARDUINO	Course Category	O	Open Elective	L	T	P	C
							2	0	2	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Electronics and Communication		Data Book / Codes/Standards	Nil	

Course Learning Rationale (CLR):	The purpose of learning this course is to:			Learning			Program Learning Outcomes (PLO)																			
CLR-1 :	Get to know about ARDUINO hardware details and environment			1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15					
CLR-2 :	To understand the core elements of ARDUINO programming language			Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge																			
CLR-3 :	Create insights to the concepts of serial communication						Problem Analysis																			
CLR-4 :	To use common input and output devices						Design & Development																			
CLR-5 :	Apply the ARDUINO programming into real time applications						Analysis, Design, Research																			
CLR-6 :	Apply the ARDUINO programming into real time applications						Modern Tool Usage																			
							Society & Culture																			
				Environment & Sustainability																						
				Ethics																						
				Individual & Team Work																						
				Communication																						
				Project Mgt. & Finance																						
				Life Long Learning																						
				PSO - 1																						
				PSO - 2																						
				PSO - 3																						

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:			2	80	70	H																
CLO-1 :	Analyze the programming skill			2	85	75	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H
CLO-2 :	Apply the real time data's into digital			2	75	70	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H
CLO-3 :	Interact with almost many devices			2	75	70	H		H	H	H	H	H	H	H	H	H	H	H	H	H	H	H
CLO-4 :	Learn techniques to handle timer delays and IO devices			2	85	80	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H
CLO-5 :	Use and modifying the existing libraries			2	85	75	H		H	H	H	H	H	H	H	H	H	H	H	H	H	H	H
CLO-6 :	Use and modifying the existing libraries			2	85	80	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H

Duration (hour)	12		12		12		12		12	
S-1	SLO-1	Introduction to arduino platform	Introduction to Arduino C	Analog and Serial Communication	IO Programming	Case Studies				
	SLO-2	Block diagram	Arduino C Data Types	Introduction to Analog Communication	Introduction to Timer/Counters	Wireless Communication Using Zigbee				
S-2	SLO-1	AT mega 328p architecture	Decision Making in C	Pulse Width Modulation	Introduction to Timer/Counters	Bluetooth				
	SLO-2	AT mega 328p architecture	Decision Making in C	RS232	Timer programming	Robotics -Motor and Sensor				
S-3-4	SLO-1	Lab 1 Getting Started with Adriano	Lab 4 -Sensor Interfacing for Temperature Monitoring	Lab 7: Actuators – Stepper Motor	Lab10: Interrupt Programming	Lab 13: Mini Project				
	SLO-2	CCS and AVR Studio 7 Blinking Led	Lab 4 -Sensor Interfacing for Displacement Measurement	Lab 7: Actuators – Stepper Motor	Lab10: Interrupt Programming	Lab 13: Mini Project				
S-5	SLO-1	Pin function	Program Loops in C	I2C	Timer programming	Security-RFID, Infrared				
	SLO-2	Overview of main features-I/O ports	Functions in C	I2C	Timer programming	Security-RFID, Infrared				
S-6	SLO-1	Features-timers,interrupts	Introduction to Pointers	I2C	Timer programming	Bio medical application				
	SLO-2	Features-timers,interrupts	Introduction to Pointers	I2C	Timer programming	Bio medical application				

S 7-8	SLO-1	Lab 2 GPIO LED	Lab 5: PWM BASED SERVO MOTOR INTERFACING	Lab 8: DC MOTOR	Lab11: Watch Dog Timer	Lab14: Model Practical
	SLO-2	Switch Based Led Control	Lab 5: PWM Based Servo Motor Interfacing	Lab 8: DC MOTOR	Lab11: Watch Dog Timer	Lab14: Model Practical
S-9	SLO-1	Features-PWM,SERIAL PORT	Using Pointers Effectively	SPI Protocol	Interrupts	Bio medical application
	SLO-2	Features-ADC	Structures, Unions, and Data Storage	SPI Protocol	Interrupt programming	Bio medical application
S-10	SLO-1	Introduction to Arduino IDE	Arduino Libraries	Interfacing with sensors	External interrupt	GPS Navigation
	SLO-2	Writing ,saving,compiling with IDE.	Arduino Libraries	Interfacing with sensors	External interrupt	GPS Navigation
S 11-12	SLO-1	Lab 3: DISPLAY INTERFACE-7 SEGMENT	Lab 6: SERIAL COMMUNICATION	Lab 9: Repeat/Revision of Experiments	Lab 12 : I2C	Lab:15 University Practical
	SLO-2	LCD 16x2 Matrix	Lab 6: Serial Communication	Lab 9: Repeat/Revision of Experiments	Lab 12: I2C	Lab:15 University Practical

Learning Resources	<ol style="list-style-type: none"> <li>1. Michael-Margolis,Arduino-Cookbook., Revised edition, O'Reilly,1<sup>st</sup> edition, 2011</li> <li>2. D.Dale.Wheat, Arduino.Internals, TIA publication, 5th edition, 2011</li> </ol>	<ol style="list-style-type: none"> <li>3. James M. Fiore, Embedded Controllers Using C and Arduino, ARDUINO open source community, 2018</li> <li>4. Jack Purdum ,Beginning C for Arduino , Apress, 2012</li> </ol>
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Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#		Theory	Practice
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice		
Level 1	Remember Understand	20%	20%	15%	15%	15%	15%	15%	15%	15%	15%
Level 2	Apply Analyze	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%
Level 3	Evaluate Create	10%	10%	15%	15%	15%	15%	15%	15%	15%	15%
	Total	100 %		100 %		100 %		100 %		100 %	

# CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Mr. Anuj Kumar, Bombardier Transportation, Ahmedabad, kumaranj.anii@gmail.com	1. Dr. Meenakshi, Professor of ECE, CEG, Anna University, meena68@annauniv.edu	1.Mrs. S. Suhasini,, SRM IST
2. Mr. Hariharasudhan - Johnson Controls, Pune, hariharasudhan.v@jci.com	2. Dr. Venkatesan, Sr. Scientist, NIOT, Chennai, venkat@niot.res.in	

Course Code	18ECO121T	Course Name	BASIC BIOMEDICAL ENGINEERING	Course Category	O	Open Elective	L	T	P	C
							3	0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Electronics and Communication		Data Book / Codes/Standards	Nil	

Course Learning Rationale (CLR):	The purpose of learning this course is to:			Learning			Program Learning Outcomes (PLO)																																	
CLR-1 :	Analyze the scopes and roles of Biomedical Engineering			1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15																			
CLR-2 :	Utilize biomedical instrumentation modules			Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3																			
CLR-3 :	Utilize medical imaging principles and its applications																					-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
CLR-4 :	Analyze the scope of biomechanics and its applications																					L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	L
CLR-5 :	Utilize biomaterials and its applications																					M	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLR-6 :	Gain the knowledge about Biomedical Engineering																					L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:																																							
CLO-1 :	Analyze the areas in which biomedical engineers can work			2	85	75	-	-	-	-	-	-	-	-	-	-	-	L	-	-	-	L																		
CLO-2 :	Analyze the basic biomedical instrumentation unit			3	85	75	L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	L																		
CLO-3 :	Analyze basic medical imaging principles			3	85	75	M	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-																		
CLO-4 :	Apply the concepts of biomechanics on human body			3	85	75	L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	L																		
CLO-5 :	Identify domains where biomedical engineers can work			3	85	75	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-																		
CLO-6 :	Analyze the applications of Biomedical Engineer			3	85	75	M	-	-	-	-	-	-	-	-	-	-	L	-	-	-	L																		

		Introduction to Biomedical Engineering	Biomedical Instrumentation	Medical Imaging system	Biomechanics	Biomaterials
Duration (hour)		9	9	9	9	9
S-1	SLO-1	Evolution of the modern health care system	Introduction: Bioinstrumentation	X-Ray production	Introduction: Principal Areas of Biomechanics	Biomaterials Introduction
	SLO-2	Modern Healthcare system	Basic Bioinstrumentation System	X-Ray Imaging principle	Fundamentals of biomechanics and qualitative analysis	Classification of Biomaterials
S-2	SLO-1	What is Biomedical Engineering	Physiological Systems of the body	Application of X-ray imaging	Kinematics of Human Body Models	Properties of Biomaterials: Mechanical
	SLO-2	Roles played by the Biomedical Engineers	Sources of Biomedical Signals	CT-Imaging principle	Kinetics of Human Body Models	Properties of Biomaterials: Chemical
S-3	SLO-1	Types of Biomedical Engineering	Origin of Bioelectric Signals	CT-Imaging Applications	Modelling of Bio systems	Properties of Biomaterials: Biological
	SLO-2	Surgical instruments and medical devices	Origin of Bioelectric Signals	MRI- Introduction	Tissue Biomechanics	Biomedical alloys and its medical applications- titanium
S-4	SLO-1	Biomaterials	Various Electrodes used for picking the biomedical signals	MRI Imaging principles	Modelling in Cellular Biomechanics	Biomedical alloys and its applications- Stainless steel, Cobalt-Chromium alloys
	SLO-2	Biomechanics	Various Electrodes used for picking the biomedical signals	MRI Imaging principles	Fluid mechanics	Introduction to ceramics
S-5	SLO-1	Tissue Engineering	ECG Introduction	MRI Imaging Applications	Mechanics of the musculoskeletal system impact	Alumina, Zirconia

	SLO-2	Neural Engineering	ECG system Block diagram and its uses	Ultrasound basics	Mechanics of Blood Vessels	Titanium, Hydroxyapatite
S-6	SLO-1	Telehealth	EEG Introduction	Ultrasound Imaging	Cardiac Biomechanics	Glass ceramics
	SLO-2	Bio signal processing	EEG system Block diagram and its uses	Ultrasound Application	Biomechanics of Chest and Abdomen	Introduction to polymers
S-7	SLO-1	Medical Imaging	EMG Introduction	fMRI Imaging	Cochlear Mechanics	Types of polymers
	SLO-2	Computational modelling	EMG system Block diagram and its uses	fMRI Imaging Application	Dynamics of Human Body Models	Biodegradable polymers and its applications
S-8	SLO-1	BioMEMS	Cardiac pacemakers and its uses	PET- Imaging	Gait analysis	Composites and its applications
	SLO-2	Mobile POCT	Cardiac Defibrillators and its uses	PET Imaging Application	Biomechanics in physical education	Wound-Healing process
S-9	SLO-1	Professional Status of Biomedical Engineering	Patient Monitoring System Introduction	SPECT Imaging	Biomechanics in strength and conditioning	Biomaterials for artificial valve, Ear
	SLO-2	Professional Societies	Patient Monitoring System Block diagram and its uses	SPECT Imaging Application	Biomechanics in sports medicine and rehabilitation	Biomaterials for artificial Skin, Eye

Learning Resources	1. Anthony Y. K. Chan, <i>Biomedical Device Technology: Principles and Design</i> , Charles C Thomas publisher, 2008	4. John Enderle, Joseph Bronzino, <i>Introduction to Biomedical Engineering</i> , Academic Press, 2011
	2. R.S Khandpur, <i>Handbook of Biomedical Instrumentation</i> , 3 <sup>rd</sup> ed., McGraw Hill, 2014	
	3. Joseph J. Carr, John M. Brown, <i>Introduction to Biomedical Equipment Technology</i> , 4 <sup>th</sup> ed., Pearson, 2002	6. Sujata V. Bhat, <i>Biomaterials</i> , 2 <sup>nd</sup> ed., Alpha Science International, 2005

Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#		Theory	Practice
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice		
Level 1	Remember	40 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Understand										
Level 2	Apply	40 %	-	40 %	-	40 %	-	40 %	-	40%	-
	Analyze										
Level 3	Evaluate	20 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

# CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Sathyanarayanan J, Mindray Medical India Pvt Ltd, sathyanarayananjayagopal@mindray.com	1. Dr. S. Poonguzhali, Anna University, poongs@annauniv.edu	1. Ms. Oinam Robita Chanu, SRMIST
2. Mr. Anuj Kumar, Bombardier Transportation, Ahmedabad, kumaranuj.aniii@gmail.com	2. Dr. Meenakshi, Professor of ECE, CEG, Anna University, meena68@annauniv.edu	2. Dr. D. Kathirvelu, SRMIST

Course Code	18ECO122T	Course Name	HOSPITAL INFORMATION SYSTEMS			Course Category	O	Open Elective							L	T	P	C										
Pre-requisite Courses	Nil			Co-requisite Courses	Nil			Progressive Courses	Nil																			
Course Offering Department	Electronics and Communication			Data Book / Codes/Standards	Nil																							
Course Learning Rationale (CLR):	The purpose of learning this course is to:							Learning			Program Learning Outcomes (PLO)																	
CLR-1 :	Utilize the planning and organizational activities of Hospitals							1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15			
CLR-2 :	Analyze the concepts in clinical and diagnostic services							Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3			
CLR-3 :	Utilize the policies and procedures about support services and material management										M	-	-	-	-	M	-	-	-	-	-	-	-	-	L	-	-	
CLR-4 :	Utilize the features in staff and safety management in hospital										M	-	-	-	-	-	-	L	-	-	-	-	L	L	-	-	-	
CLR-5 :	Analyze the reporting system and recent advancement in hospital administration										L	-	-	-	-	M	-	L	L	-	-	-	-	L	L	L	-	
CLR-6 :	Apply all the advanced application the field of telemedicine										L	-	-	-	-	M	-	-	-	-	-	-	-	-	L	-	-	-
Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:																											
CLO-1 :	Analyze the role of hospitals and ensure proper healthcare delivery							2	85	75	L	-	-	-	-	M	-	-	-	-	-	-	L	-	-			
CLO-2 :	Suggest appropriate technologies and services in clinical and diagnostic field							3	85	75	M	-	-	-	-	-	-	-	-	-	-	-	L	-	-			
CLO-3 :	Analyze the supportive services and the use of proper material management							3	85	75	M	-	-	-	-	-	M	L	-	-	-	-	M	-	L			
CLO-4 :	Identify objectives of staff management and ensure safety management in hospitals							3	85	75	M	-	-	-	-	-	-	L	-	-	-	L	L	-	-			
CLO-5 :	Implement the advance technologies and effectively evaluate the healthcare information							3	85	75	L	-	-	-	-	M	-	L	L	-	-	-	L	L	L			
CLO-6 :	Implement the various standards in hospital and healthcare services							3	85	75	L	-	-	-	-	M	-	-	-	-	-	-	L	-	-			
	Planning and designing of hospitals			Inpatient and Outpatient services			Material management services			Management services in hospitals			Patient record and advancement in healthcare services															
Duration (hour)	9			9			9			9			9															
S-1	SLO-1	Hospital as a social system		Design and planning of emergency department			Pharmacy services- goals of hospital pharmacy services			Human resource management- Human resource development			Medical record management- Importance of medical record															
	SLO-2	Primary health care and hospitals		Health information and counselling			Staff organization and divisions of hospital pharmacy services			Hospital staff skill development			Methods of record keeping															
S-2	SLO-1	Hospital planning and design-Guiding principles in planning		Outpatient services –Types and functions of outpatient department			Benefits of formulary system			Nursing management-Functions of nursing management			Electronic medical record-Benefits and drawbacks															
	SLO-2	Regionalization of Hospital service		Physical features of outpatient department			Other services of hospital pharmacy			Nursing management- organizational structure			Record retention and disposal															
S-3	SLO-1	Role of health promotion approach in hospitals		Ward/Indoor services-Components of the ward system			Transport services-Types of ambulance			Biomedical waste management- Types and Composition of Biomedical Waste			Office management -skills required by the office staff															
	SLO-2	Health promoting hospital system		Design of special units			Communication and physical facilities of ambulance service			Categories of biomedical waste			Functions of office management															
S-4	SLO-1	Healthy hospital environment		Operation theatre services-Planning and designing of Operation theatres			Staff transport services			Concept of total quality management			Operations research in hospitals-Phases of operation research															
	SLO-2	Components of healthy hospital environment		Types of Operation theatres			Other transport services in hospitals			Types of approaches in quality management			Operations research in hospitals- Tools and techniques of operations research															
S-5	SLO-1	Creating manpower services		Policies and procedures of operation theatres			Medicolegal services- Steps for Medicolegal Examination			Quality assessment and management tools			Emerging health insurance – components of health insurance															



