

CURRICULUM AND SYLLABI

REGULATIONS - 2019



M. Tech.

COMPUTER SCIENCE AND ENGINEERING



B.S. Abdur Rahman
Crescent
Institute of Science & Technology
Deemed to be University u/s 3 of the UGC Act, 1956

VISION AND MISSION OF THE INSTITUTION

VISION

B. S. Abdur Rahman Crescent Institute of Science and Technology aspires to be a leader in Education, Training and Research in Engineering, Science, Technology and Management and to play a vital role in the Socio-Economic progress of the Country.

MISSION

- To blossom into an internationally renowned Institution
- To empower the youth through quality education and to provide professional leadership
- To achieve excellence in all its endeavors to face global challenges
- To provide excellent teaching and research ambience
- To network with global institutions of Excellence, Business, Industry and Research Organizations
- To contribute to the knowledge base through Scientific enquiry, Applied research and Innovation

VISION AND MISSION OF THE DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

VISION

The vision of the Department of Computer Science and engineering is to impart quality education, inculcate professionalism and enhance the problem solving skills of the students in the domain of Computer Science and Engineering with a focus to make them industry ready, involve in possible areas of research, to pursue and have continual professional growth.

MISSION

- To equip the students with strong fundamental concepts, analytical capability, programming and problem solving skills.
- To create an academic environment conducive for higher learning through faculty training, self learning, sound academic practices and research endeavors.
- To provide opportunities in order to promote organizational and leadership skills in students through various co-curricular and extra – curricular activities
- To make the students industry ready and to enhance their employability through training and internships.
- To improve department industry collaboration through interaction including participation in professional society activities, guest lecturers and industrial visit.

PROGRAMME EDUCATIONAL OBJECTIVES AND OUTCOMES

M. Tech. (Computer Science and Engineering)

PROGRAMME EDUCATIONAL OBJECTIVES

- To provide advanced knowledge and skills in the field of Computer Science and Engineering.
- To provide essential skill sets needed for Software Development as per the Industry requirements.
- To instill confidence and provide necessary ambience to take up fundamental as well as applied Research in Computer related domains with social relevance.
- To impart required analytical skills and tools for solving problems with varied complexity.
- To hone necessary skills to effectively communicate, work as a team for a successful professional career.

PROGRAMME OUTCOMES

On completion of the programme the graduates will

- have the capability to design and develop computer based systems for different domains.
- be able to apply the knowledge of computing tools and techniques for solving real life problems encountered in Software Industries.
- be able to pursue quality research in areas of social relevance. be able to work as a team exhibiting effective managerial skills.

REGULATIONS – 2019
FOR
M. Tech. / MCA / M.Sc. DEGREE PROGRAMMES

1.0 PRELIMINARY DEFINITIONS AND NOMENCLATURE

In these Regulations, unless the context otherwise requires

- i. **"Programme"** means a Post Graduate Degree Programme (M. Tech. /MCA / M.Sc.)
- ii. **"Course"** means a theory or practical subject that is normally studied in a semester, like Applied Mathematics, Structural Dynamics, Computer Aided Design, etc.
- iii. **"Institution"** means B.S. Abdur Rahman Crescent Institute of Science and Technology, Chennai, 600048.
- iv. **"Dean (Academic Affairs)"** means Dean (Academic Affairs) of B.S. Abdur Rahman Crescent Institute of Science and Technology, who administers the academic matters.
- v. **"Dean (P.G. Studies)"** means Dean (P.G. Studies) of B.S. Abdur Rahman Crescent Institute of Science and Technology, who administers all P.G. Programmes of the Institution in coordination with Dean (Academic Affairs)
- vi. **"Dean (Student Affairs)"** means Dean (Student Affairs) of B.S. Abdur Rahman Crescent Institute of Science and Technology, who looks after the welfare and discipline of the students.
- vii. **"Controller of Examinations"** means the Controller of Examinations of B.S. Abdur Rahman Crescent Institute of Science and Technology, who is responsible for conduct of examinations and declaration of results.

2.0 PROGRAMMES OFFERED, MODE OF STUDY AND ADMISSION REQUIREMENTS

2.1 P.G. Programmes Offered

The various P.G. Programmes and their modes of study are as follows:

Degree	Mode of Study
M. Tech. /M.C.A. / M.Sc.	Full Time & Part Time – Day / Evening / Weekends

2.2 Modes of Study

2.3.1 Full-time

Students admitted under "Full-Time" shall be available in the Institution during the complete working hours for curricular, co-curricular and extra-curricular activities assigned to them.

2.3.2

A full time student, who has completed all non-project courses desiring to do the Project work in part-time mode for valid reasons, shall apply to the Dean (Academic Affairs) through the Head of the Department. Permission may be granted based on merits of the case. Such conversion is not permitted in the middle of a semester.

2.3.3 Part-time

In this mode of study, the students are required to attend classes for the courses in the time slots selected by them, during the daytime (or) evenings (or) weekends.

2.3 Admission Requirements

2.3.1

Students for admission to the first semester of the Master's Degree Programme shall be required to have passed the appropriate degree examination of this Institution as specified in the Table shown for eligible entry qualifications for admission to P.G. programmes or any other degree examination of any University or authority accepted by this Institution as equivalent thereto.

2.3.2

Eligibility conditions for admission such as class obtained, number of attempts in the qualifying examination and physical fitness will be as prescribed by this Institution from time to time.

2.3.3

All part-time students should satisfy other conditions regarding experience, sponsorship etc., which may be prescribed by this Institution from time to time.

2.3.4

Student eligible for admission to M.C.A under lateral entry scheme shall be required to have passed three year degree in B.Sc (Computer Science) / B.C.A / B.Sc (Information Technology)

3.0 DURATION AND STRUCTURE OF THE P.G. PROGRAMME

3.1

The minimum and maximum period for completion of the P.G. Programmes are given below:

Programme	Min. No. of Semesters	Max. No. of Semesters
M. Tech. (Full Time)	4	8
M. Tech. (Part Time)	6	12
M.C.A. (Full Time)	6	12
M.C.A. (Part Time)	9	18
M.C.A. (Full Time) – (Lateral Entry)	4	8
M.C.A. (Part Time) – (Lateral Entry)	6	12
M.Sc. (Full Time)	4	8
M. Sc. (Part Time)	6	12

3.2

The PG. programmes consist of the following components as prescribed in the respective curriculum

- i. Core courses
- ii. General Elective courses
- iii. Professional Elective courses
- iv. Project work / thesis / dissertation
- v. Laboratory Courses
- vi. Case studies
- vii. Seminars
- viii. Mini Project
- ix. Industrial Internship

3.3

The curriculum and syllabi of all PG. programmes shall be approved by the Academic Council of this Institution.

3.4

The minimum number of credits to be earned for the successful completion of the programme shall be specified in the curriculum of the respective specialization of the P.G. programme.

3.5

Each academic semester shall normally comprise of 80 working days. Semester-end examinations will follow immediately after the last working day.

ELIGIBLE ENTRY QUALIFICATIONS FOR ADMISSION TO P.G. PROGRAMMES

Sl. No.	Name of the Department	P.G. Programmes offered	Qualifications for admission
01	Civil Engineering	M. Tech. (Structural Engineering)	B.E / B. Tech. (Civil Engineering) / (Structural Engineering)
		M. Tech. (Construction Engineering and Project Management)	
02	Mechanical Engineering	M. Tech. (Manufacturing Engineering)	B.E. / B. Tech. (Mechanical / Auto / Manufacturing / Production / Industrial / Mechatronics / Metallurgy / Aerospace /Aeronautical / Material Science / Marine Engineering)
		M. Tech. (CAD/CAM)	
03	Polymer Engineering	M. Tech. (Polymer Technology)	B. E. / B. Tech. Mechanical / Production /Polymer Science or Engg or Tech / Rubber Tech / M.Sc (Polymer Sc./ Chemistry Appl. Chemistry)
04	Electrical and Electronics Engineering	M. Tech. (Power Systems Engg)	B.E / B.Tech (EEE / ECE / E&I / I&C / Electronics / Instrumentation)
		M. Tech. (Power Electronics & Drives)	B.E / B.Tech (EEE / ECE / E&I / I&C / Electronics / Instrumentation)
05	Electronics and Communication Engineering	M. Tech. (Communication Systems)	B.E / B.Tech (EEE/ ECE / E&I / I&C / Electronics / Instrumentation)
		M. Tech. (VLSI and Embedded Systems)	B.E. / B. Tech. (ECE / Electronics / E&I / I&C / EEE)
06	ECE Department jointly with Physics Dept.	M. Tech. (Optoelectronics and Laser Technology)	B.E. / B. Tech. (ECE / EEE / Electronics / EIE / ICE) M.Sc (Physics / Materials Science / Electronics / Photonics)
07	Electronics and Instrumentation Engineering	M. Tech. (Electronics and Instrumentation Engineering)	B.E. / B. Tech. (EIE / ICE / Electronics / ECE / EEE)

Sl. No.	Name of the Department	P.G. Programmes offered	Qualifications for admission
08	Computer Science and Engineering	M. Tech. (Computer Science and Engineering)	B.E. / B. Tech. (CSE / IT / ECE / EEE / EIE / ICE / Electronics / MCA)
		M. Tech. (Software Engineering)	B.E. / B. Tech. (CSE / IT) MCA
		M. Tech. (Network Security)	B.E. / B. Tech. (CSE / IT / ECE / EEE / EIE / ICE / Electronics / MCA)
		M. Tech. (Computer Science and Engineering with specialization in Big Data Analytics)	B.E. / B. Tech. (CSE / IT / ECE / EEE / EIE / ICE / Electronics / MCA)
09	Information Technology	M. Tech. (Information Technology)	B.E / B. Tech. (IT / CSE / ECE / EEE / EIE / ICE / Electronics) MCA
		M. Tech. (Information Security & Digital Forensics)	B.E / B. Tech. (IT / CSE / ECE / EEE / EIE / ICE / Electronics) MCA
10	Computer Applications	M.C.A.	Bachelor Degree in any discipline with Mathematics as one of the subjects (or) Mathematics at +2 level
		M.C.A. – (Lateral Entry)	B.Sc Computer Science / B.Sc Information Technology / B.C.A
		M. Tech. (Systems Engineering and Operations Research)	BE / B. Tech. (Any Branch) or M.Sc., (Maths / Physics / Statistics / CS / IT / SE) or M.C.A.
		M. Tech. (Data & Storage Management)	BE / B. Tech. (Any Branch) or M.Sc., (Maths / Physics / Statistics / CS / IT / SE) or M.C.A.
11	Mathematics	M.Sc. (Actuarial Science)	Any Degree with Mathematics / Statistics as one of the subjects of study.
		M.Sc. Mathematics	B.Sc. (Mathematics)
12	Physics	M.Sc.(Physics)	B.Sc.(Physics / Applied Science / Electronics / Electronics Science / Electronics & Instrumentation)
		M.Sc. (Material Science)	B.Sc.(Physics / Applied Science / Electronics / Electronics

Sl. No.	Name of the Department	P.G. Programmes offered	Qualifications for admission
			Science / Electronics & Instrumentation)
13	Chemistry	M.Sc.(Chemistry)	B.Sc (Chemistry / Applied Science)
14	Life Sciences	M.Sc. Molecular Biology & Biochemistry	B.Sc. in any branch of Life Sciences
		M.Sc. Genetics	B.Sc. in any branch of Life Sciences
		M.Sc. Biotechnology	B.Sc. in any branch of Life Sciences
		M.Sc. Microbiology	B.Sc. in any branch of Life Sciences
		M.Sc. Bioscience	B.Sc. in any branch of Life Sciences
		M. Tech. Biotechnology	B. Tech. (Biotechnology / Chemical Engineering) / M.Sc. in any branch of Life Sciences

3.6

The curriculum of PG programmes shall be so designed that the minimum prescribed credits required for the award of the degree shall be within the limits specified below:

Programme	Minimum prescribed credits
M. Tech.	73
M.C.A.	120
M.Sc.	72

3.7

Credits will be assigned to the courses for all P.G. programmes as given below:

- One credit for one lecture period per week (or) 15 periods per semester
- One credit for one tutorial period per week
- One credit each for seminar/practical session/project of two or three periods per week
- One credit for two weeks of industrial internship
- One credit for 15 periods of lecture (can even be spread over a short span of time)

3.8

The number of credits registered by a student in non-project semester and project semester should be within the range specified below:

P.G. Programme	Full Time		Part Time	
	Non-project Semester	Project semester	Non-project Semester	Project semester
M. Tech.	9 to 28	12 to 28	6 to 12	12 to 28
M.C.A.	9 to 29	12 to 29	6 to 12	12 to 29
M.Sc.	9 to 25	12 to 20	6 to 12	12 to 20

- 3.9** The student may choose a course prescribed in the curriculum from any department depending on his / her convenient time slot. All attendance will be maintained course-wise only.
- 3.10** The electives from the curriculum are to be chosen with the approval of the Head of the Department.
- 3.11** A student may be permitted by the Head of the Department to choose electives from other PG programmes either within the Department or from other Departments up to a maximum of nine credits during the period of his/her study, with the approval of the Head of the Departments offering such courses.
- 3.12** To help the students to take up special research areas in their project work and to enable the department to introduce courses in latest/emerging areas in the curriculum, "Special Electives" may be offered. A student may be permitted to register for a "Special Elective" up to a maximum of three credits during the period of his/her study, provided the syllabus of this course is recommended by the Head of the Department and approved by the Chairman, Academic Council before the commencement of the semester, in which the special elective course is offered. Subsequently, such course shall be ratified by the Board of Studies and Academic Council.
- 3.13** The medium of instruction, examination, seminar and project/thesis/dissertation reports will be English.
- 3.14** Industrial internship, if specified in the curriculum shall be of not less than two weeks duration and shall be organized by the Head of the Department.
- 3.15 Project Work / Thesis / Dissertation**
- 3.15.1** Projectwork / Thesis / Dissertation shall be carried out under the supervision of a Faculty member in the concerned Department.
- 3.15.2** A student may however, in certain cases, be permitted to work for the project in an Industrial/Research Organization, on the recommendation of the Head of the Department. In such cases, the project work shall be jointly supervised by a faculty of the Department and an Engineer / Scientist from

the organization and the student shall be instructed to meet the faculty periodically and to attend the review committee meetings for evaluating the progress.

- 3.15.3** Project work / Thesis / Dissertation (Phase - II in the case of M. Tech.) shall be pursued for a minimum of 16 weeks during the final semester, following the preliminary work carried out in Phase-1 during the previous semester.
- 3.15.4** The Project Report/Thesis / Dissertation report / Drawings prepared according to approved guidelines and duly signed by the supervisor(s) and the Head of the Department shall be submitted to the concerned department.
- 3.15.5** The deadline for submission of final Project Report / Thesis / Dissertation is within 30 calendar days from the last working day of the semester in which Project / Thesis / Dissertation is done.
- 3.15.6** If a student fails to submit the Project Report / Thesis / Dissertation on or before the specified deadline he / she is deemed to have not completed the Project Work / Thesis / dissertation and shall re-register the same in a subsequent semester.

4.0 CLASS ADVISOR AND FACULTY ADVISOR

4.1 Class Advisor

A faculty member will be nominated by the HOD as Class Advisor for the whole class.

He / she is responsible for maintaining the academic, curricular and co-curricular records of all students throughout their period of study.

4.2 Faculty Advisor

To help the students in planning their courses of study and for general counseling on the academic programme, the Head of the Department of the students will attach a certain number of students to a faculty member of the department who shall function as Faculty Advisor for the students throughout their period of study. Such Faculty Advisor shall offer advice to the students on academic and personal matters and guide the students in taking up courses for registration and enrolment every semester.

5.0 CLASS COMMITTEE

5.1 Every class of the PG Programme will have a Class Committee constituted by the Head of the Department as follows:

- i. Teachers of all courses of the programme
- ii. One senior faculty preferably not offering courses for the class, as Chairperson.

- iii. Minimum two students of the class, nominated by the Head of the Department.
- iv. Class Advisor / Faculty Advisor of the class - Ex-Officio Member
- v. Professor in-charge of the PG Programme - Ex-Officio Member.

5.2The Class Committee shall be constituted by the respective Head of the Department of the students.

5.3The basic responsibilities of the Class Committee are to review periodically the progress of the classes to discuss problems concerning curriculum and syllabi and the conduct of classes. The type of assessment for the course will be decided by the teacher in consultation with the Class Committee and will be announced to the students at the beginning of the semester. Each Class Committee will communicate its recommendations to the Head of the Department and Dean (Academic Affairs). The class committee, **without the student members**, will also be responsible for finalization of the semester results and award of grades.

5.4The Class Committee is required to meet at least thrice in a semester, first within a week of the commencement of the semester, second, after the first assessment and the third, after the semester-end examination to finalize the grades.