	SLO-2	Hospital engineering: Key to efficient healthcare services	Assessing operation theatre utilisation	Problems faced by healthcare professionals in medicolegal service	Clinical audit	Emerging health insurance-Types of health insurance
S-6	SLO-1	Designing disabled friendly hospitals- Barriers faced and implications in Persons with disabilities	Clinical laboratory services-Introduction and role of laboratory medicine	Food safety in hospitals-Need of food safety	Quality improvement-Cause and effect method	Advantages and common problems of health insurance schemes
	SLO-2	Need for disabled-friendly health services	Testing procedure in clinical laboratory	Sources of food contamination	Pareto analysis	Role of health and hospital administrators in Health insurance
S-7	SLO-1	Barrier-Free Environment to Universal Design	Radio diagnosis and imaging services- Planning and equipments of radiology department	Materials management- Principles of material management	Failure mode and effect analysis	Telemedicine clinic –functions and classification of telemedicine
	SLO-2	Overcoming the barriers	Advancement in radiology service	Concepts of Inventory control	Triggers of quality improvement strategy in a hospital	Challenges for telemedicine
S-8	SLO-1	Energy conservation- Classification	Radiation oncology service-Radiotherapy facilities	Modern techniques for inventory control	Occupational safety-Roles and responsibilities	Growth of mobile phones and potential of mobile health
	SLO-2	Types of energy streams in hospitals	Nuclear medicine services-Categorization and nuclear medicine department	Integrated concept for materials management	Prevention of hazards specific to health sector	Mobile health and its applications
S-9	SLO-1	Need for energy conservation	Planning of nuclear medicine department	Purchase and procurement system- Essentials for procurement process	Hospital security-Physical security	Challenges in implementing information and Communication technology in healthcare
	SLO-2	Energy conservation opportunities in hospitals	Ancillary requirements	Purchase system	Organizational chart of security wing	Information and communication technology applications in healthcare

Learning Resources	<p>1. SonuGoel, Anil Kumar Gupta, Amarjeet Singh, Hospital administration A problem- solving approach, 1<sup>st</sup> ed., Elsevier, 2014</p> <p>2. Sakharkar B M, Principles of hospital administration and planning, 2<sup>nd</sup> ed., Jaypee Brothers Medical Publishers, 2009</p> <p>3. Kunders G D, Hospitals: Facilities planning and management, 1<sup>st</sup> ed., Tata Mcgraw Hill, 2008</p>
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Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#		Theory	Practice
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice		
Level 1	Remember Understand	40 %	-	30 %	-	30 %	-	30 %	-	30%	-
Level 2	Apply Analyze	40 %	-	40 %	-	40 %	-	40 %	-	40%	-
Level 3	Evaluate Create	20 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Total	100 %		100 %		100 %		100 %		100 %	

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2. Mr. Hariharasudhan - Johnson Controls, Pune, hariharasudhan.v@jci.com	2. Dr. Venkatesan, Sr. Scientist, NIOT, Chennai, venkat@niot.res.in	2. Mr. P. Muthu, SRMIST

Course Code	18ECO123T	Course Name	BIOMEDICAL IMAGING	Course Category	O	Open Elective	L	T	P	C
							3	0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Electronics and Communication		Data Book / Codes/Standards	Nil	

Course Learning Rationale (CLR):	The purpose of learning this course is to:			Learning			Program Learning Outcomes (PLO)														
CLR-1 :	Utilize the working principle of X-ray imaging			1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CLR-2 :	Analyze the principle behind tomographic imaging and the reconstruction techniques			Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3
CLR-3 :	Interpret the theory behind nuclear medicine and utilize the working of imaging modalities in nuclear medicine																				
CLR-4 :	Analyze the physics of ultrasound and the different imaging modes using ultrasound																				
CLR-5 :	Utilize the physical principle of nuclear magnetic resonance and magnetic resonance image reconstruction																				
CLR-6 :	Utilize imaging modalities X-ray, computed tomography, nuclear medicine, ultrasound and magnetic resonance imaging																				
Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:																				
CLO-1 :	Analyze the physics and principle behind the working of X-ray imaging			2	85	75	M	-	-	-	-	-	-	-	-	-	-	-	M	-	-
CLO-2 :	Identify the principle behind working of tomographic imaging and reconstruction procedures.			3	85	75	M	-	-	-	-	-	-	-	-	-	-	-	M	-	-
CLO-3 :	Analyze the working principle of nuclear medicine imaging modalities			3	85	75	M	-	-	-	-	-	-	-	-	-	-	-	M	-	-
CLO-4 :	Identify the physics of ultrasound and the modes of ultrasound imaging			3	85	75	M	-	-	-	-	-	-	-	-	-	-	-	M	-	-
CLO-5 :	Explain the physical principle of magnetic resonance imaging and the instrumental components involved in MR imaging			3	85	75	M	-	-	-	-	-	-	-	-	-	-	-	M	-	-
CLO-6 :	Understand the basic principle and working of medical Imaging systems			3	85	75	M	-	-	-	-	-	-	-	-	-	-	-	M	-	-

		X-ray	Computed Tomography	Ultrasound	Magnetic Resonance Imaging	Nuclear medicine
Duration (hour)		9	9	9	9	9
S-1	SLO-1	General principles of Imaging with X-rays	Introduction: Tomographic Imaging	Characteristics of sound: Propagation, wavelength, frequency and speed	Principles of NMR Imaging	Radionuclide decay terms and relationship
	SLO-2	X-ray Production –X-ray source	Comparison between tomographic and planar imaging	Pressure, Intensity and dB scale	Free Induction decay	Nuclear transformation
S-2	SLO-1	X-ray tube current, tube output	Basic principle: Technique of producing CT images	Interaction of ultrasound with matter: Acoustic impedance, reflection, refraction	Excitation, Emission	Radionuclide production
	SLO-2	Beam intensity, X-ray Energy Spectrum	Contrast scale	Scattering, Attenuation	Relaxation times-T1 & T2	Radiopharmaceuticals
S-3	SLO-1	Coherent and Compton scattering	System components: first generation, second generation, third generation,	Transducers: Piezoelectric materials, resonance transducers	Spin echo technique	Radiation detection and measurement: types of detectors, Gas-filled detectors
	SLO-2	Photoelectric effect	Fourth, fifth and spiral/helical CT	Damping block, matching layer, Resolution	Spin echo contrast weighting	Scintillation detectors
S-4	SLO-1	Linear and Mass attenuation coefficient of X-rays in tissue	X-ray source, types of detectors	Transducer arrays	T1 weighted image	Semiconductor detectors
	SLO-2	Instrumentation for Planar X-ray Imaging: Collimators	Gantry and slip ring technology, Collimation and filtration	Multi-element linear array scanners	T2 weighted image	Pulse height spectroscopy

S-5	SLO-1	Antiscatter grids Intensifying screens	Processing system	Multi-linear and phased array	Gradient recalled sequence	Non-imaging detector applications
	SLO-2	X-ray films	Iterative reconstruction, back projection reconstruction	Generation and detection of ultrasound	Proton density weighted images, pulse sequence for fast imaging	Counting statistics
S-6	SLO-1	Instrumentation for computed and digital radiography	Filtered back projection	Basic pulse echo apparatus: A-scan	Slice selection gradient	Nuclear imaging
	SLO-2	X-ray Image characteristics: Signal to Noise ratio	Helical /Spiral CT: Helical pitch	B-Mode	Frequency encode gradient	Anger scintillation camera
S-7	SLO-1	Spatial resolution, Contrast to Noise ratio	Basic reconstruction approaches	M-mode	Phase encode gradient	Basic principle :Emission computed tomography
	SLO-2	X-ray contrast agents, X-ray angiography	Slice sensitivity profile	Echocardiograph	2D spin echo data acquisition	Single photon emission computed tomography
S-8	SLO-1	X-ray Fluoroscopy	Multislice CT	Duplex scanner	Basic NMR components: Main magnet, RF transmitter/receiver	Positron emission tomography
	SLO-2	X-ray mammography	Detector configuration	Intravascular imaging	Body coils, gradient coils	Imaging techniques and scanner instrumentation
S-9	SLO-1	Dual energy Imaging	Measurement of X-ray dosage	Artefacts: Refraction, shadowing and enhancement	fMRI : Basic principle	Dual modality: PET/CT
	SLO-2	Abdominal X-ray scans	Methods for dose reduction	Reverberation	BOLD concept, MR spectroscopy	Working and applications

Learning Resources	1. R.S.Khandpur, Handbook of Biomedical instrumentation, 3 <sup>rd</sup> ed., Tata McGraw Hill, 2014	2. Jerrold T. Bushberg, John M. Boone, The essential physics of medical imaging, 3 <sup>rd</sup> ed., Lippincott Williams & Wilkins, 2011
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Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#		Theory	Practice
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice		
Level 1	Remember Understand	40 %	-	30 %	-	30 %	-	30 %	-	30%	-
Level 2	Apply Analyze	40 %	-	40 %	-	40 %	-	40 %	-	40%	-
Level 3	Evaluate Create	20 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Total	100 %		100 %		100 %		100 %		100 %	

# CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Sathyanarayanan J, Mindray Medical India Pvt Ltd, sathyanarayananjayagopal@mindray.com	1. Dr. S. Poonguzhali, Anna University, poongs@annauniv.edu	1. Dr. T. Jayanthi, SRMIST
2. Mr. Anuj Kumar, Bombardier Transportation, Ahmedabad, kumaranuj.ani@gmail.com	2. Dr. Meenakshi, Professor of ECE, CEG, Anna University, meena68@annauniv.edu	2. Dr. U. Snehalatha, SRMIST

Course Code	18ECO124T	Course Name	HUMAN ASSIST DEVICES	Course Category	O	Open Elective	L	T	P	C
							3	0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Electronics and Communication		Data Book / Codes/Standards	Nil	

Course Learning Rationale (CLR):	The purpose of learning this course is to:			Learning			Program Learning Outcomes (PLO)																																		
CLR-1 :	Utilize the latest technology and device used for assisting human disability			1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15																				
CLR-2 :	Analyze various devices used for mobility			Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3																				
CLR-3 :	Utilize the various assist device used for hearing																					M	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	M	-	-	
CLR-4 :	Utilize the various assist device used for vision																					M	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	L	-	-
CLR-5 :	Utilize the various assist device used in orthopaedic																					M	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	M	L	-
CLR-6 :	Analyze the working principles of cardiac assist devices and Artificial kidney																					M	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	M	-	-
CLR-6 :	Analyze the working principles of cardiac assist devices and Artificial kidney																					M	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	M	-	-
Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:																																								
CLO-1 :	Comprehend the assistive technology (AT) used for mobility			2	85	75																																			
CLO-2 :	Analyze the Assist technology used for hearing			3	85	75																																			
CLO-3 :	Evaluate the Assist technology used for sensory impairment of vision			3	85	75																																			
CLO-4 :	Evaluate the assist device used in orthopedic			3	85	75																																			
CLO-5 :	Analyze the latest use of assist technology in health care			3	85	75																																			
CLO-6 :	Design the prosthetic heart valves and pacemaker			3	85	75																																			

Duration (hour)	9		9		9		9		9	
S-1	SLO-1	Basic assessment and evaluation for mobility	Basic ear anatomy, Mechanism of hearing	Anatomy of eye	Anatomy of upper & lower extremities -	Basic Anatomy and physiology of heart.				
	SLO-2	Basic assessment and evaluation for mobility	Common tests audiograms	Categories of visual impairment	Classification of amputation types	Cardiac assist devices				
S-2	SLO-1	Manual wheelchairs	Air conduction, Bone conduction	Intraocular Devices	Prosthesis prescription	Intra-Aortic Balloon Pump (IABP),				
	SLO-2	Electric power wheelchairs	Masking techniques,	Extraocular Devices	Hand and arm replacement	Prosthetic heart valves				
S-3	SLO-1	Power assisted wheelchairs	SISI	Permanent Vision Restoration	Different types of models, externally powered limb prosthesis	Evaluation of prosthetic valve				
	SLO-2	Wheel chair standards & tests -	Hearing aids principles	Non-Permanent Vision Restoration	Different types of models, externally powered limb prosthesis	Heart pacemaker				
S-4	SLO-1	Wheel chair transportation	Drawbacks in the conventional unit	Voice Control Sound Control.	Foot orthosis	CABG				
	SLO-2	Control systems, navigation in virtual space by wheelchairs	DSP based hearing aids	Sensor Technology Adapted for the Vision Impaired	Pediatric orthoses	Extracorporeal support				
S-5	SLO-1	Wheel chair seating and pressure ulcers.	Cochlear Implants	Libraile	Wrist-hand orthosis	Vascular prosthesis				