6.0 COURSE COMMITTEE

Each common theory course offered to more than one group of students shall have a "Course Committee" comprising all the teachers teaching the common course with one of them nominated as Course coordinator. The nomination of the Course coordinator shall be made by the Head of the Department / Dean (Academic Affairs) depending upon whether all the teachers teaching the common course belong to a single department or to several departments. The Course Committee shall meet as often as possible and ensure uniform evaluation of the tests and arrive at a common scheme of evaluation for the tests. Wherever it is feasible, the Course Committee may also prepare a common question paper for the test(s).

7.0 REGISTRATION AND ENROLMENT

7.1For the first semester every student has to register for the courses within one week from the commencement of the semester

7.2For the subsequent semesters registration for the courses will be done by the student one week before the last working day of the previous semester. The curriculum gives details of the core and elective courses, project and seminar to be taken in different semester with the number of credits. The

student should consult his/her Faculty Advisor for the choice of courses. The Registration form shall be filled in and signed by the student and the Faculty Advisor.

7.3 From the second semester onwards all students shall pay the prescribed fees and enroll on a specified day at the beginning of a semester.

7.4 A student will become eligible for enrolment only if he/she satisfies clause 9 and in addition he/she is not debarred from enrolment by a disciplinary action of the Institution. At the time of enrolment a student can drop a course registered earlier and also substitute it by another course for valid reasons with the consent of the Faculty Advisor. Late enrolment will be permitted on payment of a prescribed fine up to two weeks from the date of commencement of the semester.

7.5 Withdrawal from a course registered is permitted up to one week from the date of the completion of the first assessment test.

7.6 Change of a course within a period of 15 days from the commencement of the course, with the approval of Dean (Academic Affairs), on the recommendation of the HOD, is permitted.

7.7 Courses withdrawn will have to be taken when they are offered next if they belong to the list of core courses.

7.8 A student undergoing a full time PG Programme should have enrolled for all preceding semesters before registering for a particular semester

7.9 A student undergoing the P.G. programme in Part Time mode can choose not to register for any course in a particular semester with written approval from the head of the department. However the total duration for the completion of the programme shall not exceed the prescribed maximum number of semesters (vide clause 3.1)

8.0 TEMPORARY BREAK OF STUDY FROM THE PROGRAMME

A student may be permitted by the Dean (Academic Affairs) to avail temporary break of study from the programme up to a maximum of two semesters for reasons of ill health or other valid grounds. Such student has to rejoin only in the same semester from where he left. However the total duration for completion of the programme shall not exceed the prescribed maximum number of semesters (vide clause 3.1).

9.0 MINIMUM REQUIREMENTS TO REGISTER FOR PROJECT / THESIS / DISSERTATION

9.1 A student is permitted to register for project semester, if he/she has earned the minimum number of credits specified below:

Programme	Minimum No. of credits to be earned to enroll for project semester
M. Tech. (Full time / Part time)	18
M.C.A. (Full time / Part time)	45
M.C.A. (Full time / Part time) – (Lateral Entry)	22
M.Sc.(Full time / Part time)	18

9.2 If the student has not earned minimum number of credits specified, he/she has to earn the required credits, at least to the extent of minimum credits specified in clause 9.1 and then register for the project semester.

10.0 DISCIPLINE

10.1 Every student is required to observe discipline and decorous behavior bothinside and outside the campus and not to indulge in any activity, which will tend to bring down the prestige of the Institution.

10.2 Any act of indiscipline of a student reported to the Head of the Institution willbe referred to a Discipline and Welfare Committee for taking appropriate action.

11.0 ATTENDANCE

11.1 Attendance rules for all Full Time Programme and Part time Programmes aregiven in the following sub-clause.

11.2 Ideally every student is expected to attend all classes and earn 100%attendance in the contact periods of every course, subject to a maximum relaxation of 25% for genuine reasons like on medical grounds, representing the Institution in approved events etc., to become eligible to appear for the semester-end examination in that course, failing which the student shall be awarded "I" grade in that course. If the course is a core course, the student should register for and repeat the course when it is offered next. If the course is an elective, either he/she can register and repeat the same elective or can register for a new elective.

11.3 The students of Full Time mode of study, who have not attended a singlehour in all courses in a semester and awarded „I“ grade are not permitted to

write the examination and also not permitted move to next higher semester. Such students should repeat all the courses of the semester in the next Academic year.

12.0 SUMMER TERM COURSES

- 12.1** Summerterm courses may be offered by a department on the recommendation of the Departmental Consultative Committee and approved by the Dean (Academic Affairs). No student should register for more than three courses during a summer term.
- 12.2** Summer term courses will be announced by the Head of the department at the end of the even semester before the commencement of the end semester examinations. A student will have to register within the time stipulated in the announcement. A student has to pay the fees as stipulated in the announcement.
- 12.3** The number of contact hours and the assessment procedure for any course during summer term will be the same as those during regular semesters. Students with U grades will have the option either to write semester end arrears exam or to redo the courses during summer / regular semesters, if they wish to improve their continuous assessment marks subject to the approval of the Head of the department.
- 12.4** Withdrawal from a summer term course is not permitted. No substitute examination will be conducted for the summer term courses.
- 12.5** The summer term courses are not applicable for the students of Part Time mode.

13.0 ASSESSMENTS AND EXAMINATIONS

- 13.1** The following rule shall apply to all the PG programmes (M. Tech. / M.C.A./ M.Sc.)

For lecture-based courses, normally a minimum of two assessments will be made during the semester. The assessments may be combination of tests and assignments. The assessment procedure as decided in the Class Committee will be announced to the students right from the beginning of the semester by the course teacher.

- 13.2** There shall be one examination of three hours duration, at the end of the semester.
- 13.3** In one (or) two credit courses that are not spread over the entire semester, the evaluation will be conducted at the completion of the course itself. Anyhow approval for the same is to be obtained from the HoD and the Dean of Academic Affairs.

13.4 The evaluation of the Project work will be based on the project report and a Viva-Voce Examination by a team consisting of the supervisor concerned, an Internal Examiner and External Examiner to be appointed by the Controller of Examinations.

13.5 At the end of industrial internship, the student shall submit a certificate from the organization and also a brief report. The evaluation will be made based on this report and a Viva-Voce Examination, conducted internally by a Departmental Committee constituted by the Head of the Department.

14.0 WEIGHTAGES

14.1 The following shall be the weightages for different courses:

i) Lecture based course

Two continuous assessments	50%
Semester-end examination	50%

ii) Laboratory based courses

Laboratory work assessment	75%
Semester-end examination	25%

iii) Project work

Periodic reviews	50%
Evaluation of Project Report by External Examiner	20%
Viva-Voce Examination	30%

14.2 Appearing for semester end examination for each course (Theory and Practical) is mandatory and a student should secure a minimum of 40% marks in semester end examination for the successful completion of the course.

14.3 The markings for all tests, tutorial, assignments (if any), laboratory work and examinations will be on absolute basis. The final percentage of marks is calculated in each course as per the weightages given in clause 13.1.

15.0 SUBSTITUTE EXAMINATION

15.1 A student who has missed for genuine reasons any one of the three assessments including semester-end examination of a course may be permitted to write a substitute examination. However, permission to take up a substitute examination will be given under exceptional circumstances, such as accident or admissions to a hospital due to illness, etc.

15.2 A student who misses any assessment in a course shall apply in a prescribed form to the Dean (Academic Affairs) through the Head of the department within a week from the date of missed assessment. However

the substitute tests and examination for a course will be conducted within two weeks after the last day of the semester-end examinations.

16.0 COURSEWISE GRADING OF STUDENTS AND LETTER GRADES

16.1 Based on the semester performance, each student is awarded a final lettergrade at the end of the semester in each course. The letter grades and the corresponding grade points are as follows, but grading has to be relative grading

Letter grade	Grade points
S	10
A	9
B	8
C	7
D	6
E	5
U	0
W	-
I	-
AB	-

- Flexible range grading system will be adopted
- “W” denotes withdrawal from the course.
- “I” denotes inadequate attendance and hence prevention from semester-end examination
- “U” denotes unsuccessful performance in a course.
- “AB” denotes absent for the semester end examination

16.2 A student is considered to have completed a course successfully if he / she secure five grade points or higher. A letter grade „U” in any course implies unsuccessful performance in that course.

16.3 A course successfully completed cannot be repeated for any reason.

17.0 AWARD OF LETTER GRADE

17.1 A final meeting of the Class Committee without the student member(s) will be convened within ten days after the last day of the semester end examination. The letter grades to be awarded to the students for different courses will be finalized at the meeting.

17.2 After finalization of the grades at the class committee meeting the Chairman will forward the results to the Controller of Examinations, with copies to Head of the Department and Dean (Academic Affairs).

18.0 DECLARATION OF RESULTS

18.1 After finalization by the Class Committee as per clause 16.1 the Letter grades awarded to the students in the each course shall be announced on the departmental notice board after duly approved by the Controller of Examinations.

18.2 In case any student feels aggrieved about the results, he/she can apply for reevaluation after paying the prescribed fee for the purpose, within one week from the announcement of results.

A committee will be constituted by the concerned Head of the Department comprising of the Chairperson of the concerned Class Committee (Convener), the teacher concerned and a teacher of the department who is knowledgeable in the concerned course. If the Committee finds that the case is genuine, it may jointly revalue the answer script and forward the revised marks to the Controller of Examinations with full justification for the revision, if any.

18.3 The “U” and “AB” grade once awarded stays in the grade sheet of the students and is not deleted when he/she completes the course successfully later. The grade acquired by the student later will be indicated in the grade sheet of the appropriate semester.

19.0 COURSE REPETITION AND ARREARS EXAMINATION

19.1 A student should register to re-do a core course wherein “I” or “W” grade is awarded. If the student is awarded “I” or “W” grade in an elective course either the same elective course may be repeated or a new elective course may be taken.

19.2 A student who is awarded “U” or “AB” grade in a course shall write the semester-end examination as arrear examination, at the end of the next semester, along with the regular examinations of next semester courses.

19.3 A student who is awarded “U” or “AB” grade in a course will have the option of either to write semester end arrear examination at the end of the subsequent semesters, or to redo the course whenever the course is offered. Marks earned during the redo period in the continuous assessment for the course, will be used for grading along with the marks earned in the end-semester (redo) examination.

19.4 If any student obtained “U” or “AB” grade, the marks earned during the redo

period for the continuous assessment for that course will be considered for further appearance as arrears.

19.5 If a student with “U” or “AB” grade prefers to redo any particular course fail to earn the minimum 75% attendance while doing that course, then he/she will not be permitted to write the semester end examination and his / her earlier „U” grade and continuous assessment marks shall continue.

20.0 GRADE SHEET

20.1 The grade sheet issued at the end of the semester to each student will contain the following:

the credits for each course registered for that semester.

the performance in each course by the letter grade obtained.

the total credits earned in that semester.

the Grade Point Average (GPA) of all the courses registered for that semester and the Cumulative Grade Point Average (CGPA) of all the courses taken up to that semester.

20.2 The GPA will be calculated according to the formula

$$GPA = \frac{\sum_{i=1}^n (C_i)(GP_i)}{\sum_{i=1}^n (C_i)}$$

where n = number of courses

where C_i is the number of credits assigned for i^{th}

course GP_i - Grade point obtained in the i^{th} course

for the cumulative grade point average (CGPA) a similar formula is used except that the sum is over all the courses taken in all the semesters completed up to the point of time.

„I” and „W” grades will be excluded for GPA calculations.

„U”, „AB”, „I” and „W” grades will be excluded for CGPA calculations.

20.3 Classification of the award of degree will be as follows:

20.3.1 For students under full time mode of study

CGPA	Classification
8.50 and above, having completed all courses in first appearance	First class with Distinction
6.50 and above, having completed within a period of 2 semesters beyond the programme period	First Class
All others	Second Class

However, to be eligible for First Class with Distinction, a student should not have obtained U or I grade in any course during his/her study and should have completed the PG Programme within a minimum period covered by the minimum duration (clause 3.1) plus authorized break of study, if any (clause 8). To be eligible for First Class, a student should have passed the examination in all courses within the specified minimum number of semesters reckoned from his/her commencement of study plus two semesters. For this purpose, the authorized break of study will not be counted. The students who do not satisfy the above two conditions will be classified as second class. For the purpose of classification, the CGPA will be rounded to two decimal places. For the purpose of comparison of performance of students and ranking, CGPA will be considered up to three decimal places.

20.3.2 For students under part time mode of study

CGPA	Classification
8.50 and above, having completed all courses in first appearance	First class with Distinction
6.50 and above	First Class
All others	Second Class

For the purpose of classification, the CGPA will be rounded to two decimal places.

21.0 ELIGIBILITY FOR THE AWARD OF THE MASTERS DEGREE

21.1 A student shall be declared to be eligible for the award of the MastersDegree, if he/she has:

- i) successfully acquired the required credits as specified in the Curriculum corresponding to his/her programme within the stipulated time,
- ii) no disciplinary action is pending against him/her.

21.2 The award of the degree must be approved by the Institution.

22.0 POWER TO MODIFY

Notwithstanding all that have been stated above, the Academic Council has the right to modify any of the above regulations from time to time.

CURRICULUM & SYLLABI FOR M. Tech. (Computer Science and Engineering)

CURRICULUM

S.No	Semester	Course Code	Course Title	L	T	P	C
1	I	MAD6181	Applied Algebra and Discrete Algorithms	3	1	0	4
2		CSD6101	Advanced Computer Architecture	3	0	0	3
3		CSD6102	Algorithm Design and Implementation	3	0	2	4
4		CSD6103	Computer Networks and Management	3	0	0	3
4		CSD6104	Advanced Software Engineering	2	0	0	2
6			Professional Elective – 1	3	0	0	3
7		CSD6105	Case Study 1	0	0	2	1
							20
8	II	GED6201	Research Methodology For Engineers	3	1	0	4
9		CSD6201	Machine Learning Techniques	3	0	2	4
10		CSD6202	Applied Cryptography & Network Security	3	0	0	3
11			Professional Electives#	9			
			* Value Added Course	-			
							20
12	III	CSD7101	Internship	0	0	2	1
13			Professional Electives -2	6			
14			General Elective	3	0	0	3
15		CSD7102	Project – Phase I	0	0	1	6
						2	
							16
16	IV	CSD7102	Project – Phase II	0	0	3	1
					6		8
							6+18=24
			Total				75

Note:

- ❖ Departments can have fixed core courses in each semester or giving choice of students to select satisfying prerequisite condition.(Optional)
- ❖ Enrollment in Value added course is mandatory for Programme completion.
- ❖ Enrollment in MOOC course (noncredit) is mandatory for Phase I Project completion and Project supervisor will act as course coordinator.
- ❖ For professional electives students can choose MOOC courses for credit transfer.

Value Added Course: Guidelines

- ❖ Any relevant certification course offered by the Institution.
- ❖ Any relevant certification course offered by other Institutions / Universities; Bombay IIT(ST);MOOC courses etc.

MOOC courses: Guide lines

A minimum of one credit MOOC course relevant to project work shall be selected.

Important Note:

The selection of Value added course and MOOC by students shall be endorsed by Head of the Department.

ELECTIVE I

Sl.No	Code	Course Title	L	T	P	C
1	CSDY001	Cloud Computing and Technology	3	0	0	3
2	CSDY002	Cloud Storage and computing	3	0	0	3
3	CSDY003	Virtualization	3	0	0	3
4	CSDY004	Cloud architecture and computing	3	0	0	3
5	CSDY005	Pervasive Computing	3	0	0	3
6	CSDY006	Social Network Analysis & Mining	3	0	0	3
7	CSDY007	Security issues in Cloud Computing	3	0	0	3

ELECTIVE II

Sl.No	Code	Course Title	L	T	P	C
1	CSDY008	Data warehousing and data mining	3	0	0	3
2	CSDY009	Data Science with Python	3	0	0	3
3	CSDY010	Big data analytics and IoT	3	0	0	3
4	CSDY011	Predictive Analytics	3	0	0	3
5	CSDY012	IoT Architecture and Protocols	3	0	0	3
6	CSDY013	Statistics for Business Analytic	3	0	0	3
7	CSDY014	Data Analytics	3	0	0	3

ELECTIVE III

SI.No	Code	Course Title	L	T	P	C
1	CSDY015	Software Testing and Quality Assurance	3	0	0	3
2	CSDY016	Software Project Management	3	0	0	3
3	CSDY017	Object Oriented Analysis and Design	3	0	0	3
4	CSDY018	Software Design and Architecture	3	0	0	3
5	CSDY019	Formal methods of software engineering	3	0	0	3
6	CSDY020	Agile software development	3	0	0	3
7	CSDY021	Software Engineering Process, Tools and Methods	3	0	0	3