	SLO-2	EOG based voice controlled wheelchair	Internal Hearing Aid	GRAB	feedback in orthotic system	Vascular prosthesis
S-6	SLO-1	BCI based wheelchair	External Hearing Aid	mathematical Braille	Components of upper limb prosthesis	Artificial heart
	SLO-2	Fuzzy logic expert system for automatic tuning of myoelectric prostheses	Permanent Hearing Restoration	Blind mobility aids	Components of lower limb prosthesis	Intermittent positive pressure breathing (IPPB) type assistance for lungs
S-7	SLO-1	Intelligent prosthesis	Non-Permanent Hearing Restoration	Reading writing & graphics access,	Lower extremity- and upper extremity-orthoses	Dialysis for kidneys
	SLO-2	Intelligent prosthesis	Touch Tactile Haptic Technology	Orientation & navigation Aids	Lower extremity- and upper extremity-orthoses	Artificial Kidney
S-8	SLO-1	Future trends in assistive technology	Sound Coding Translation	Wearable Assistive Devices for the Blind	functional electrical stimulation	Haemodialysis
	SLO-2	virtual reality based training system for disabled children	Acoustic Transducers Hearing Quality	Wearable tactile display for the fingertip.	Sensory assist devices	Membrane dialysis
S-9	SLO-1	Information technology, telecommunications,	Electric Electronic Stimulation	Cortical implants	Sensory assist devices	Portable dialysis monitoring and functional parameter
	SLO-2	new media in assisting healthcare	Hearing Enhancement	Retinal implants	Slints – materials used	Latest use of assistive technology for chronic heart diseases and healthcare

Learning Resources	<ol style="list-style-type: none"> <li>1. Levine S.N. <i>Advances in Bio-medical engineering and Medical physics</i>, 1<sup>st</sup> ed., Vol. I, II, IV, Interuniversity publications, 1968.</li> <li>2. Marion. A. Hersh, Michael A. Johnson, <i>Assistive Technology for visually impaired and blind</i>, 1<sup>st</sup> ed., Springer Science &amp; Business Media, 2010</li> <li>3. Kopff W.J, <i>Artificial Organs</i>, 1<sup>st</sup> ed., John Wiley and Sons, 1976</li> <li>4. Daniel Goldstein, Mehmet Oz, <i>Cardiac assist Devices</i>, Wiley, 2000</li> <li>5. Kenneth J. Turner, <i>Advances in Home Care Technologies: Results of the match Project</i>, 1<sup>st</sup> ed., Springer, 2011</li> </ol>	<ol style="list-style-type: none"> <li>6. Albert M.Cook, Webster J.G, <i>Therapeutic Medical Devices</i>, Prentice Hall Inc., 1982</li> <li>7. Gerr .M. Craddock <i>Assistive Technology-Shaping the future</i>, 1<sup>st</sup> ed., IOS Press, 2003</li> <li>8. Brownsell, Simon, et al., A systematic review of lifestyle monitoring technologies, <i>Journal of telemedicine and telecare</i> 17.4 (2011): 185-189</li> <li>9. Yadin David, Wolf W. von Maltzahn, Michael R. Neuman, Joseph.D, Bronzino, <i>Clinical Engineering</i>, 1<sup>st</sup> ed., CRC Press, 2010</li> <li>10. Pascal Verdonck, <i>Advances in Biomedical Engineering</i>, 1<sup>st</sup> ed., Elsevier, 2009</li> </ol>
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Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember Understand	40 %	-	30 %	-	30 %	-	30 %	-	30%	-
Level 2	Apply Analyze	40 %	-	40 %	-	40 %	-	40 %	-	40%	-
Level 3	Evaluate Create	20 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Total	100 %		100 %		100 %		100 %		100 %	

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1. Sathyanarayanan J, Mindray Medical India Pvt Ltd, sathyanarayananjayagopal@mindray.com	1. Dr. S. Poonguzhali, Anna University, poongs@annauniv.edu	1. Mrs. Lakshmi Prabha, SRMIST
2. Mr. Hariharasudhan - Johnson Controls, Pune, hariharasudhan.v@jci.com	2. Dr. Venkatesan, Sr. Scientist, NIOT, Chennai, venkat@niot.res.in	2. Dr. U. Snehalatha, SRMIST

Course Code	18ECO125T	Course Name	QUALITY CONTROL FOR BIOMEDICAL DEVICES	Course Category	O	Open Elective	L	T	P	C
							3	0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Electronics and Communication		Data Book / Codes/Standards	Nil	

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning			Program Learning Outcomes (PLO)														
CLR-1 :	Utilize Quality, Quality control measures essential for an organization	1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CLR-2 :	Utilize the quality management principles and good management practices	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3
CLR-3 :	Utilize the various quality control tools																		
CLR-4 :	Utilize the various quality management tools																		
CLR-5 :	Analyze the various standards applicable to healthcare globally and nationally																		
CLR-6 :	Implement the global standards in healthcare																		

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Learning			Program Learning Outcomes (PLO)														
CLO-1 :	Analyze the underlying concepts of quality and quality control concepts of an organization	2	85	75	-	-	-	M	-	-	-	M	M	-	-	L	-	M	L
CLO-2 :	Evaluate the various quality management principles and good management practices	3	85	75	L	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-3 :	Evaluate various tools of quality control	3	85	75	M	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-4 :	Analyze the various quality management tools	3	85	75	L	-	-	-	-	-	-	-	-	-	-	-	-	-	L
CLO-5 :	Analyze the various standards applicable to healthcare globally and nationally	3	85	75	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-6 :	Analyze the outcomes of implementing global standards	3	85	75	M	-	-	-	-	-	-	-	-	-	-	L	-	-	L

		Introduction to quality	TQM principles	Statistical process control	TQM tools	Quality systems
Duration (hour)		9	9	9	9	9
S-1	SLO-1	Definition of Quality	Customer satisfaction – Customer Perception of Quality	The seven tools of quality	Benchmarking	ISO 9000 Systems
	SLO-2	Dimensions of Quality	Customer Complaints	Cause-and-effect diagram	Reasons to Benchmark	ISO 9000 Systems
S-2	SLO-1	Quality Planning	Service Quality	Check sheet	Benchmarking Process	ISO 9000:2000 Quality System –Elements
	SLO-2	Quality Planning	Customer Retention	Check sheet	Benchmarking Process	ISO 9000:2000 Quality System –Elements
S-3	SLO-1	Quality costs	Employee Involvement	Control chart	Quality Function Deployment (QFD)	Need for Accreditation of hospitals
	SLO-2	Quality costs	Motivation	Control chart	Quality Function Deployment (QFD)	Need for Accreditation of hospitals
S-4	SLO-1	Basic concepts of Total Quality Management	Empowerment	Histogram	House of Quality	FDA Regulations
	SLO-2	Principles of TQM	Teams and Team Work	Histogram	House of Quality	FDA Regulations
S-5	SLO-1	Leadership – Concepts	Recognition and Reward	Pareto chart	QFD Process - Benefits	Joint Commission

	SLO-2	Role of Senior Management	Performance Appraisal	Pareto chart	QFD Process - Benefits	Joint Commission
S-6	SLO-1	Quality Council	Juran Trilogy	Scatter diagram	Total Productive Maintenance (TPM) – Concept	Regulatory Bodies of India
	SLO-2	Quality Statements	Juran Trilogy	Scatter diagram	Total Productive Maintenance	Medical Council of India
S-7	SLO-1	Strategic Planning	PDSA Cycle	Stratification	Improvement Needs	Pharmacy Council Of India
	SLO-2	Strategic Planning	PDSA Cycle	Stratification	Improvement Needs	Pharmacy Council Of India
S-8	SLO-1	Deming Philosophy	Kaizen	Six sigma	FMEA	Indian Nursing Council
	SLO-2	Deming Philosophy	Kaizen	Six sigma	FMEA	Indian Nursing Council
S-9	SLO-1	Barriers to TQM Implementation	5S	Six sigma	Stages of FMEA	Dental Council of India
	SLO-2	Barriers to TQM Implementation	5S	Six sigma	Stages of FMEA	Homeopathy Central Council

Learning Resources	<ol style="list-style-type: none"> <li>Rose J.E, Total Quality Management, Kogan Page Ltd., 1993</li> <li>Cesar A. Cacere, Albert Zana. The Practise of clinical Engineering, Academic Press, 1997</li> <li>Greg Bounds, Beyond Total Quality Management-Toward the emerging paradigm, McGraw Hill, 2013</li> </ol>	<ol style="list-style-type: none"> <li>Joseph J.Carr, Elements of Electronics Instrumentation and Measurement, 2nd ed., Pearson Education, 2003</li> <li>Jerrold T. Bushberg, John M. Boone, The essential physics of medical imaging, 3rd ed., Lippincott Williams &amp; Wilkins, 2011</li> </ol>
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Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#		Theory	Practice
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice		
Level 1	Remember	40 %	-	30 %	-	30 %	-	30 %	-	30%	-
Level 2	Understand	40 %	-	40 %	-	40 %	-	40 %	-	40%	-
	Apply	40 %	-	40 %	-	40 %	-	40 %	-	40%	-
Level 3	Analyze	20 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Evaluate	20 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Create	20 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Total	100 %		100 %		100 %		100 %		100 %	

# CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
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2. Mr. Anuj Kumar, Bombardier Transportation, Ahmedabad, kumaranuj.anii@gmail.com	2. Dr. Meenakshi, Professor of ECE, CEG, Anna University, meena68@annauniv.edu	2. Dr. D. Ashok Kumar, SRMIST

Course Code	18ECO131J	Course Name	VIRTUAL INSTRUMENTATION			Course Category	O	Open Elective					L	T	P	C																										
												2	0	2	3																											
Pre-requisite Courses	Nil		Co-requisite Courses	Nil		Progressive Courses	Nil																																			
Course Offering Department	Electronics and Communication		Data Book / Codes/Standards			Nil																																				
Course Learning Rationale (CLR):	The purpose of learning this course is to:					Learning			Program Learning Outcomes (PLO)																																	
CLR-1 :	To study the concepts of Virtual instrumentation and to learn the programming concepts in VI.					1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15																			
CLR-2 :	To study about the various real time data acquisition methods.					Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3																			
CLR-3 :	To study about the various Instrument Interfacing concepts.																																									
CLR-4 :	To study the programming techniques for various control techniques using VI software																																									
CLR-5 :	To study various analysis tools for Process control applications.																																									
CLR-6 :	To study various real time measurement systems																																									
Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:																																									
CLO-1 :	An ability to understand the purpose of virtual instrumentation and understand the construction of VI					2	80	70	H													H																				
CLO-2 :	An ability to understand and apply various data acquisition methods.					2	85	75	H													H	H																			
CLO-3 :	An ability to understand and implement the available interfacing instruments					2	75	70	H	H	H	H	H									H	H	H																		
CLO-4 :	An ability to understand and implement various control techniques using VI software					3	85	80	H	H	H	H	H									H		H																		
CLO-5 :	An ability to understand and develop a program for an engineering application.					3	85	75	H	H	H	H	H				H	H	H	H	H	H	H																			
CLO-6 :	An ability to understand and implement various measurement systems					3	80	70	H	H	H	H	H				H	H	H	H	H	H	H																			
Duration (hour)	12		12		12		12		12		12		12																													
S-1	SLO-1	Historical perspective, Need of VI, Advantages of VI, Virtual Instruments versus Traditional Instruments	A/D Converters, Organization of the DAQ VI system -	Introduction to PC Buses		Introduction to Non continuous controllers in LabVIEW		PC based digital storage oscilloscope																																		
	SLO-2	Review of software in Virtual Instrumentation, Software environment Architecture of VI, Introduction to the block diagram and Front panel Palettes	D/A Converters, Types of D/A	Local Buses-ISA, PCI,		Introduction to continuous controllers in LabVIEW		Sensor Technology																																		
S-2	SLO-1	Creating and saving a VI, Front Panel Tool Bar, Block diagram Tool Bar, Palettes	plug-in Analog Input/Output cards - Digital Input and Output Cards,	RS232, RS422		Design of ON/OFF controller		Applications of sensor Technology																																		
	SLO-2	Creating sub VI, Creating an ICON, Building a connector pane, Displaying VI'S Placing and Saving Sub VI'S on block diagram Example of full adder circuit using half adder circuit	Organization of the DAQ VI system -	RS485		Proportional controller for a mathematically described processes using VI software		Signal processing Techniques																																		
S-3-4	SLO-1	Front Panel controls and Indicator Verification of Arithmetic Operations	Measurement of diode I-V characteristics using LabVIEW	Load cell Data acquisition using RS232		On-off temperature controller using LabVIEW		Design of DSO																																		
	SLO-2	Verification of Half Adder Verification of Full adder.	Temperature measurement using LabVIEW and DAQ hardware.	Load cell Data acquisition using RS422		Continuous Control of temperature using LabVIEW		Analysis of different signal Filters using LabVIEW																																		
S-5	SLO-1	Loops-For Loop,	Opto Isolation need	Interface Buses-USB,PXI		Modeling of level process		Spectrum Analyser																																		
	SLO-2	While Loop	Performing analog input and analog output	VXI,		Basic control of level process in LabVIEW		Waveform Generator																																		
S-6	SLO-1	Arrays,	Scanning multiple analog channels	SCXI		Modeling of Reactor Processes		Data visualization from multiple locations																																		