ELECTIVE IV

SI.No	Code	Course Title	L	T	P	C
1	CSDY022	Mobile Adhoc Networks	3	0	0	3
2	CSDY023	Hacking Techniques & Digital Forensics	3	0	0	3
3	CSDY024	Information Security	3	0	0	3
4	CSDY025	Mobile & Wireless Network security	3	0	0	3
5	CSDY026	Wireless Networks	3	0	0	3
6	CSDY027	Mobile Application Development	3	0	0	3
7	CSDY028	RFID and Microcontroller	3	0	0	3

ELECTIVE V

Sl.No	Code	Course Title	L	T	P	C
1	CSDY029	Knowledge Engineering and Expert Systems	3	0	0	3
2	CSDY030	Agent based intelligent systems	3	0	0	3
3	CSDY031	Deep Learning techniques	3	0	0	3
4	CSDY032	Statistical Natural Language Processing	3	0	0	3
5	CSDY033	Robotics and Intelligent Systems	3	0	0	3
6	CSDY034	Intelligent Information Retrieval	3	0	0	3
7	CSDY035	Soft computing	3	0	0	3

GENERAL ELECTIVES FOR M.TECH PROGRAMMES

Sl. No.	Course Code	Course Title	L	T	P	C
1	GECY101	Project Management	3	0	0	3
2	GECY102	Society, Technology & Sustainability	3	0	0	3
3	GECY103	Artificial Intelligence	3	0	0	3
4	GECY104	Green Computing	3	0	0	3
5	GECY105	Gaming Design	3	0	0	3
6	GECY106	Social Computing	3	0	0	3
7	GECY107	Soft Computing	3	0	0	3
8	GECY108	Embedded System Programming	3	0	0	3
9	GECY109	Principles of Sustainable Development	3	0	0	3
10	GECY110	Quantitative Techniques in Management	3	0	0	3
11	GECY111	Programming using MATLAB & SIMULINK	1	0	2	2
12	GECY112	JAVA Programming	1	0	2	2
13	GECY113	PYTHON Programming	1	0	2	2
14	GECY114	Intellectual Property Rights	1	0	0	1

SEMESTER I

MAD 6181	APPLIED ALGEBRA AND DISCRETE ALGORITHMS	L	T	P	C
	(For M Tech CS and IT)	3	1	0	4

OBJECTIVES : The aim of this course is to

- Make the students familiarize on the concepts of mathematical induction and codes.
- Motivate the students to solve problems applying techniques of logic.
- To have a knowledge on the concepts of Formal languages and Automata theory.
- Familiarize students with basics of graph theory.
- Train the students in applying the basic concepts of Cryptography.

MODULE I INTEGERS, COMPUTER ALGEBRA AND CODES 9+3

Integers – computer algebra versus numerical analysis – sums and products – mathematical induction – Binary, Hexadecimal, ASCII, Morse, Braille, Two out of Five and Hollerith Codes.

MODULE II LOGIC 9+3

Propositional logic–logical connectives – truth tables – normal forms (conjunctive and disjunctive) – solving word problems - predicate logic - universal and existential quantifiers - proof techniques – direct and indirect – proof by contradiction – applications.

MODULE III MODELING, COMPUTATION AND LANGUAGES 9+3

Finite state machines - deterministic and non-deterministic finite state machines - classes of grammars - phrase structure grammar - context sensitive - context-free - regular grammars - formal languages - ambiguity - Turing machines.

MODULE IV GRAPH THEORY 9+3

Multigraphs - applications of graph theory - classes of graphs - subgraphs and morphisms - Hamilton circuits – planar graphs – shortest paths and spanning trees – applications.

MODULE V CIPHERS 9+3

Cryptography - cryptanalysis - substitution and permutation ciphers – block cipher – the play fair cipher – unbreakable ciphers – applications.

L – 45; T – 15; Total Hours : 60

TEXT BOOKS:

- 1 Hopcraft, J. E, R. Motwani and Ullman, J. D, 'Introduction to Automata theory, Languages and Computation', Narosa publishing House, 4thedition 2006.
- 2 Kenneth H. Rosen, "Discrete Mathematics and its Applications", 7th edition, Tata

McGraw-Hill Publishing Company Limited, New Delhi, 2015.

- 3 J.P. Tremblay and R. Manohar, "Discrete Mathematical Structures with Applications to Computer Science", Tata McGraw Hill, 1997.

REFERENCES:

- 1 Juraj Hromkovic, Theoretical Computer Science: Introduction to Automata, Computability, Complexity, Algorithmics, Randomization, Communication and Cryptography, Springer, 2003.
- 2 Darel W. Hardy, Fred Richman, Carol L. Walker, Applied Algebra: Codes, Ciphers and Discrete Algorithms, Second Edition (Discrete Mathematics and Its Applications), CRC Press, New York, 2009.
- 3 David Gries and Fred B. Schneider, A Logical Approach to Discrete Math, Springer, Edition 3, 1993

OUTCOMES: At the end of the course students will be able to

- Authenticate the correctness of a given statement using mathematical induction.
- Test and analyze the logic of a program.
- Apply the concept of finite state machines and to generate languages.
- Analyze the types of graphs solve problems using the concepts of graph theory.
- Apply encryption and decryption techniques to send messages securely.

OBJECTIVES :

- To understand the functional requirements and their role in the system design
- To acquire essential knowledge to measure or predict system performance
- To understand the various parameters that contribute to the performance of a computer system and the technology of achieving the best performance through these parameters
- To understand how the memory hierarchy and optimization contribute to the performance of the system
- To understand the approaches in designing a new system through Instruction level parallel processing and to improve the Performance overcoming the hazards-meeting the functionality.
- To understand the data level parallel processing and Vector Processing for performance

PREREQUISITES :

- Computer Architecture

MODULE I FUNDAMENTALS OF COMPUTER DESIGN 09

Functional Requirements and architecture - Measuring and reporting performance - Quantitative principles of computer design - Classifying instruction set architecture - Operands and operations for media and signal processing –Graphic processing - Encoding an instruction set - Example architecture - MIPS and TM32.

MODULE II MEMORY HIERARCHY DESIGN 09

Memory Hierarchy - Cache performance - Reducing cache miss penalty and miss rate - Reducing hit time - Main memory and performance - Memory technology and optimization-Virtual memory and Virtual Machine and protection.

MODULE III INSTRUCTION LEVEL PARALLELISM 09

Concepts of ILP - Pipelining and hazards –Compiler techniques for exposing ILP Dynamic scheduling - Dynamic hardware prediction - Multiple issues - Hardware based speculation - Limitations of ILP - Case studies: IP6 Micro architecture. Compiler techniques for exposing ILP - Static branch prediction - Static multiple issues: VLIW - Advanced compiler support –Hardware VS software speculation.– Case study: Intel core i7 and ARM Cortex-A8

MODULE IV DATA-LEVEL PARALLELISM 09

Vector Architecture - SIMD Instruction Set Extensions for Multimedia - Graphic Processing Units- Detecting and Enhancing Loop Level Parallelism - Mobile versus Server GPUs - Case Studies

Centralized Symmetric and shared memory Multiprocessor architectures - Performance issues - Distributed Shared Memory architecture- Directory based architecture- Synchronization - Cache Coherence and memory consistency - Trends in processor design- Need for multi-core processor – difference between multiprocessor and multicore processor- Thread level processing – Simultaneous multi-threading.

L – 45; Total Hours : 45

REFERENCES :

1. John L. Hennessey and David A. Patterson," Computer Architecture: A Quantitative Approach", Morgan Kaufmann / Elsevier, 6th Edition, 2017.
2. David A. Patterson and John L. Hennessy, Computer Organization and Design – The Hardware / Software Interface, 5th Edition, Morgan Kaufmann, Elsevier, 2014.
3. B.Govindarajalu, "Computer Architecture and Organization", Tata McGraw Hill Education Pvt. Ltd., 2010.
4. Vincent P. Heuring and Harry F. Jordan, "Computer System Design and Architecture", Addison Wesley, 2nd Edition, 2004.
5. D.Sima, T. Fountain and P. Kacsuk, "Advanced Computer Architectures: A Design Space Approach", Addison Wesley, 2000.

OUTCOMES :

Students to complete this course will be able to

- Suggest the requirements for a new instruction set, to meet the functional requirement and to contribute to performance.
- Test the performance of a computer system
- Analyze changes in performance with various configurations and Memory Hierarchy
- Analyze code for instruction level Parallel Processing and modify the code for out of order execution for better performance
- Modify the code to exploit SIMD architecture and improve the performance of the system.
- Analyze how multi-threading in multiple processors and multi-core processors will share the resources for performance.

OBJECTIVES :

- To discuss various algorithm design techniques for developing algorithms.
- To study the basic techniques for designing algorithms, including the techniques of recursion, divide-and-conquer, and greedy.
- To provide the basic knowledge of computational complexity, approximation and randomized algorithms.
- To Learn the advanced techniques for designing algorithms, including dynamic programming, network flow and problem reduction
- To Illustrate the NP completeness and identify different NP complete problems.
- To determine the time and space complexity of simple algorithms and recursively defined algorithms.

MODULE I INTRODUCTION 9

Introduction and Motivation-Lower Bound-Asymptotic Notations-Mathematical Induction-Mathematical models-Formulating the Equations-Solving the equations-Homogeneous Linear Recurrence with Constant Coefficients-Non-homogeneous Equations-Transformations.

MODULE II GRAPH ALGORITHMS 9

Elementary Graph Algorithms Breadth-first search- Depth-first search - Topological sort- Minimum Spanning Trees -The algorithms of Kruskal and Prim -Single-Source Shortest Paths - The Bellman-Ford algorithm - Single-source shortest paths in directed acyclic graphs -Dijkstra's algorithm -All-Pairs Shortest Paths -The Floyd-Warshall algorithm - Johnson's algorithm for sparse graphs- Maximum Flow- Flow network- The Ford-Fulkerson method- Maximum bipartite matching-Push-relabel algorithms-The relabel-to-front algorithm.

MODULE III DIVIDE-AND-CONQUERANDRANDOMIZED ALGORITHMS 9

The maximum-sub array problem- Strassen's algorithm for matrix multiplication- The substitution method for solving recurrences-The recursion-tree method for solving recurrences-The master method for solving recurrences-Proof of the master theorem-The hiring problem- Indicator random variables-Randomized algorithms-Probabilistic analysis and further uses of indicator random variables.

MODULE IV MULTITHREADED AND NUMBER-THEORETIC ALGORITHMS 9

The basics of dynamic multithreading-Multithreaded matrix multiplication Multithreaded merge sort-Elementary number-theoretic notions- Greatest common divisor - Modular arithmetic -Solving modular linear equations - The Chinese remainder theorem - Powers of an element- The RSA public-key cryptosystem-

MODULE V NP-COMPLETENESS AND APPROXIMATION ALGORITHMS 9

Polynomial time-Polynomial-time verification-NP-completeness and reducibility-NP-completeness proofs-NP-complete problems- **Approximation Algorithms**-The vertex-cover problem-The traveling-salesman problem-The set-covering problem-Randomization and linear programming-The subset-sum problem .

L – 45; P – 15; Total Hours : 60

REFERENCES :

1. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein, "Introduction to Algorithms", 3rd Edition MIT Press, 978-0262033848,2009.
2. Robert Sedgewick, Kevin Wayne, "Algorithms", 4th Edition, Addison Wesley, ISBN-13: 978-0321573513, 2011.
3. Alfred V Aho, John E Hopcroft," The Design and Analysis of Computer Algorithms",Pearson Education,4th Edition, ISBN:978813170205,2009.
4. Mark Allen Weiss," Data Structures and Algorithm Analysis in C++", Addison-Wesley,3rd edition, ISBN: 978-0132847377,2013.

OUTCOMES :

Students who complete this course will be able to

- Prove the correctness of algorithms using inductive proofs and invariants.
- Analyze randomized algorithms with respect to expected running time, probability of error using tail inequalities
- Classify problems into different complexity classes corresponding to both deterministic and randomized algorithms
- Analyze approximation algorithms including algorithms that are PTAS and FPTAS..
- Implement both a greedy and a divide-and-conquer algorithm to solve problems.
- Design the techniques of proof by contradiction, mathematical induction and recurrence relation, and apply them to prove the correctness and to analyze the running time of algorithms.

CSD6103

COMPUTER NETWORKS AND MANAGEMENT

L T P C
3 0 0 3

OBJECTIVES :

- To outline the basic concepts of computer networks
- To illustrate the operations of network traffic, congestion, controlling and Queuing delay models
- To compare different mechanism for quality of service and Internet protocol
- To describe the concept and architecture of network management
- To showcase the different network management protocols like SNMP and ARP, RARP concepts
- To identify various network tools to simulate the working of connection oriented and connectionless networks.

PREREQUISITES :

- Computer Networks

MODULE I INTRODUCTION TO COMPUTER NETWORKS 9

Introduction – Reliable Transmission via Redundancy – Reliable transmission by retransmission - Routing and addressing – Link Layer Protocols and Technologies– Quality of Service overview.

MODULE II TRANSMISSION CONTROL PROTOCOL (TCP) AND SWITCHING AND QUEUING DELAY MODELS 9

Introduction to UDP and TCP – User Datagram Protocol (UDP) – TCP and Reliable Byte Stream Service – Congestion Control – Fairness – Recent TCP Versions – TCP Wireless Links - Packet Switching in Routers - Queuing Model – Networks of Queues.

MODULE III MECHANISMS FOR QUALITY OF SERVICE AND INTERNET PROTOCOLS 9

Queue Scheduling – Policing – Active Queue Management – MPLS - Internet Protocol Version (IPV6) – Routing Protocols – Address Translation Protocols – Domain Name System (DNS) – Network Management Protocols – Network Tools

MODULE IV NETWORK MANAGEMENT AND SNMP 9

Network Management : goals , Organization and Functions – Network Management Architecture and organization – Network Management perspective – NMS platform – Current Status & future of Network Management – SNMP V1 Network Management- Basic Foundation standards, Models and languages - Organization and information Models - Communication and functional Models – SNMP V2 – SNPV3.

MODULE V INTERNETWORKING 9

Network as a Graph, Distance Vector(RIP), Link State(OSPF), Metrics, The Global Internet, Routing Areas, Routing among Autonomous systems(BGP) - Mobility and Mobile IP

L – 45; P-15; Total Hours : 45

REFERENCES :

1. Simon Parkinson, Andrew Cawton and Richard Hill, "Guide to Vulnerability Analysis of Computer Networks and Systems", Springer, 2018.
2. Ivan Marsic, "Computer Networks Performance and Quality of Service", Rutgers University, New Brunswick, New Jersey, 1st edition, FREE PDF, ISBN-10: N/A, <http://www.ece.rutgers.edu/~marsic/books/CN>, 2013.
3. Olivier Bonaventure, "Computer Networking: Principles, Protocols and Practice", Creative Commons Attribution, ISBN: 978-1-365-18583-0, 2011.
4. Douglas E Comer, "Internetworking with TCP/IP, Principles, Protocols and Architecture" 6th Edition, PHI, ISBN-13: 978-0136085300, 2014.
5. [Olivier Bonaventure](#), "Computer Networking: Principles, Protocols and Practice", ISBN 1365185834, 9781365185830, 2016.

OUTCOMES :

Students to complete this course will be able to

- Describe the network services, protocols and architectures.
- Access MIBS from devices using SNMP on a workstation.
- Develop effective communication mechanisms using techniques like connection establishment, queuing theory, recovery Etc.
- Identify the different congestion control techniques.
- Analyze and interpret the data provided by an NMS and take suitable actions.
- Apply BGF and OSPF for Network.

OBJECTIVES :

- To expose students to social, legal and ethical issues for Software Engineers.
- To provide experience using an agile like process.
- To expose to requirements engineering and development of software systems of high quality.
- To demonstrate the necessary understanding of methods and techniques for software management.
- To accumulate knowledge of the analysis, design and management of large and complex software systems.
- To develop the ability to understand, design and implement such systems in the global market.

PREREQUISITES :

Software Engineering

MODULE I	ADVANCED SOFTWARE ENGINEERING	10
	Agile Process Development- Software Reuse – Reuse Landscape – Application Framework Application System reuse – Component Based Software Engineering Components and Components models – CBSE Processes – Component composition – Distributed Software Management.	
MODULE II	SERVICE ORIENTED SOFTWARE ENGINEERING	10
	Service Oriented Architecture – RESTful services – Service Engineering – Service Composition – Systems Engineering – Systems of Systems – Real Time Software Engineering – Embedded System Design – Architectural Patterns for real-time Software – Time Analysis – Real-Time Operating Systems.	
MODULE III	SOFTWARE TESTING, MAINTENANCE AND MANAGEMENT	10
	Test Strategies - Software Reengineering - Reverse Engineering – Forward Engineering – Project Management – Project Planning – Software Pricing – Plan Driven development – Project Scheduling – Agile planning – Estimation Techniques – COCOMO Testing Modeling – Quality Management – Configuration management.	
		Total Hours : 30

REFERENCES :

1. Ian Sommerville, Software engineering, Pearson education Limited, 10th edition, ISBN : 978-1-292-09613-1,2016.
2. Roger S.Pressman, Software engineering- A practitioner's Approach, McGraw- Hill International Edition, 8th edition,ISBN-13: 978-0-0780-2212-8, 2014.
3. Dogru, Ali H., Modern Software Engineering Concepts and Practices: Advanced Approaches: Advanced Approaches, IGI Global,ISBN: 978-1-60960-215-4, 2011.