	SLO-2	Clusters, plotting data	Issues involved in selection of Data acquisition cards	PCMCIA	Basic control of Reactor process in LabVIEW	Distributed monitoring and control
S 7-8	SLO-1	Program to find Addition of First n natural numbers using for loop Program to find Addition of First n odd numbers using while loop.	Flow measurement in water using LabVIEW and DAQ hardware.	DC motor control using VXI	On-off Level controller using LabVIEW	Real time spectrum analysis using LabVIEW
	SLO-2	Implementation of Array functions. Calculation of BMI using cluster	Level measurement in water using LabVIEW and DAQ hardware	GPIB with VISA functions	Continuous Control of pressure controller using LabVIEW	Arbitrary Waveform Generator using LabVIEW
S-9	SLO-1	Charts	Data acquisition modules with serial communication	Instrumentation Buses - Modbus and GPIB	Case studies on development of HMI in VI	Vision and Motion Control
	SLO-2	Graphs	Design of digital voltmeters with transducer input	Networked busses – ISO/OSI	Case studies on development of HMI in VI	Examples on Integrating Measurement with vision and motion
S-10	SLO-1	Case and Sequence Structures	Timers and Counters	Reference model,	Case studies on development of SCADA in VI	NI Motion control
	SLO-2	Formula nodes, String and File Input/Output.	Timers and Counters	Ethernet and TCP / IP Protocols	Case studies on development of SCADA in VI	Speed control system
S 11-12	SLO-1	Monitoring of temperature using Charts and Graphs. Program for implementing Seven segment display..	Design of digital voltmeters with transducer input using LabVIEW	Online temperature control using LabVIEW using TCP/IP	On-off pressure controller using LabVIEW	Minor Project
	SLO-2	Program to perform Traffic light control	Pressure measurement using LabVIEW and DAQ hardware DAQ.	Online temperature control using Webpublishing tool	Continuous Control of pressure controller using LabVIEW	Minor Project

Learning Resources	<ol style="list-style-type: none"> <li>Nadovich, C., <i>Synthetic Instruments Concepts and Applications</i>, Elsevier, 2005</li> <li>Bitter, R., Mohiuddin, T. and Nawrocki, M., <i>Labview Advanced Programming Techniques</i>, 2<sup>nd</sup> ed., CRC Press, 2007</li> <li>Gupta, S. and Gupta, J. P., <i>PC Interfacing for Data Acquisition and Process Control</i>, 2<sup>nd</sup> ed., Instrument Society of America, 1994</li> </ol>	<ol style="list-style-type: none"> <li>Jamal, R., Picklik, H., <i>Labview – Applications and Solutions</i>, National Instruments Release.</li> <li>Johnson, G., <i>Labview Graphical programming</i>, McGraw-Hill, 1997</li> <li>Wells, L.K., Travis, J., <i>Labview for Everyone</i>, Prentice Hall, 1997</li> <li>Buchanan, W., <i>Computer Busses</i>, CRC Press, 2000</li> </ol>
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Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#		Theory	Practice
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice		
Level 1	Remember Understand	20%	20%	15%	15%	15%	15%	15%	15%	15%	15%
Level 2	Apply Analyze	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%
Level 3	Evaluate Create	10%	10%	15%	15%	15%	15%	15%	15%	15%	15%
	Total	100 %		100 %		100 %		100 %		100 %	

# CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. D. Karthikeyan, Controlsoft Engineering India Pvt Ltd, karthikeyan.d@controlsoftengg.in	1. Dr. J. Prakash, MIT, Chennai, prakait@rediffmail.com	1. Dr. K. A. Sunitha, SRMIST
2. V. Venkateswaran, Instrumentation Consultant, vvenkat99@gmail.com	2. Dr. D. Nedumaran, Madras University, dnmaran@gmail.com	2. Mrs. A. Brindha, SRMIST

Course Code	18ECO132T	Course Name	ANALYTICAL INSTRUMENTATION			Course Category	O	Open Elective							L	T	P	C							
Pre-requisite Courses	Nil		Co-requisite Courses	Nil		Progressive Courses	Nil																		
Course Offering Department	Electronics and Communication			Data Book / Codes/Standards			Nil																		
Course Learning Rationale (CLR):	The purpose of learning this course is to:					Learning			Program Learning Outcomes (PLO)																
CLR-1 :	Understand the principle and theory of analytical instruments					1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15		
CLR-2 :	Understand the quantitative analysis of dissolved components					Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3		
CLR-3 :	Study the concept of separation science and its applications								H	H	L	L	H	H	H	-	-	-	-	-	-	-	H	H	L
CLR-4 :	Study the various spectroscopic techniques and its instrumentation								H	H	L	L	H	H	H	-	-	-	-	-	-	-	H	H	L
CLR-5 :	Identify and solve engineering problems associated with Radiation Techniques								H	H	L	L	H	H	H	-	-	-	-	-	-	-	H	H	L
CLR-6 :	Understand the working of Analytical Instrument and their importance in industries								H	H	L	L	H	H	H	-	-	-	-	-	-	-	H	H	L
Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:								2	80	70	H	H	L	L	H	H	-	-	-	-	-	-	H	H
CLO-1 :	Apply the principles and theory of instrumental analysis					2	80	70	H	H	L	L	H	H	-	-	-	-	-	-	H	H	L		
CLO-2 :	Apply the principles of various chemical analysis instruments in industries					2	80	70	H	H	L	L	H	H	-	-	-	-	-	-	H	H	L		
CLO-3 :	Analyze and understand the operation of various radio chemical methods of analysis					2	80	70	H	H	L	L	H	H	-	-	-	-	-	-	H	H	L		
CLO-4 :	To analyze and understand the operation of instruments based on optical properties					2	80	70	H	H	L	L	H	H	-	-	-	-	-	-	H	H	L		
CLO-5 :	To identify and solve engineering problems associated with Radiation Techniques					2	80	70	H	H	L	L	H	H	-	-	-	-	-	-	H	H	L		
CLO-6 :	To understand the working of analytical Instruments in industries					2	80	70	H	H	L	L	H	H	-	-	-	-	-	-	H	H	L		
Duration (hour)	9		9		9			9			9														
S-1	SLO-1	Introduction to Chemical instrumental analysis	Dissolved oxygen analyzer, Importance of measuring dissolved oxygen in Industry, Principle working	Chromatography, Importance, Basic working of Chromatography	Spectral methods of analysis- Properties or parameters of electromagnetic radiation	NMR spectrometers ,Importance and basic working of NMR Spectroscopy																			
	SLO-2	Spectral method of analysis	Working of Dissolved oxygen analyzer	Gas chromatography Instrumentation	Electromagnetic spectrum Types of spectrometers	Magnetic assembly, Probe unit, Instrument stabilization																			
S-2	SLO-1	Electro analytical and seperative methods	sodium analyzer, Importance of measuring sodium in Industry, Principle working	Basic parts of a gas chromatography	Beer's law UV-visible spectrophotometers Transmittance and absorbance	Types of NMR spectrometer, Minimal type																			
	SLO-2	Instrumental methods of analysis-basic components and their classification	Working of sodium analyzer	Carrier gas supply Sample injection system	Beer's law Application of beer's law	Multipurpose NMR, Wideline																			
S-3	SLO-1	Sampling systems	Silica analyzer, Importance of measuring Silica in Industry, Principle working	Chromatographic column, Selection of column	Derivations of beer's law	Applications of NMR Spectrometer																			
	SLO-2	Importance of Sampling system in chemical Industries and Safety aspects	Working of Silica Analyzer	Thermal compartment Detection system Recording system	Single beam and double beam instruments	Mass Spectrometers, Basic working and Importance																			
S-4	SLO-1	PH Measurement, Principle of PH measurement &Importance of PH measurement in Industries	Moisture measurement Importance of Moisture measurement	Liquid chromatography-Principles, types and applications	IR spectrophotometers Instruments of IR	Components of Mass Spectrometers																			
	SLO-2	Types of Electrodes, Reference Electrodes and types	Types of Moisture measurement	High pressure liquid chromatography	Types of IR Components required for three types of IR	Types of Mass spectrometers Magnetic Sector analyzer ,Double focusing spectrometers																			
S-5	SLO-1	Secondary Electrodes and Types	Oxygen analyzer Methods of oxygen analyzers and importance	Instrumentation or basic component of HPLC	Instruments of dispersive instrument , IR Radiation Sources and types	Time of flight analyzers, Quadrupole Mass analyzers																			

	SLO-2	Indicator electrodes	Paramagnetic oxygen analyzer Electro analytical method	Solvent reservoir and its treatment system	Importance of Monochromators and types of Monochromators	Application of mass spectrophotometers
S-6	SLO-1	pH meters direct reading type pH meter null detector type pH meter	CO monitor, Importance of measuring CO	Pumping system, Types of working systems and Importance	Samples And Sample Cells detectors	nuclear radiation detectors, importance of measurement
	SLO-2	ion selective electrodes Types of ion selective electrodes Glass membrane electrodes Liquid membrane electrodes Solid membrane Electrodes	Types of CO monitor	Pulse dampers	FTIR spectrometers Main components Advantages disadvantages	GM counter
S-7	SLO-1	Features of Biosensor Block diagram of bio sensor	NO2 analyzer, Importance of NO2 measurement	Sample injection system and types	Types of sources Selection factors	Working setup, advantages of GM Counter
	SLO-2	Applications of Biosensors in industries	Types of NO2 measurement	Liquid chromatographic column working , Types of Column thermostats	Types of detectors Selection factors	proportional counter, Basic Principle
S-8	SLO-1	conductivity meters ,Importance in Chemical Industries	H2S analyzer, Importance of H2 S Measurement	Detection system types	atomic absorption spectrophotometer instruments for atomic absorption spectroscopy	Working setup, advantages of GM Counter
	SLO-2	Types of Conductivity meters	Types of H2S measurement	Types of Recording system	radiation source chopper	solid state detectors, Basic Principle
S-9	SLO-1	Air pollution Monitoring Instruments	Dust and smoke measurement- dust measurement and Importance Types of dust measurement	Application of HPLC, Advantages of HPLC over gas chromatography	production of atomic vapor by flame, Parts by flame photometer Emission system	Working setup, advantages of Solid state detectors
	SLO-2	Estimation of Air pollution	Thermal analyzer , Importance of Thermal analyzers, Types of Thermal analyzer	Detectors types, Factors Influencing the Selection of Detectors	Monochromators And types, Types of Detectors and recording systems and their selection criteria	scintillation counter, Basic principle

Learning Resources	<ol style="list-style-type: none"> <li>1. Khandpur. R.S, "Handbook of Analytical Instruments", Tata McGraw Hill publishing Co. Ltd., 2006</li> <li>2. Bella. G. Liptak, "Process Measurement and analysis", CRC press LLC.,2003.</li> <li>3. Francis Rousseau and Annick Rouessac "Chemical analysis Modern Instrumentation Methods and Techniques", John wiley &amp; sons Ltd.2007.</li> </ol>	<ol style="list-style-type: none"> <li>4. James W.Robinson, "Undergraduate Instrumental Analysis", Marcel Dekker., 2005.</li> <li>5. Dwayne Heard, "Analytical Techniques for atmospheric measurement", Blackwell Publishing, 2006.</li> </ol>
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Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#		Theory	Practice
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice		
Level 1	Remember Understand	40 %	-	30 %	-	30 %	-	30 %	-	30%	-
Level 2	Apply Analyze	40 %	-	40 %	-	40 %	-	40 %	-	40%	-
Level 3	Evaluate Create	20 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Total	100 %		100 %		100 %		100 %		100 %	

# CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. D.Karthikeyan, Controlsoft Engineering India Pvt Ltd, karthikeyan.d@controlsoftengg.in	1. Dr. J. Prakash, MIT, Chennai, prakaiit@rediffmail.com	1. Dr. K. A. Sunitha, SRMIST
2. V. Venkateswaran, Instrumentation Consultant, vvenkat99@gmail.com	2. Dr. D. Nedumaran, Madras University, dnmaran@gmail.com	2. Mrs. A. Brindha, SRMIST

Course Code	18ECO133T	Course Name	SENSORS AND TRANSDUCERS	Course Category	O	Open Elective	L	T	P	C
							3	0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Electronics and Communication		Data Book / Codes/Standards	Nil	

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning			Program Learning Outcomes (PLO)														
CLR-1 :	Gain knowledge on classification, and characteristics of transducers	1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CLR-2 :	Acquire the knowledge of different types of inductive and capacitive sensors	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3
CLR-3 :	Acquire the knowledge of different types of thermal and radiation sensors																		
CLR-4 :	Acquire the knowledge of different types of magnetic sensors																		
CLR-5 :	Acquire the knowledge of different types of sensors measuring non-Electrical quantity																		
CLR-6 :	Locate the Applications of sensors in industries and home appliances																		

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	3	80	75	H	-	H	-	H	H	H	-	-	-	-	H	H	-	-
CLO-1 :	To demonstrate the various types of basic sensors.	3	80	75	H	-	H	-	H	H	H	-	-	-	-	H	H	-	-
CLO-2 :	Understand the inductive and capacitive sensors which are used for measuring various parameters.	3	80	75	-	-	-	H	-	-	-	-	-	H	H	-	-	H	-
CLO-3 :	Understand the thermal and radiation sensors	3	80	75	-	-	-	-	H	-	-	-	H	H	-	-	-	H	-
CLO-4 :	Have an adequate knowledge on the various magnetic sensors	3	80	75	-	H	H	-	-	-	-	-	-	-	-	-	-	-	H
CLO-5 :	To demonstrate the various types of basic sensors measuring non electrical quantity	3	80	75	-	-	H	-	H	-	-	-	-	-	-	H	-	-	H
CLO-6 :	Select the right transducer for the given application	3	80	75	H	-	H	-	-	H	H	H	-	-	-	H	H	-	-

Duration (hour)	9		9		9		9		9	
S-1	SLO-1	Introduction to sensors/ transducers, Principles	Introduction to Inductive sensor	Thermal sensors: Introduction	Magnetic sensors: Introduction	Measurement of Non-Electrical quantity: Introduction				
	SLO-2	Classification based on different criteria	Sensitivity and linearity of the sensor	Thermal Expansion type.	Villari effect	Flow Measurement – Introduction.				
S-2	SLO-1	Characteristics of measurement systems	Transformer type transducer	Acoustics temperature sensors.	Wiedmann effect	Ultrasonic Flow Meters.				
	SLO-2	Static characteristics Accuracy, Precision, Resolution, Sensitivity	Electromagnetic transducer	Thermo-emf sensor.	Hall effect	Hot Wire Anemometers.				
S-3	SLO-1	Dynamic characteristics.	Magnetostriuctive transducer	Materials for thermos-emf sensors.	Construction,	Electromagnetic Flow meters.				
	SLO-2	Environmental Parameters	Materials used in inductive sensor	Thermocouple construction	performance characteristics,	Principle and types.				
S-4	SLO-1	Characterization and its type	Mutual Inductance change type	Types.	and its Application	Measurement of Displacement.				
	SLO-2	Electrical characterization.	LVDT: Construction.	Thermo-sensors using semiconductor device	Introduction to smart sensors	Introduction and types.				
S-5	SLO-1	Mechanical Characterization.	Material, input output relationship,	Pyroelectric thermal sensors	Film sensors: Introduction	Measurement of Velocity/ Speed.				
	SLO-2	Thermal Characterization	Synchros-Construction	Introduction	Thick film sensors	Introduction and types.				