OUTCOMES :

Students who complete this course will be able to

- Expose technical issues through a software development project.
- Analyze the impact of computing on individuals, organizations and society, including ethical, legal, security and global policy issues;
- Design models to reflect abstract architectures of software systems.
- Create and understand descriptions of SOA using high level UML models
- Apply the Software Engineering concepts to Software Projects in a real business environment and carry out Software Maintenance.
- Evaluate research articles and thus be aware of the research front in software development.

SEMESTER II

GED6201	RESEARCH METHODOLOGY FOR ENGINEERS	L	T	P	C
		3	1	0	4

OBJECTIVES :

- To provide a perspective on research to the scholars
- To educate on the research conceptions for designing the research
- To be trained about research, design, information retrieval, problem formulation.
- To impart knowledge on statistical techniques for hypothesis construction
- To gain knowledge on methods of data analysis and interpretation
- To learn about the effective communications of research finding and writing of research reports, papers and ethics in research.

PREREQUISITES :

- Basics knowledge of engineering, probability, statistics

MODULE I	Research Problem Formulation	9
	Research - objectives - types, Research methods and methodology, Research process, solving engineering problems-Identification of research topic - Formulation of research problem, literature survey and review.	
MODULE II	Research Design	10
	Research design - meaning and need - basic concepts - Different research designs, Experimental design - principle - important experimental designs, Design of experimental setup, Mathematical modelling - Simulation, validation and experimentation - Dimensional analysis - similitude.	
MODULE III	Use of Statistical Tools in Research	12
	Importance of statistics in research - Concept of probability - Popular distributions - Sample design. Hypothesis testing, ANOVA, Design of experiments - Factorial designs - Orthogonal arrays.	
MODULE IV	Data Collection, Analysis And Interpretation of Data	10
	Sources of Data, Use of Internet in Research, Types of Data - Research Data Processing and analysis - Interpretation of results- Correlation with scientific facts - repeatability and reproducibility of results - Accuracy and precision –limitations, Application of Computer in Research- Spreadsheet tool, Presentation tool-Basic principles of Statistical Computation.	
MODULE V	Optimization Techniques	10
	Use of optimization techniques - Traditional methods – Evolutionary Optimization Techniques. Multivariate analysis Techniques, Classifications, Characteristics, Applications - correlation and regression, Curve fitting.	
MODULE V1	The Research Report	9
	Purpose of written report - Audience - Synopsis writing - preparing papers for International Journals, Software for paper formatting like LaTeX/MS Office, Reference Management Software, Software for detection of Plagiarism –Thesis writing, - Organization of contents -	

style of writing- graphs and charts - Referencing, Oral presentation and defence - Ethics in research - List of funding agencies - scope for research funding - Patenting, Intellectual Property Rights.

L – 45; T – 15; Total Hours : 60

TEXT BOOKS :

1. . Ganesan R., Research Methodology for Engineers, MJP Publishers, Chennai, 2011.
2. Ernest O., Doebelin, Engineering Experimentation: planning, execution, reporting, McGraw Hill International edition, 1995.
3. George E. Dieter., Engineering Design, McGraw Hill – International edition, 2000.
4. Madhav S. Phadke, Quality Engineering using Robust Design, Printice Hall, Englewood Cliffs, New Jersey, 1989.
5. Kothari C.R., Research Methodology – Methods and Techniques, New Age International (P) Ltd, New Delhi, 2003.
6. Kalyanmoy Deb., “Genetic Algorithms for optimization”, KanGAL report, No.2001002.

Reference Book

1. Holeman, J.P., Experimental methods for Engineers, Tata McGraw Hill Publishing Co., Ltd., New Delhi, 2007.
2. Govt. of India, Intellectual Property Laws; Acts, Rules & Regulations, Universal Law Publishing Co. Pvt. Ltd., New Delhi 2010.

OBJECTIVES :

- To expose the applications of machine learning.
- To study the various algorithms related to supervised and unsupervised learning.
- To recognize the different types of machine learning models and how to use them.
- To learn the theoretical and practical aspects of probabilistic models.
- To acquire the knowledge of various classification techniques.
- To learn the various neural network algorithms.

PREREQUISITES :

- Data Mining

MODULE I	INTRODUCTION	8
	Introduction – Classic and Adaptive Machines – Types of Learning – Elements – Data Formats – Learnability – Statistical Learning Approaches .	
MODULE II	FEATURE SELECTION AND CLASSIFICATION	10
	Feature Selection and Feature Engineering – Linear Regression – Logistic Regression – Naïve Bayes – Support Vector Machines – Decision Trees – Ensemble Learning.	
MODULE III	CLUSTERING	9
	Clustering Basics – K-Means – DBSCAN – Spectral Clustering - Evaluation Methods – Hierarchical Clustering - Hierarchical Strategies – Agglomerative Clustering.	
MODULE IV	RECOMMENDATION SYSTEM AND NLP	9
	Introduction to NLP – NLTK and Built-in Corpora – BoW Strategy – Topic Modeling – Latent Semantic Analysis – Probabilistic Latent Semantic Analysis – Latent Dirichlet Allocation - Sentiment Analysis in NLP – VADER Sentiment Analysis with NLTK.	
MODULE V	DEEP LEARNING	9
	Introduction to Deep Learning –ANN – Deep Architectures - Fully Connected Layers – Convolutional Layers – Drop out Layers – Recurrent Neural Networks - Tensor Flow – Computing Gradients – Logistic Regression – Classification with Multilayer Perceptron – Creating Machine Learning Architectures.	

L-45 ; P – 15 ; Total Hours-60 ;

REFERENCES :

- 1 Giuseppe Bonaccorso, “Machine Learning Algorithms”, Packt, ISBN:9781785889622, 2017.
- 2 EthemAlpaydin, “Introduction to Machine Learning”, 3rd Edition, MITPress, ISBN: 9780262028189, 2014.
- 3 Kevin Patrick Murphy, “Machine Learning: a Probabilistic Perspective”, 4th edition, MIT

- . Press, ISBN:9780262018029, 2013.
- 4 Ian H. Witten, Eibe Frank, Mark A. Hall, "Data Mining: Practical Machine Learning Tools and Techniques", 3rd Edition, Morgan Kaufmann,2011.

OUTCOMES :

Students to complete this course will be able to

- Describe the concepts and models of machine learning.
- Design and implement algorithms for supervised and unsupervised learning.
- Develop skills of using recent machine learning software for solving practical problems.
- Analyze the efficient clustering techniques for solving real world problems.
- Implement deep learning algorithms for an application and analyze the results.
- Apply the appropriate algorithms for Sentiment analysis and Recommendation Systems.

CSD6202	APPLIED CRYPTOGRAPHY AND NETWORK SECURITY	L	T	P	C
		3	0	0	3

OBJECTIVES :

The Student should

- have a theoretical understanding of the principles underlying cryptography and cryptanalysis.
- have a fundamental understanding of symmetric and asymmetric encryption, hashing, and digital signatures.
- learn the basic concepts in networking and wireless security, applied cryptography, as well as ethical, legal, social and economic facets of security.
- become familiar with the cryptographic techniques that provide information and network security.
- be able to evaluate the security of communication systems, networks and protocols based on a multitude of security metrics.
- provide an awareness of network security issues in emerging technologies.