S-6	SLO-1	Optical Characterization.	Capacitive sensor: Introduction	characteristics	Microelectromechanical systems	Measurement of Liquid Level.
	SLO-2	Errors and its classification.	Parallel plate capacitive sensor	Application	Micromachining.	Introduction and types.
S-7	SLO-1	Selection of transducers.	Variable thickness dielectric capacitive sensor	Radiation sensors	Nano sensors	Measurement of Pressure.
	SLO-2	Introduction to mechanical sensors	Electrostatic transducer	Introduction	Applications: Industrial weighing systems: Link-lever mechanism.	Introduction and types.
S-8	SLO-1	Resistive potentiometer and types	Piezoelectric elements	Characteristics	Load cells – pneumatic, elastic and their mounting.	Measurement of Vibration.
	SLO-2	Strain gauge: Theory, type, design consideration, sensitivity.	Ultrasonic Sensors	Geiger counters	different designs of weighing systems.	Introduction and types.
S-9	SLO-1	Resistive transducer: RTD, materials used in RTD	Calculation of sensitivity.	Scintillation detectors	conveyors type.	Application of sensors in industries
	SLO-2	Thermistor: thermistor material, shape	Capacitor microphone, response characteristics	Application on radiation sensors	weighfeeder type.	Application of sensors in home appliances

Learning Resources	<ol style="list-style-type: none"> <li>1. Patranabis, D., "Sensors and Transducers", 2<sup>nd</sup> Edition, Prentice Hall India Pvt. Ltd, 2010</li> <li>2. Doebelin, E.O., "Measurement Systems: Applications and Design", 6<sup>th</sup> Edition, Tata McGraw-Hill Book Co., 2011</li> <li>3. Bentley, J. P., "Principles of Measurement Systems", 4<sup>th</sup> Edition, Addison Wesley Longman Ltd., UK, 2004.</li> </ol>	<ol style="list-style-type: none"> <li>4. Murthy, D.V.S., "Transducers and Instrumentation", Prentice Hall of India Pvt. Ltd., New Delhi, 2010</li> <li>5. Neubert H.K.P., "Instrument Transducers – An Introduction to their performance and Design", Oxford University Press, Cambridge, 2003</li> </ol>
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Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#		Theory	Practice
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice		
Level 1	Remember Understand	40 %	-	30 %	-	30 %	-	30 %	-	30%	-
Level 2	Apply Analyze	40 %	-	40 %	-	40 %	-	40 %	-	40%	-
Level 3	Evaluate Create	20 %	-	30 %	-	30 %	-	30 %	-	30%	-
Total		100 %		100 %		100 %		100 %		100 %	

# CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. D. Karthikeyan, ControlsoftEngineering India Pvt Ltd, karthikeyan.d@controlsoftengg.in	1. Dr. J. Prakash, MIT, Chennai, prakait@rediffmail.com	1. Mrs.K.Vibha, SRMIST
2. Mr. Prasad, KCP Sugar & Industries, kcpengineering@gmail.com	2. Mr. Prashanth Ravi, NTU, prashantrar@gmail.com	2. Dr. G.JoselinRetna Kumar, SRMIST

Course Code	18ECO134T	Course Name	INDUSTRIAL AUTOMATION	Course Category	O	Open Elective	L	T	P	C
							3	0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Electronics and Communication		Data Book / Codes/Standards	Nil	

Course Learning Rationale (CLR):	The purpose of learning this course is to:			Learning			Program Learning Outcomes (PLO)																																		
CLR-1 :	Understand basic components of PLC			1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15																				
CLR-2 :	Understand the use of timers and counters in process automation			Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3																				
CLR-3 :	Understand DCS architecture																					H	M	L	-	-	-	-	-	-	-	M	-	M	L	M	L	M	H	H	
CLR-4 :	Understand operator and engineering interface in DCS																					H	H	H	H	H	-	L	-	H	M	L	L	H	H	H	H	L	M	L	M
CLR-5 :	Understand HART signal standard and Field bus																					H	M	-	-	-	-	-	-	L	-	-	L	M	L	M	L	M	L	M	M
CLR-6 :	Understand Field bus signal standard.																					H	H	-	H	-	-	-	-	-	H	M	-	L	H	L	H	L	M	L	M
CLR-6 :	Understand Field bus signal standard.																					H	-	-	-	-	-	-	-	-	-	-	L	-	L	H	-	L	-	L	M
Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:			3	80	75	H	L	-	-	-	-	-	-	-	-	L	H	-	L	-	L	M																		
CLO-1 :	Select PLC based on I/O's			3	80	75	H	L	-	-	-	-	-	-	-	-	L	H	-	L	-	L	M																		
CLO-2 :	Apply timers and counters in process automation			3	80	75	H	H	H	H	-	L	-	H	M	L	L	H	H	H	H	H	H																		
CLO-3 :	Select LCU based on application			3	80	75	H	M	-	-	-	-	-	L	-	-	L	M	L	M	L	M	M																		
CLO-4 :	Analyse data's in Operator displays			3	80	75	H	H	-	H	-	-	-	H	M	-	L	H	L	M	L	M	M																		
CLO-5 :	Interpret industrial data communication modes			3	80	75	H	-	-	-	-	-	-	-	-	L	-	L	H	-	L	-	L																		
CLO-6 :	Gain knowledge on field bus			3	80	75	H	L	-	-	-	-	-	-	-	-	L	H	-	L	-	L	M																		

Duration (hour)	9		9		9		9		9	
S-1	SLO-1	Programmable logic controllers	PLC Programming Languages	Evolution of DCS	Operator Interfaces Requirements	Introduction to HART				
	SLO-2	PLC vs Computer	Ladder Diagram	Hybrid System Architecture	Process Monitoring	Evolution of Signal standard				
S-2	SLO-1	Parts of a PLC	Functional block	Central Computer system Architecture	Process Control	HART Networks: Point-to-Point				
	SLO-2	Architecture	Sequential Function Chart	DCS Architecture	Process Diagnostics	Multi-drop				
S-3	SLO-1	PLC size and Application.	Instruction List	Comparison of Architecture	Process Record Keeping	Split range control valve				
	SLO-2	Fixed and Modular I/O	Structured Text	Local Control Unit Architecture	Low Level Operator Interface	HART Field Controller Implementation				
S-4	SLO-1	Discrete Input Modules	Wiring Diagram	Architectural Parameters	High Level Operator Interface	Hart Commends: Universal				
	SLO-2	Discrete Output Modules	Ladder logic Program	Comparison Of LCU Architecture	Hardware Elements In The Operator Interface	Common Practice				
S-5	SLO-1	Analog Input Modules	On-Delay Timer Instruction	LCU Language Requirements	Operator Input And Output Devices	Device Specific				

	SLO-2	Analog Output Modules	Off-Delay Timer Instruction	Function Blocks	Operator Display Hierarchy	Wireless Hart
S-6	SLO-1	Special I/O Modules	Retentive Timer	Function Block Libraries	Plant-Level Display	Field Bus Basics
	SLO-2	High Speed Counter Module	Cascading Timer	Problem-Oriented Language	Area- Level Display	Field Bus Architecture
S-7	SLO-1	Power Supplies	Up-Counter	LCU Process Interfacing Issues	Group- Level Display	Field Bus Standard
	SLO-2	Isolators	Down-Counter	Security Requirements	Loop- Level Display	Field Bus Topology
S-8	SLO-1	Input/output Devices: Switches	Cascading Counters	Security Design Approach	Engineering Interface Requirements	H1 Field Bus
	SLO-2	sensors	Combining Counter And Timer Functions	On-Line Diagnostics	Requirement For Operator Interface Configuration	H2 Field Bus
S-9	SLO-1	Relays	Math Operation	Redundant Controller Design	Low Level Engineering Interface,	Interoperability
	SLO-2	Solenoid valve	Program	One-On-One, One-On-Many Redundancy	High Level Engineering Interfaces	Interchangeability

Learning Resources	<ol style="list-style-type: none"> <li>1. Frank D. Petruzella, Programmable Logic Controller, Tata McGraw Hill Fifth Edition, 2017</li> <li>2. Bolton. W, Programmable Logic Controllers, 6th Edition, Elsevier Newnes, Sixth Edition 2016.</li> <li>3. Krishna Kant, Computer Based Industrial Control, Second edition, Prentice Hall of India, New Delhi, 2015</li> </ol>	<ol style="list-style-type: none"> <li>4. Bowten, R HART Application Guide, HART Communication foundation, 2015.</li> <li>5. Berge, J, Field Busses for process control: Engineering, operation, maintenance, ISA press, 2015</li> </ol>
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Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember Understand	40 %	-	30 %	-	30 %	-	30 %	-	30%	-
Level 2	Apply Analyze	40 %	-	40 %	-	40 %	-	40 %	-	40%	-
Level 3	Evaluate Create	20 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Total	100 %		100 %		100 %		100 %		100 %	

# CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

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2. V. Venkateswaran, Instrumentation Consultant, vvenkat99@gmail.com	2. Mr. Prashanth Ravi, NTU, prashantrar@gmail.com	2. Dr. G.Joselin Retna Kumar, SRMIST

# ACADEMIC CURRICULA

**Project Work, Seminar,  
Internship in Industry / Higher Technical Institutions  
Courses**

**Regulations 2018**

**Volume – 4 (8)**



**SRM INSTITUTE OF SCIENCE AND TECHNOLOGY**

**(Deemed to be University u/s 3 of UGC Act, 1956)**

**Kattankulathur, Kancheepuram, Tamil Nadu, India**



Course Code	18ASP101L	18ASP104L	18AUP101L	18AUP104L	18BTP101L	18BTP104L	Course Name	MASSIVE OPEN ONLINE COURSE - I / MASSIVE OPEN ONLINE COURSE - II	Course Category	P	Project Work, Seminar, Internship in Industry / Higher Technical Institutions	L	T	P	C
	18CHP101L	18CHP104L	18CEP101L	18CEP104L	18CSP101L	18CSP104L						0	0	2	1
	18EEP101L	18EEP104L	18ECP101L	18ECP104L	18MEP101L	18MEP104L									
	18MHP101L	18MHP104L	18NTP101L	18NTP104L											

Course Learning Rationale (CLR):		<i>The purpose of learning this course is to:</i>			Program Learning Outcomes (PLO)																																		
CLR-1:	<i>Improve Student Academic Characteristics and learning goals through forums, discussion groups, and blogs</i>				1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15																	
CLR-2:	<i>Improve Student Personal Characteristics through self-learning habits</i>				Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3																	
CLR-3:	<i>Characterize self-learning environment that includes pedagogy, tools, tasks, duration, feedback and assessments</i>																						H	M	M	H	H	H	-	H	H	H	-	H	-	H	-	-	-
CLR-4:	<i>Improve lifelong learning habits and Learning process</i>																						H	M	M	H	H	H	-	H	H	H	-	H	-	H	-	-	-
CLR-5:	<i>Characterize learning engagement methods and activities</i>																						H	M	M	H	H	H	-	H	H	H	-	H	-	H	-	-	-
CLR-6:	<i>Inculcate self-learning behavior and lifelong learning tendency</i>																						H	M	M	H	H	H	-	H	H	H	-	H	-	H	-	-	-
																							3	95	85														
Course Learning Outcomes (CLO):		<i>At the end of this course, learners will be able to:</i>																																					
CLO-1:	<i>Inculcate student characteristics: prior-knowledge, prior-experience, expertise, academic achievement and matriculation</i>				3	95	85	H	M	M	H	H	H	-	H	H	H	-	H	-	-	-																	
CLO-2:	<i>Inculcate self-motivation, self-confidence, intrinsic motivation, participation, social economic stature, and task-orientation</i>				3	95	85	H	M	M	H	H	H	-	H	H	H	-	H	-	-	-																	
CLO-3:	<i>Enhance self-learning through peer learning, learning groups, positive collaboration</i>				3	95	85	H	M	M	H	H	H	-	H	H	H	-	H	-	-	-																	
CLO-4:	<i>Explore different learning styles and activities, identify self-learning pace, difficulties and remedial measures</i>				3	95	85	H	M	M	H	H	H	-	H	H	H	-	H	-	-	-																	
CLO-5:	<i>Identify ways of students' engagement, achievement, and attrition</i>				3	95	85	H	M	M	H	H	H	-	H	H	H	-	H	-	-	-																	
CLO-6:	<i>Identify ethical practices in self-learning and practice both individual and group learning dynamics</i>				3	95	85	H	M	M	H	H	H	-	H	H	H	-	H	-	-	-																	

MOOC Course Selection: List of MOOC Courses that are Approved to be learned by the student in the respective semester will be displayed by the Department MOOC Committee. Student can pick any course from that list.

Learning Assessment	MOOC Certification Obtained (80% weightage)	Final Presentation (20% weightage)
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Note: Final Presentation by the student would be evaluated by the Department MOOC Committee.

Course Code	18ASP102L	18ASP105L	18AUP102L	18AUP105L	18BTP102L	18BTP105L	Course Name	INDUSTRIAL TRAINING – I / INDUSTRIAL TRAINING – II	Course Category	P	Project Work, Seminar, Internship in Industry / Higher Technical Institutions	L	T	P	C	
	18CHP102L	18CHP105L	18CEP102L	18CEP105L	18CSP102L	18CSP105L						0	0	2	1	
	18EEP102L	18EEP105L	18ECP102L	18ECP105L	18MEP102L	18MEP105L										
	18MHP102L	18MHP105L	18NTP102L	18NTP105L												

Course Learning Rationale (CLR):	<i>The purpose of learning this course is to:</i>
CLR-1:	<i>Train oneself in finding the aspects in real-time work environment and prepare them to join the workforce in the future</i>
CLR-2:	<i>Gain Exposure to the actual working conditions including rules, regulations and safety practices</i>
CLR-3:	<i>Enhance and supplement the knowledge and skills of the students</i>
CLR-4:	<i>Develop the students in terms of ability, competence and interpersonal relationship</i>
CLR-5:	<i>Enhance students' knowledge in one particular technology</i>
CLR-6:	<i>Provide learning platform that can enhance their employ ability skills</i>

Course Learning Outcomes (CLO):	<i>At the end of this course, learners will be able to:</i>
CLO-1:	<i>Apply knowledge of Mathematics, Science, and Engineering Fundamentals in the real world of work</i>
CLO-2:	<i>Demonstrate competency in relevant engineering fields through problem identification, formulation and solution</i>
CLO-3:	<i>Effectively implement skills in professional communication, technical writing and using multimedia tools</i>
CLO-4:	<i>Develop ability to work as an individual and in a group as an effective team member</i>
CLO-5:	<i>Master the professional and ethical responsibilities of an engineer</i>
CLO-6:	<i>Generate a report based on the experiences and projects carried out in a real-world work environment</i>

Learning			Program Learning Outcomes (PLO)														
1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3
3	95	85	H	M	M	H	H	H	L	H	H	H	H	H	-	-	-
3	95	85	H	M	M	H	H	H	L	H	H	H	H	H	-	-	-
3	95	85	H	M	M	H	H	H	L	H	H	H	H	H	-	-	-
3	95	85	H	M	M	H	H	H	L	H	H	H	H	H	-	-	-
3	95	85	H	M	M	H	H	H	L	H	H	H	H	H	-	-	-

Industrial Training Selection: List of Industries for Industrial Training for students would be finalized by the Department Internship/Industrial Training Committee.

Learning Assessment	Industrial Training Certification Obtained (80% weightage)	Final Presentation (20% weightage)
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Note: Final Presentation Evaluation would be done by the Internship/Industrial Training Committee formed by the Department.

Course Code	18ASP103L	18ASP106L	18AUP103L	18AUP106L	18BTP103L	18BTP106L	Course Name	SEMINAR – I / SEMINAR – II	Course Category	P	Project Work, Seminar, Internship in Industry / Higher Technical Institutions	L	T	P	C
	18CHP103L	18CHP106L	18CEP103L	18CEP106L	18CSP103L	18CSP106L						0	0	2	1
	18EEP103L	18EEP106L	18ECP103L	18ECP106L	18MEP103L	18MEP106L									
	18MHP103L	18MHP106L	18NTP103L	18NTP106L											

Course Learning Rationale (CLR):	<i>The purpose of learning this course is to:</i>
CLR-1:	<i>Utilize fundamental principles, generalizations, or theories and ability to present the same</i>
CLR-2:	<i>Increase self-motivation, personal responsibility, understand one's role of being an informed participant</i>
CLR-3:	<i>Create an environment that helps the student establish healthy relationships and support networks</i>
CLR-4:	<i>State and explain some specific skills, competencies, and points of view</i>
CLR-5:	<i>Identify, apply appropriate note-taking, test-taking, and time-management strategies to the academic studies</i>
CLR-6:	<i>Develop critical thinking, information literacy, Interdisciplinary Inquiry, Engaging with Big Questions and Major Works</i>

Course Learning Outcomes (CLO):	<i>At the end of this course, learners will be able to:</i>			
CLO-1:	<i>Gaining factual knowledge (terminology, classifications, methods, trends)</i>	3	95	85
CLO-2:	<i>Rlate to their interests, abilities, career choices, and personal development</i>	3	95	85
CLO-3:	<i>Develop a plan that demonstrates their responsibility for their own education</i>	3	95	85
CLO-4:	<i>Explain the role of self-efficacy, personal goals, and motivation in improving academic life</i>	3	95	85
CLO-5:	<i>Describe the behaviors and characteristics of an effective learner</i>	3	95	85
CLO-6:	<i>Improve the Presentation Skills, Discussion Skills, Listening Skills, Argumentative Skills, Critical Thinking, Questioning</i>	3	95	85

Learning			Program Learning Outcomes (PLO)														
1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3
H	M	M	H	H	H	L	H	H	H	H	H	H	-	H	-	-	-
H	M	M	H	H	H	L	H	H	H	H	H	H	-	H	-	-	-
H	M	M	H	H	H	L	H	H	H	H	H	H	-	H	-	-	-
H	M	M	H	H	H	L	H	H	H	H	H	H	-	H	-	-	-
H	M	M	H	H	H	L	H	H	H	H	H	H	-	H	-	-	-

Seminar Selection: List of Seminar Topics that are Approved to be learned by the student in the respective semester will be displayed by the Department Seminar Selection/Evaluation Committee. Student can pick any topic from that list.

Learning Assessment	
Seminar Preparation Materials & Report (80% weightage)	Final Presentation (20% weightage)

Note: Final Presentation Evaluation would be done by the Seminar Evaluation Committee formed by the Department.

Course Code	18ASP107L 18EEP107L	18AUP107L 18ECP107L	18BTP107L 18MEP107L	18CHP107L 18MHP107L	18CEP107L 18NTP107L	18CSP107L	Course Name	MINOR PROJECT	Course Category	P	Project Work, Seminar, Internship in Industry / Higher Technical Institutions	L	T	P	C
												0	0	6	3

Course Learning Rationale (CLR):		The purpose of learning this course is to:			Learning			Program Learning Outcomes (PLO)																															
CLR-1:	Learn responsible and professional way of working	1	2	3	1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15																	
CLR-2:	Practice development-oriented approach to work	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3																				
CLR-3:	Enhance students' knowledge in one particular technology																			H	M	M	H	H	H	L	H	H	H	H	H	H	H	H	H	H	-	-	-
CLR-4:	Create awareness of the social, cultural, global and environmental responsibility as an engineer																			H	M	M	H	H	H	L	H	H	H	H	H	H	H	H	H	H	-	-	-
CLR-5:	Grow more empathetic, become systems thinkers, become explorers, problem-solvers.																			H	M	M	H	H	H	L	H	H	H	H	H	H	H	H	H	H	-	-	-
CLR-6:	Learn project management.																			H	M	M	H	H	H	L	H	H	H	H	H	H	H	H	H	H	-	-	-
Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:																																						
CLO-1:	Develop capability to acquire and apply fundamental principles of engineering	3	95	85																																			
CLO-2:	Become updated with all the latest changes in technological world	3	95	85																																			
CLO-3:	Make deep connections between ideas	3	95	85																																			
CLO-4:	Learn to take creative risks	3	95	85																																			
CLO-5:	Be ready for the creative economy also engage in iterative thinking and divergent thinking	3	95	85																																			
CLO-6:	Identify, formulate and model problems and find engineering solution based on a systems approach	3	95	85																																			

Project Work Selection: Project Work Titles for students would be finalized by the Department Project Work Evaluation Committee.

Learning Assessment	
MOOC Certification Obtained (80% weightage)	Final Presentation (20% weightage)

Note: Final Presentation Evaluation would be done by the Department Project Work Evaluation Committee formed by the Department.

Course Code	18ASP108L 18EEP108L	18AUP108L 18ECP108L	18BTP108L 18MEP108L	18CHP108L 18MHP108L	18CEP108L 18NTP108L	18CSP108L	Course Name	INTERNSHIP	Course Category	P	Project Work, Seminar, Internship in Industry / Higher Technical Institutions	L	T	P	C
												0	0	6	3

Course Learning Rationale (CLR):	The purpose of learning this course is to:			Learning			Program Learning Outcomes (PLO)																	
CLR-1:	Understanding of industry/organization customs and practices			1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15			
CLR-2:	Demonstrate professional skills that pertain directly to the internship experience			Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3			
CLR-3:	Demonstrate effective verbal and written communication skills, Allocate time effectively						H	M	M	H	H	H	L	H	H	H	H	H	H	H	H	-	-	-
CLR-4:	1. Demonstrate effective listening skills						H	M	M	H	H	H	L	H	H	H	H	H	H	H	H	-	-	-
CLR-5:	2. Participate well as a team member and build professional network						H	M	M	H	H	H	L	H	H	H	H	H	H	H	H	-	-	-
CLR-6:	Build a record of work experience, Develop work habits and attitudes necessary for job success						H	M	M	H	H	H	L	H	H	H	H	H	H	H	H	-	-	-

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:			3	95	85	H	M	M	H	H	H	L	H	H	H	H	H	H	-	-	-
CLO-1:	3. Adapt effectively to changing conditions			3	95	85	H	M	M	H	H	H	L	H	H	H	H	H	H	-	-	-
CLO-2:	4. Demonstrate appropriate workplace attitudes			3	95	85	H	M	M	H	H	H	L	H	H	H	H	H	H	-	-	-
CLO-3:	Demonstrate individual responsibility			3	95	85	H	M	M	H	H	H	L	H	H	H	H	H	H	-	-	-
CLO-4:	Demonstrate effective management of personal behavior, ethics and attitudes			3	95	85	H	M	M	H	H	H	L	H	H	H	H	H	H	-	-	-
CLO-5:	Practice ethical standards appropriate to the internship site			3	95	85	H	M	M	H	H	H	L	H	H	H	H	H	H	-	-	-
CLO-6:	Explore career alternatives prior to graduation, Integrate theory and practice			3	95	85	H	M	M	H	H	H	L	H	H	H	H	H	H	-	-	-

Internship Training Selection: List of Industries / Research Centre's for Internship Training for students would be finalized by the Department Internship/Industrial Training Committee.

Learning Assessment	Internship Certification Obtained (80% weightage)	Final Presentation (20% weightage)
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Note : Final Presentation Evaluation would be done by the Internship/Industrial Training Committee formed by the Department.

Course Code	18ASP109L 18EEP109L	18AUP109L 18ECP109L	18BTP109L 18MEP109L	18CHP109L 18MHP109L	18CEP109L 18NTP109L	18CSP109L	Course Name	PROJECT	Course Category	P	Project Work, Seminar, Internship in Industry / Higher Technical Institutions	L	T	P	C
												0	0	20	10

Course Learning Rationale (CLR):	The purpose of learning this course is to:			Learning			Program Learning Outcomes (PLO)																	
CLR-1:	Learn responsible and professional way of working			1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15			
CLR-2:	Practice development-oriented approach to work			Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3			
CLR-3:	Enhance students' knowledge in one particular technology						H	M	M	H	H	H	L	H	H	H	H	H	H	H	H	-	-	-
CLR-4:	Create awareness of the social, cultural, global and environmental responsibility as an engineer						H	M	M	H	H	H	L	H	H	H	H	H	H	H	H	-	-	-
CLR-5:	Grow more empathetic, become systems thinkers, become explorers, problem-solvers.						H	M	M	H	H	H	L	H	H	H	H	H	H	H	H	-	-	-
CLR-6:	Learn project management.						H	M	M	H	H	H	L	H	H	H	H	H	H	H	H	-	-	-

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:			3	95	85	H	M	M	H	H	H	L	H	H	H	H	H	H	-	-	-
CLO-1:	Develop capability to acquire and apply fundamental principles of engineering			3	95	85	H	M	M	H	H	H	L	H	H	H	H	H	H	-	-	-
CLO-2:	Become updated with all the latest changes in technological world			3	95	85	H	M	M	H	H	H	L	H	H	H	H	H	H	-	-	-
CLO-3:	Make deep connections between ideas			3	95	85	H	M	M	H	H	H	L	H	H	H	H	H	H	-	-	-
CLO-4:	Learn to take creative risks			3	95	85	H	M	M	H	H	H	L	H	H	H	H	H	H	-	-	-
CLO-5:	Be ready for the creative economy also engage in iterative thinking and divergent thinking			3	95	85	H	M	M	H	H	H	L	H	H	H	H	H	H	-	-	-
CLO-6:	Identify, formulate and model problems and find engineering solution based on a systems approach			3	95	85	H	M	M	H	H	H	L	H	H	H	H	H	H	-	-	-

Project Work Selection: Project Work Titles for students would be finalized by the Department Project Work Evaluation Committee.

Learning Assessment	Project Report (80% weightage)	Final Presentation (20% weightage)
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Note: Final Presentation Evaluation would be done by the Department Project Work Evaluation Committee formed by the Department.

Course Code	18ASP110L 18EEP110L	18AUP110L 18ECP110L	18BTP110L 18MEP110L	18CHP110L 18MHP110L	18CEP110L 18NTP110L	18CSP110L	Course Name	SEMESTER INTERNSHIP	Course Category	P	Project Work, Seminar, Internship in Industry / Higher Technical Institutions	L	T	P	C
												0	0	20	10

Course Learning Rationale (CLR):		The purpose of learning this course is to:			Learning			Program Learning Outcomes (PLO)														
					1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
					Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3
CLR-1:	Become job ready along with real corporate exposure			3	95	85	H	M	M	H	H	H	L	H	H	H	H	H	H	-	-	-
CLR-2:	Increase self-confidence and helps in finding their own proficiency			3	95	85	H	M	M	H	H	H	L	H	H	H	H	H	H	-	-	-
CLR-3:	Cultivate leadership ability and responsibility to perform or execute the given task			3	95	85	H	M	M	H	H	H	L	H	H	H	H	H	H	-	-	-
CLR-4:	Inculcate learners hands on practice within a real job situation			3	95	85	H	M	M	H	H	H	L	H	H	H	H	H	H	-	-	-
CLR-5:	Create awareness of the social, cultural, global and environmental responsibility as an engineer			3	95	85	H	M	M	H	H	H	L	H	H	H	H	H	H	-	-	-
CLR-6:	Become able to identify, formulate and model problems and find engineering solution based on a systems approach			3	95	85	H	M	M	H	H	H	L	H	H	H	H	H	H	-	-	-
Course Learning Outcomes (CLO):		At the end of this course, learners will be able to:			Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3
CLO-1:	Enhance capability to acquire and apply fundamental principles of engineering			3	95	85	H	M	M	H	H	H	L	H	H	H	H	H	H	-	-	-
CLO-2:	Become master in one's specialized technology			3	95	85	H	M	M	H	H	H	L	H	H	H	H	H	H	-	-	-
CLO-3:	Become updated with all the latest changes in technological world			3	95	85	H	M	M	H	H	H	L	H	H	H	H	H	H	-	-	-
CLO-4:	Demonstrate hands on practice within a real job situation			3	95	85	H	M	M	H	H	H	L	H	H	H	H	H	H	-	-	-
CLO-5:	Inculcate self-improvement through continuous professional development and life-long learning			3	95	85	H	M	M	H	H	H	L	H	H	H	H	H	H	-	-	-
CLO-6:	Be a multi-skilled engineer with good technical knowledge, management, leadership and entrepreneurship skills			3	95	85	H	M	M	H	H	H	L	H	H	H	H	H	H	-	-	-

Internship Training Selection: List of Industries / Research Centre's for Internship Training for students would be finalized by the Department Internship/Industrial Training Committee.

Learning Assessment	
Internship Certification Obtained (80% weightage)	Final Presentation (20% weightage)

Note : Final Presentation Evaluation would be done by the Internship/Industrial Training Committee formed by the Department.



**SRM INSTITUTE OF SCIENCE AND TECHNOLOGY**

**(Deemed to be University u/s 3 of UGC Act, 1956)**

**Kattankulathur, Kancheepuram District-603203, Tamil Nadu,  
India**



# ACADEMIC CURRICULA

**Mandatory Courses**

**Regulations - 2018**



**SRM INSTITUTE OF SCIENCE AND TECHNOLOGY**

**(Deemed to be University u/s 3 of UGC Act, 1956)**

Kattankulathur, Kancheepuram, Tamil Nadu, India

Course Code	18PDM201L	Course Name	COMPETENCIES IN SOCIAL SKILLS	Course Category	M	Mandatory	L	T	P	C
							0	0	2	0

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Career Development Centre		Data Book / Codes/Standards	Nil	

Course Learning Rationale (CLR):	The purpose of learning this course is to:			Learning			Program Learning Outcomes (PLO)																																		
CLR-1 :	enable students understand subtle meanings of words used in academic texts			1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15																				
CLR-2 :	determine the grammatical, syntactical, and logical accuracy of sentences			Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3																				
CLR-3 :	comprehend an argument's line of reasoning																					L	H	-	M	-	-	-	-	-	M	H	-	H	-	-	-	-			
CLR-4 :	understand the structure, organization, tone, and main idea behind the passage																					L	H	-	M	-	-	-	-	-	M	H	-	H	-	-	-	-			
CLR-5 :	recognize the logical coherence of ideas in a text																					L	H	-	M	-	-	-	-	-	M	H	-	H	-	-	-	-			
CLR-6 :	give the right knowledge, skill and aptitude to face any competitive examination																					L	H	-	M	-	-	-	-	-	M	H	-	H	-	-	-	-			
Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:																																								
CLO-1 :	build vocabulary through methodical approaches and nurture passion for enriching vocabulary			3	80	75																																			
CLO-2 :	detect and correct any grammatical, syntactical, and logical fallacies			2	80	75																																			
CLO-3 :	hone critical thinking skills by analyzing arguments with explicit and implicit premises to validate the author's point of view			3	80	75																																			
CLO-4 :	analyze and evaluate texts critically in multifarious ways			3	80	75																																			
CLO-5 :	identification of relationships between sentences based on their function, usage and characteristics			2	80	75																																			
CLO-6 :	ace competitive examinations			2	80	75																																			

Duration (hour)	6		6		6		6		6	
S-1	SLO-1	Synonyms in Isolation and Context	Spotting Errors – Level I	Critical Reasoning – Weakening	Reading Comprehension – Main Idea	Para Jumble-Type I				
	SLO-2	Practice	Practice	Practice	Practice	Practice				
S-2	SLO-1	Antonyms in Isolation and Context	Spotting Errors – Level II	Critical Reasoning – Inference	Reading Comprehension – Tone	Para Jumble-Type II				
	SLO-2	Practice	Practice	Practice	Practice	Practice				
S-3	SLO-1	Common Confusables	Spotting Errors – Level II	Critical Reasoning – Conclusion	Reading Comprehension – Inference	Para Jumble-Type III				
	SLO-2	Practice	Practice	Practice	Practice	Practice				
S-4	SLO-1	Cloze Passage	Sentence Correction-Type I & II	Critical Reasoning - Explain the paradox	Reading Comprehension – Summary	Para Completion				
	SLO-2	Practice	Practice	Practice	Practice	Practice				
S-5	SLO-1	Word Analogy	Sentence Correction-Type III & IV	Critical Reasoning – Miscellaneous	Reading Comprehension – Conclusion	Para Completion				
	SLO-2	Practice	Practice	Practice	Practice	Practice				

S-6	SLO-1	Sentence Completion	Sentence Correction-Type V& VI	Critical Reasoning – Miscellaneous	Reading Comprehension – Miscellaneous	Para Summary
	SLO-2	Practice	Practice	Practice	Practice	Practice

Learning Resources	<ol style="list-style-type: none"> <li>Charles Harrington Elstor, <i>Verbal Advantage: Ten Easy Steps to a Powerful Vocabulary</i>, Random House Reference, 2002</li> <li>Merriam Webster's <i>Vocabulary Builder</i>, Merriam Webster Mass Market, 2010</li> <li>Norman Lewis, <i>How to Read Better and Faster</i>, Goyal, 4<sup>th</sup> Edition</li> <li>Franklin GRE Word List, 3861 GRE Words, Franklin Vocab System, 2014</li> <li>Wiley's <i>GMAT Reading Comprehension Grail</i>, Wiley, 2016</li> </ol>	<ol style="list-style-type: none"> <li>Manhattan Prep GRE : <i>Reading Comprehension and Essays</i>, 5<sup>th</sup> Edition</li> <li>Martin Hewings, <i>Advanced Grammar in Use</i>, Cambridge University Press, 2013</li> <li>Manhattan GMAT – <i>Critical Reasoning, GMAT Strategy Guide</i>, 12<sup>th</sup> Edition</li> <li>Joern Meissner, <i>Manhattan Review, GRE Analytical Writing Guide</i>, Manhattan Review Inc, 2011</li> <li>GRE Analytical Writing, <i>Solutions to the Real Essay Topics (Test Prep. Series)</i>, Vibrant Publishers, 2011</li> </ol>
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Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (100% weightage)								Final Examination	
		CLA – 1 (20%)		CLA – 2 (30%)		CLA – 3 (30%)		CLA – 4 (20%)#		Theory	Practice
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice		
Level 1	Remember	-	40%	-	30%	-	30%	-	30%	-	-
	Understand	-	40%	-	30%	-	30%	-	30%	-	-
Level 2	Apply	-	40%	-	40%	-	40%	-	40%	-	-
	Analyze	-	40%	-	40%	-	40%	-	40%	-	-
Level 3	Evaluate	-	20%	-	30%	-	30%	-	30%	-	-
	Create	-	20%	-	30%	-	30%	-	30%	-	-
	Total	100 %		100 %		100 %		100 %		-	

# CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers					
Experts from Industry		Experts from Higher Technical Institutions		Internal Experts	
1. Mr. Vijay Nayar, Director, Education Matters, vijayn@edumat.com		1. Dr. Dinesh Khattar, Delhi University, dinesh.khattar31@gmail.com		1. Dr. M. Snehalatha, SRMIST	
2. Mr. Ajay Zenner, Career Launcher, ajay.z@careerlauncher.com		2. Mr. Nishith Sinha, due North India Academics LLP, nsinha.alexander@gmail.com		2. Mr. Jayapragash J., SRMIST	
				3. Dr. P. Madhusoodhanan, SRMIST	
				4. Mr. Clement A, SRMIST	

Course Code	18PDM202L	Course Name	CRITICAL AND CREATIVE THINKING SKILLS	Course Category	M	Mandatory	L	T	P	C
							0	0	2	0

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Career Development Centre	Data Book / Codes/Standards	Nil		

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning			Program Learning Outcomes (PLO)																														
CLR-1 :	identify problems	1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15																
CLR-2 :	recognize the logical coherence of ideas	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3																
CLR-3 :	understand the structure and principles of writing																			L	H	-	M	-	-	-	-	M	L	-	H	-	-	-	
CLR-4 :	interpret the structure, organization, tone, and main idea of the content																			L	H	-	M	-	-	-	-	M	L	-	H	-	-	-	-
CLR-5 :	hone comprehension skills																			L	H	-	M	-	-	-	-	M	H	-	H	-	-	-	-
CLR-6 :	give the right knowledge, skill and aptitude to face any competitive examination																			L	H	-	M	-	-	-	-	M	H	-	H	-	-	-	-
Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:																																		
CLO-1 :	solve problems	3	80	75	L	H	-	M	-	-	-	-	M	L	-	H	-	-	-																
CLO-2 :	grasp the approaches and strategies to find solutions	2	80	75	L	H	-	M	-	-	-	-	M	L	-	H	-	-	-																
CLO-3 :	organize and articulate ideas clearly	2	80	75	L	H	-	M	-	-	-	-	M	L	-	H	-	-	-																
CLO-4 :	analyze and evaluate contents critically in multifarious ways	2	80	75	L	H	-	M	-	-	-	-	M	L	-	H	-	-	-																
CLO-5 :	understand, comprehend and provide logical conclusions	2	80	75	L	H	-	M	-	-	-	-	M	H	-	H	-	-	-																
CLO-6 :	gain appropriate skills to succeed in preliminary selection process for recruitment	3	80	75	L	H	-	M	-	-	-	-	M	H	-	H	-	-	-																

Duration (hour)	6		6		6		6		6	
S-1	SLO-1	Ages	Permutations-Types	Probability-Intro	Logical Reasoning – Blood relations, Directions		Information Ordering - Analogy			
	SLO-2	Solving Problems	Solving Problems	Solving Problems	Series completion		Math operations			
S-2	SLO-1	Case Study	Statement Completion	Principles of Writing	Reading Comprehension – Bold Faced		Para Completion			
	SLO-2	Discussion	Practice	Practice	Practice		Practice			
S-3	SLO-1	Quadratic Equations	Combination-Concepts	Probability theory -Applications	Logical Reasoning- Cubes		Analytical Reasoning-Intro			
	SLO-2	In-equations	Solving Problems	Solving Problems	Logical Reasoning-syllogism		Analytical Reasoning - Level I			
S-4	SLO-1	Case Study	Statement Completion	Principles of Writing	Reading Comprehension – Bold Faced		Para Completion			
	SLO-2	Discussion	Practice	Practice	Practice		Practice			
S-5	SLO-1	Permutations-Concepts	Combination- Miscellaneous	Logical Reasoning – Coding and Decoding	Information Ordering - Arrangements		Analytical Reasoning-Level II			
	SLO-2	Solving Problems	Solving Problems	Practice	Practice		Analytical Reasoning - Level III			

S-6	SLO-1	Case Study	Statement Completion	Principles of Writing	Reading Comprehension – Miscellaneous	Para Completion
	SLO-2	Discussion	Practice	Practice	Practice	Practice

Learning Resources	1. Dinesh Khattar-The Pearson Guide to Quantitative Aptitude for competitive examinations	5. Ellet William, The Case Study Handbook: How to read, discuss, and write persuasively about cases
	2. Hari Mohan Prasad, Verbal Ability for Competitive Examinations, Tata McGraw Hill Publications	6. Manhattan GMAT – Critical Reasoning, GMAT Strategy Guide, 12 <sup>th</sup> Edition
	3. Edgar Thrope, Test of Reasoning for Competitive Examinations, Tata McGraw Hill, 4th Edition, 2012	7. Wiley’s GMAT Reading Comprehension Grail, Wiley, 2016
	4. Norman Lewis, Word Power Made Easy, W.R. Goyal Publications, 2011	8. Manhattan Prep GRE : Reading Comprehension and Essays, 5th Edition

Learning Assessment											
	Bloom’s Level of Thinking	Continuous Learning Assessment (100% weightage)								Final Examination	
		CLA – 1 (20%)		CLA – 2 (30%)		CLA – 3 (30%)		CLA – 4 (20%)#		Theory	Practice
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice		
Level 1	Remember	-	40%	-	30%	-	30%	-	30%	-	-
	Understand	-	40%	-	30%	-	30%	-	30%	-	-
Level 2	Apply	-	40%	-	40%	-	40%	-	40%	-	-
	Analyze	-	40%	-	40%	-	40%	-	40%	-	-
Level 3	Evaluate	-	20%	-	30%	-	30%	-	30%	-	-
	Create	-	20%	-	30%	-	30%	-	30%	-	-
	Total	100 %		100 %		100 %		100 %		-	

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				3. Dr. P. Madhusoodhanan, SRMIST	
				4. Mr. Clement A, SRMIST	

Course Code	18PDM203L	Course Name	ENTREPRENEURIAL SKILL DEVELOPMENT	Course Category	M	Mandatory	L	T	P	C
							0	0	2	0

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Career Development Centre		Data Book / Codes/Standards	Nil	

Course Learning Rationale (CLR):	The purpose of learning this course is to:			Learning			Program Learning Outcomes (PLO)																																	
CLR-1 :	gain knowledge about Entrepreneurship			1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15																			
CLR-2 :	study mindsets of Entrepreneur			Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3																			
CLR-3 :	assimilate skills and behavioral aspects of entrepreneurship																					L	H	-	M	-	-	-	-	M	L	-	H	-	-	-	-			
CLR-4 :	generate creative and innovative ideas																					L	H	-	M	-	-	-	-	M	L	-	H	-	-	-	-			
CLR-5 :	acquire knowledge about the entrepreneurial processes																					L	H	-	M	-	-	-	-	M	H	-	H	-	-	-	-			
CLR-6 :	develop entrepreneurial skills																					L	H	-	M	-	-	-	-	M	H	-	H	-	-	-	-			
Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:																					2	80	75	L	H	-	M	-	-	-	-	M	L	-	H	-	-	-	
CLO-1 :	Understand the concept of Entrepreneurship and Entrepreneur			2	80	75	L	H	-	M	-	-	-	M	L	-	H	-	-	-																				
CLO-2 :	Comprehend the mindset of Entrepreneurs			2	80	75	L	H	-	M	-	-	-	M	L	-	H	-	-	-																				
CLO-3 :	Understand the skills and behavioral aspects required in Entrepreneurs			3	80	75	L	H	-	M	-	-	-	M	L	-	H	-	-	-																				
CLO-4 :	Analyze the role of Creativity and Innovation in their Entrepreneurial journey			3	80	75	L	H	-	M	-	-	-	M	L	-	H	-	-	-																				
CLO-5 :	Create and present their Business Model			3	80	75	L	H	-	M	-	-	-	M	H	-	H	-	-	-																				
CLO-6 :	Acquire entrepreneurial skills			1	80	75	L	H	-	M	-	-	-	M	H	-	H	-	-	-																				

Duration (hour)	6		6		6		6		6	
S-1	SLO-1	Introduction	Motivation	Self Analysis	Negotiating skill	Business Model Canvas				
	SLO-2	Benefits of entrepreneurship	External and internal	SWOT	People Management	Business Model Canvas				
S-2	SLO-1	Origin of Entrepreneurship	Theories of Entrepreneurship	Communication	Creativity	Business Opportunity Identification				
	SLO-2	Evolution of Entrepreneurship	Theories of Entrepreneurship	Networking	Idea Generation	Business Opportunity Identification				
S-3	SLO-1	Social and Economic factors Influencing Entrepreneurship	Success Stories – Case Study Analysis	Interpersonal skills	Problem Solving	Business Model canvas presentation				
	SLO-2	Environment and Psychological factors Influencing Entrepreneurship	Success Stories – Case Study Solution	Collaborative skills	Problem solving	Business Model canvas presentation				
S-4	SLO-1	Myths about entrepreneurship	Success Stories – Case Study Analysis	Team management skills	Decision Making	Business Model canvas presentation				
	SLO-2	Myths about entrepreneurship	Success Stories – Case Study Solution	Team management skills	Six Thinking hats	Business Model canvas presentation				
S-5	SLO-1	Entrepreneurship Failures	Risk-taking Behavior	Leadership	Inventions	Business model presentation				

	SLO-2	Entrepreneurship Failures	Resilience	Shared leadership	Inventions	Business model presentation
S-6	SLO-1	Entrepreneurship in India – A Preview	Global Markets for Entrepreneurs	Time Management	Innovations	Business model presentation
	SLO-2	Indian Entrepreneurships	Understanding the cross cultural behaviors and differences	Prioritisation	Innovations	Business model presentation

Learning Resources	<ol style="list-style-type: none"> <li>1. <i>Elon Musk – Ashley Vance- Virgin Books-2015</i></li> <li>2. <i>Think and Grow Rich – Napoleon Hill - The Ralston Society – 1937</i></li> <li>3. <i>The Lean Startup – Eric Ries - Crown Publishing Group (USA) – 2011</i></li> <li>4. <i>The \$100 Startup – Chris Gullibeau - Crown Business- 2012</i></li> <li>5. <i>Creativity, Innovation, and Entrepreneurship: The Only Way to Renew Your Organization - H. James Harrington - Productivity Press- December 2018</i></li> </ol>	<ol style="list-style-type: none"> <li>6. <a href="http://www.wfnen.org">www.wfnen.org</a>; National Entrepreneurship Network – Wadhvani Foundation</li> <li>7. <a href="https://www.forbes.com/sites/.../2017/.../top-entrepreneur-stories-to-inspire-you-in-2017/">https://www.forbes.com/sites/.../2017/.../top-entrepreneur-stories-to-inspire-you-in-2017/</a></li> <li>8. <a href="https://bizstator.com/in/successful-indian-entrepreneurs-stories">https://bizstator.com/in/successful-indian-entrepreneurs-stories</a></li> <li>9. <a href="https://www.entrepreneur.com/article/299214">https://www.entrepreneur.com/article/299214</a></li> <li>10. <a href="https://www.fundera.com/blog/young-entrepreneurs">https://www.fundera.com/blog/young-entrepreneurs</a></li> <li>11. <i>The Entrepreneurs: Success and Sacrifice - by Kip Marlow</i> <a href="http://cbseacademic.nic.in/web material/Curriculum19/Main.../20_Entrepreneurship.pdf">cbseacademic.nic.in/web material/Curriculum19/Main.../20_Entrepreneurship.pdf</a></li> </ol>
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Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (100% weightage)								Final Examination	
		CLA – 1 (20%)		CLA – 2 (30%)		CLA – 3 (30%)		CLA – 4 (20%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember Understand	-	40%	-	30%	-	30%	-	30%	-	-
Level 2	Apply Analyze	-	40%	-	40%	-	40%	-	40%	-	-
Level 3	Evaluate Create	-	20%	-	30%	-	30%	-	30%	-	-
	Total	100 %		100 %		100 %		100 %		-	

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Course Designers			
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2. Mr. Ajay Zenner, Career Launcher, ajay.z@careerlauncher.com	2. Dr. A.K. Sheik Manzoor, Anna University, sheikmanzoor@annauniv.edu	2. Mr. Ananth Kumar, SRMIST	4. Mrs. Deepa Narayanan. SRMIST

Course Code	18PDM204L	Course Name	BUSINESS BASICS FOR ENTREPRENEURS	Course Category	M	Mandatory	L	T	P	C
							0	0	2	0

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Career Development Centre	Data Book / Codes/Standards	Nil		

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning			Program Learning Outcomes (PLO)														
CLR-1 :	Provides a base of Managerial application skills that enable students to understand practical managerial concepts	1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CLR-2 :	Comprehend business models	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3
CLR-3 :	Understand different accounting concepts																		
CLR-4 :	Understand the taxation and tax laws																		
CLR-5 :	Understand the process of design thinking																		
CLR-6 :	Acquire knowledge on business skills																		

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	1	80	75	L	H	-	M	-	-	-	-	M	L	-	H	-	-	-
CLO-1 :	Explain the nature and purpose of marketing; understand the fundamentals of each of the most important marketing tasks	1	80	75	L	H	-	M	-	-	-	-	M	L	-	H	-	-	-
CLO-2 :	Use the Business Models in their startups	1	80	75	L	H	-	M	-	-	-	-	M	L	-	H	-	-	-
CLO-3 :	Identify and appreciate the strong linkages between finance and globalization	2	80	75	L	H	-	M	-	-	-	-	M	L	-	H	-	-	-
CLO-4 :	Implement tax process	2	80	75	L	H	-	M	-	-	-	-	M	L	-	H	-	-	-
CLO-5 :	Acquire Design Thinking concepts to implement in the startup	1	80	75	L	H	-	M	-	-	-	-	M	H	-	H	-	-	-
CLO-6 :	Implement the essential business basics	3	80	75	L	H	-	M	-	-	-	-	M	H	-	H	-	-	-

	Marketing Management	Business Models	Financial Management	Costing and Taxation	Design Thinking	
Duration (hour)	6	6	6	6	6	
S-1	SLO-1	Introduction to Marketing Management	Business Models for startups	Introduction to Finance Management	Pricing Strategies	Design Thinking
	SLO-2	Understand the market	Introduction to SAAS	Effective and efficient management of money	Pricing for market penetration	Developing design concepts
S-2	SLO-1	6 P's of Marketing	Business model	Accounting Process	Types of Pricing	Five stages of design concepts
	SLO-2	5 P's of Marketing	Introduction to PAAS	Four steps in business transactions	Pricing strategies	Super charging with design thinking
S-3	SLO-1	Introduction to Consumer Behavior	Revenue Models	Basic Accounting Procedures	Introduction to MIS	Creating concepts
	SLO-2	Create value proposition	Application of revenue models	Basic book keeping for financial transactions	Data Analysis	Creating concepts
S-4	SLO-1	Types of Marketing	Outsourcing Models	Financial Statements	Taxation	Hackathon / Challenge Labs
	SLO-2	Business marketing concepts	Partnership Models	Profit and Loss account, Balance sheet Statement of cash flow	Taxation	Hackathon / Challenge Labs



S-5	SLO-1	Market Segmentation	Profitability	Working Capital Management	Tax laws	Hackathon / Challenge Labs
	SLO-2	Market Positioning	Business Metrics	Utilizing current assets and current liabilities for efficient operation	Tax laws	Hackathon / Challenge Labs
S-6	SLO-1	Branding	Business Model Analysis	Financial Ratios	Case studies and Problem Solving	Hackathon / Challenge Labs
	SLO-2	Creating USP	Practical Implementation	Profitability, Liquidity, Operating, Leverage	Case studies and Problem Solving	Hackathon / Challenge Labs

Learning Resources	<ol style="list-style-type: none"> <li>1. <i>Elon Musk – Ashley Vance- Virgin Books-2015</i></li> <li>2. <i>Think and Grow Rich – Napoleon Hill - The Ralston Society – 1937</i></li> <li>3. <i>The Lean Startup – Eric Ries - Crown Publishing Group (USA) – 2011</i></li> <li>4. <i>The \$100 Startup – Chris Gullibeau - Crown Business- 2012</i></li> <li>5. <i>Creativity, Innovation, and Entrepreneurship: The Only Way to Renew Your Organization - H. James Harrington - Productivity Press- December 2018</i></li> </ol>	<ol style="list-style-type: none"> <li>6. <a href="http://www.wfhen.org">www.wfhen.org</a>; National Entrepreneurship Network – Wadhvani Foundation</li> <li>7. <a href="https://www.forbes.com/sites/.../2017/.../top-entrepreneur-stories-to-inspire-you-in-2017/">https://www.forbes.com/sites/.../2017/.../top-entrepreneur-stories-to-inspire-you-in-2017/</a></li> <li>8. <a href="https://biztor.com/in/successful-indian-entrepreneurs-stories">https://biztor.com/in/successful-indian-entrepreneurs-stories</a></li> <li>9. <a href="https://www.entrepreneur.com/article/299214">https://www.entrepreneur.com/article/299214</a></li> <li>10. <a href="https://www.fundera.com/blog/young-entrepreneurs">https://www.fundera.com/blog/young-entrepreneurs</a></li> <li>11. <i>The Entrepreneurs: Success and Sacrifice - by Kip Marlow</i> <a href="http://cbseacademic.nic.in/web material/Curriculum19/Main.../20_Entrepreneurship.pdf">cbseacademic.nic.in/web material/Curriculum19/Main.../20_Entrepreneurship.pdf</a></li> </ol>
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Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (100% weightage)								Final Examination	
		CLA – 1 (20%)		CLA – 2 (30%)		CLA – 3 (30%)		CLA – 4 (20%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	-	40%	-	30%	-	30%	-	30%	-	-
	Understand	-	40%	-	30%	-	30%	-	30%	-	-
Level 2	Apply	-	40%	-	40%	-	40%	-	40%	-	-
	Analyze	-	40%	-	40%	-	40%	-	40%	-	-
Level 3	Evaluate	-	20%	-	30%	-	30%	-	30%	-	-
	Create	-	20%	-	30%	-	30%	-	30%	-	-
	Total	100 %		100 %		100 %		100 %		-	

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Course Code	18CYM101T	Course Name	ENVIRONMENTAL SCIENCE	Course Category	M	Mandatory	L	T	P	C
							1	0	0	0

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Chemistry	Data Book / Codes/Standards	Nil		

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning			Program Learning Outcomes (PLO)																																
CLR-1 :	Acquire knowledge on various causes, effects and control measures of environmental air and water pollution	1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15																		
CLR-2 :	Analyze causes, effects and control measures of soil, thermal and radiation pollution	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3																		
CLR-3 :	Utilize processes involved in waste water treatment and study the cause of a local polluted site																			H	H	H	H	-	-	H	-	-	-	-	-	-	-	-	-	-	
CLR-4 :	Analyze impacts, disposal methods and treatments involved in solid waste management																			H	H	H	H	-	-	H	-	-	H	-	-	-	-	-	-	-	-
CLR-5 :	Identify impacts, disposal methods, treatments involved in biomedical waste management																			H	H	H	H	-	-	H	-	H	-	-	-	-	-	-	-	-	-
CLR-6 :	Analyze the environmental issues and identify appropriate solutions																			H	H	H	H	-	-	H	-	H	-	-	-	-	-	-	-	-	-
Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:																																				
CLO-1 :	Analyze the sources, effects and control measures of environmental air pollution	1	80	70	H	H	H	H	-	-	H	-	-	-	-	-	-	-	-	-																	
CLO-2 :	Acquire knowledge on the treatment of soil, thermal and radiation management	1	75	65	H	H	H	H	-	-	H	-	-	-	-	-	-	-	-	-																	
CLO-3 :	Acquire knowledge on various process involved in the treatment of wastewater	1	80	70	H	H	H	H	-	-	H	-	H	-	-	-	-	-	-	-																	
CLO-4 :	Identify sources, disposal and treatment methods of solid waste management	1	80	75	H	H	H	H	-	-	H	-	H	-	-	-	-	-	-	-																	
CLO-5 :	Identify sources, disposal and treatment methods of biomedical waste management	1	75	65	H	H	H	H	-	-	H	-	H	-	-	-	-	-	-	-																	
CLO-6 :	Utilize the concepts learnt in protecting the environment towards sustainable development	1	80	70	H	H	H	H	-	-	H	-	H	-	-	-	-	-	-	-																	

Duration (hour)	3		3		3		3		3	
S-1	SLO-1	Environmental segments Structure of atmosphere	Determination of BOD, COD	Waste water treatment- Introduction	Solid waste management: Types	Biomedical Waste Management Definition and Effects				
	SLO-2	Composition of atmosphere	Determination of TDS and trace metals	Primary treatment	Effects Process of waste management	Categories of biomedical waste				
S-2	SLO-1	Air Pollution Sources	Sources, effects and control measures of Soil pollution	Secondary treatment	Disposal methods, Open dumping Engineered land filling	Process of biomedical waste management				
	SLO-2	Effects – acid rain, ozone layer depletion and greenhouse effect	Sources, effects and control measures of Thermal pollution	Tertiary treatment	Composting Incineration	Treatment and disposal methods				
S-3	SLO-1	Control measures of air pollution	Sources and effects of: Radiation pollution	Activity: Visit to a local polluted site- Urban/Rural/Industrial/Agricultural	Activity: Monitoring solid waste management in local areas	Activity: Visit a hospital to understand the biomedical waste management				
	SLO-2	Sources, Effects and control measures of Water pollution	Control measures of Radiation pollution	Activity: Visit to a local polluted site- Urban/Rural/Industrial/Agricultural	Activity: Monitoring solid waste management in local areas	Activity: Visit a hospital to understand the biomedical waste management				

Learning Resources	1. Erach Bharucha, Textbook of Environmental Studies for Undergraduate Courses, 2 <sup>nd</sup> ed., UGC 2. Kamaraj, P, Arthanareeswari. M, Environmental Science–Challenges and Changes, 6 <sup>th</sup> ed., Sudhandhira Publications, 2013	3. R. Jeyalakshmi, Principles of Environmental Science, 2 <sup>nd</sup> ed., Devi publications, 2008 4. Helen P Kavitha, Principles of Environmental Science, 1 <sup>st</sup> ed., Shine Publications and Distributors, 2013
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Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (100% weightage)								Final Examination	
		CLA – 1 (20%)		CLA – 2 (30%)		CLA – 3 (30%)		CLA – 4 (20%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember Understand	40%	-	30%	-	30%	-	30%	-	-	-
Level 2	Apply Analyze	40%	-	40%	-	40%	-	40%	-	-	-
Level 3	Evaluate Create	20%	-	30%	-	30%	-	30%	-	-	-
	Total	100 %		100 %		100 %		100 %		-	

# CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

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