MODULE I	CRYPTOGRAPHY AND ENCRYPTION TECHNIQUES	9
	Overview – Principles-Concepts –Symmetric and Asymmetric Encryption–AES – Block Cipher Operations– RSA Algorithm – Diffie Hellman Key Exchange	
MODULE II	DATA INTEGRITY ALGORITHMS AND MUTUAL TRUST	10
	Hash Functions – SHA – Message Authentication Codes – Digital Signatures- Key Management and Distribution – X.509 Certificates – Kerberos	
MODULE III	NETWORK SECURITY	8
	Vulnerabilities - Security Assessment, Analysis, and Assurance-Disaster Management – Access Control and Authentication – Authorization	
MODULE IV	WIRELESS NETWORK SECURITY	8
	Wireless Security – Wireless LAN - Smart Phones – PDA – Bluetooth- Broadband Security	
MODULE V	SECURITY IN EMERGING TECHNOLOGIES	9
	Next Generation Mobile Networks – Wireless Sensor Networks – Adhoc Networks – IP based Mobile Networks	

Total Hours : 45

REFERENCES :

1. William Stallings, “Cryptography and Network Security – Principles and Practice” 7th Edition, Pearson Education, ISBN No. 978- 0134444284,2016.
2. Joseph MiggaKizza, “ Guide to Computer Network Security” 3rd Edition, Springer Publishers, ISBN No 978-1447166535,2015.

3. Wolfgang Osterhage, “ Wireless Security”, CRC Press, ISBN No. 978-1578087686,2011.
4. William Stallings, “Network Security Essentials, Applications and Standards”,5th Edition, Pearson Education, ISBN No.978-0133370430,2013.
5. John R.Vacca , “Network and System Security”,2nd Edition, Elsevier Publishers, ISBN No.978-0124166899,2014.

OUTCOMES :

Students who complete this course should

- have a technical understanding of the main cryptographic concepts and technologies available today.
- explain the requirements and techniques for security management, including security policies, risk analysis, and physical threats and controls.
- illustrate how cryptography and its application can maintain privacy and security in electronic communications and computer networks.
- describe the vulnerabilities brought about by modern web-based application and services, and discuss countermeasures.
- identify the appropriate procedures required to secure networks.
- innovate techniques for enforcing computer and network security and developing secure e-commerce protocols.

CSDY001	CLOUD COMPUTING AND TECHNOLOGIES	L	T	P	C
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OBJECTIVES :

- To gain understanding of the basic concepts of cloud computing.
- To learn various types of cloud services, technologies and service providers.
- To know the design challenges of cloud infrastructure.
- To have knowledge about different programming models and cloud software
- To understand the privacy and security issues in cloud environments.
- To illustrate the fundamental concepts of cloud storage and demonstrate their use in storage systems such as Amazon.

MODULE I	CLOUD COMPUTING BASICS	09
Introduction to Cloud Computing – Cloud computing reference model- Essential Characteristics - Benefits and challenges of cloud computing- Cloud Delivery Models - Deployment models -Cloud computing vendors.		
MODULE II	CLOUD COMPUTING TECHNOLOGY	08
Virtualization-Types of virtualization-Virtualization and cloud computing- Clientthin, thick, mobile clients- Cloud Providers and Consumers-Variou Cloud Services- Accessing the Cloud- Frameworks- AJAX, Python- Web Hosting Services- Web Applications- Web API"s and Web Browsers.		
MODULE III	CLOUD INFRASTRUCTURE	10
Architectural Design of Compute and Storage Clouds – Layered Cloud Architecture Development– Design Challenges - Inter Cloud Resource Management – Resource Provisioning and Platform Deployment – Global Exchange of Cloud Resources. i7 and ARM Cortex-A8		
MODULE IV	PROGRAMMING MODEL	10
Map Reduce programming model - Map reduce and extensions - Relational operations – Parallel Efficiency of Map Reduce- Cloud File Systems - GFS and HDFS –Cloud platforms in Industry – Google App Engine, Amazon AWS- Cloud Software Environments -Eucalyptus, Open Nebula.		
MODULE V	SECURITY IN CLOUD	08
Cloud security fundamentals- Privacy and Security in cloud - Software-as-aService Security Risk Management – Security Monitoring – Security Architecture Design – Data Security – Application Security – Virtual Machine Security.		

L – 45; Total Hours : 45

REFERENCES :

1. Anthony T. Velte, Toby J. Velte, Robert Elsenpeter, "Cloud Computing: A Practical Approach", McGraw-Hill, 2010.
2. Rajkumar Buyya, Christian Vecchiola, S. Thamarai Selvi, "Mastering Cloud Computing", McGraw-Hill Education Private Ltd., 2013
3. John W. Rittinghouse and James F. Ransome, "Cloud Computing: Implementation, Management, and Security", CRC Press, 2010.
4. Rajkumar Buyya, James Broberg, Andrzej Goscinski, "Cloud Computing Principles and Paradigms" John Wiley & Sons, Inc Publications, 2011
5. Tim Malhar, S. Kumaraswamy, Shahed Latif, "Cloud Security & Privacy", O'Reilly media, 2009.

OUTCOMES :

Students to complete this course will be able to

- Articulate the main concepts, key technologies, strengths and limitations of cloud computing.
- Identify the architecture, infrastructure and delivery models of cloud computing.
- Discuss the cloud technologies including virtualization and web based technologies.
- Explain the cloud file systems and their applications in industry.
- Work with online cloud services and collaborate with online documents and web based applications.
- Explain the core issues of cloud computing such as security, privacy and interoperability.

OBJECTIVES :

- To understand the terms and terminologies of predictive modeling.
- To have knowledge about the evolution of cloud from the existing technologies.
- To have knowledge on the various issues in cloud computing.
- To understand the emergence of cloud as the next generation computing paradigm.
- provide sufficient foundations to enable further study and research.
- To provide comprehensive and in-depth knowledge to students in Cloud Computing concepts.

MODULE I CLOUD FUNDAMENTALS 9

Introduction to Cloud Computing – Definition of Cloud – Evolution of Cloud Computing – Underlying Principles of Parallel and Distributed Computing – Cloud Characteristics – Elasticity in Cloud – On-demand Provisioning.

MODULE II CLOUD COMPUTING TECHNOLOGIES 9

Service Oriented Architecture – REST and Systems of Systems – Web Services – Publish-Subscribe Model – Basics of Virtualization – Types of Virtualization – Implementation Levels of Virtualization – Virtualization Structures – Tools and Mechanisms – Virtualization of CPU – Memory – I/O Devices –Virtualization Support and Disaster Recovery.

MODULE III CLOUD ARCHITECTURE, SERVICES AND STORAGE 9

Layered Cloud Architecture Design – NIST Cloud Computing Reference Architecture – Public, Private and Hybrid Clouds – IaaS – PaaS – SaaS – Architectural Design Challenges – Cloud Storage – Storage-as-a-Service – Advantages of Cloud Storage – Cloud Storage Providers – S3.

MODULE IV RESOURCE MANAGEMENT AND SECURITY IN CLOUD 9

.Inter Cloud Resource Management – Resource Provisioning and Resource Provisioning Methods – Global Exchange of Cloud Resources – Security Overview – Cloud Security Challenges – Software-as-a-Service Security – Security Governance – Virtual Machine Security – IAM – Security Standards

MODULE V CLOUD TECHNOLOGIES AND ADVANCEMENTS 9

Hadoop – MapReduce – Virtual Box — Google App Engine – Programming Environment for Google App Engine — Open Stack – Federation in the Cloud – Four Levels of Federation – Federated Services and Applications – Future of Federation

L –45 ; Total Hours : 45

REFERENCES :

1. Kai Hwang, Geoffrey C. Fox, Jack G. Dongarra, “Distributed and Cloud Computing, From Parallel Processing to the Internet of Things”, Morgan Kaufmann Publishers, 2012.

2. Rittinghouse, John W., and James F. Ransome, —Cloud Computing: Implementation, Management and Security, CRC Press, 2017.
3. RajkumarBuyya, Christian Vecchiola, S. ThamaraiSelvi, —Mastering Cloud Computing, Tata Mcgraw Hill, 2013.
4. Toby Velte, Anthony Velte, Robert Elsenpeter, “Cloud Computing – A Practical Approach, Tata Mcgraw Hill, 2009.

OUTCOMES :

Students to complete this course will be able to

- Articulate the main concepts, key technologies, strengths and limitations of cloud computing
- Learn the key and enabling technologies that help in the development of cloud.
- Develop the ability to use the architecture of compute and storage cloud, service and delivery models.
- Explain the core issues of cloud computing such as resource management and security.
- Able to install and use current cloud technologies.
- Evaluate and choose the appropriate technologies, algorithms and approaches for implementation and use of cloud.

1. Dac- Nhung Le, Raghvendra Kumar, Gia Nhu Nguyen, Jyotir Moy Chatterjee, "Cloud Computing and Virtualization", 1st Edition, Scrivener Publishing, 2018. ISBN: 978-1-119-48790-6.
2. Edouard Bugnion, Jason Neih, Dan Tsafir, "Hardware and Software Support for Virtualization", 1st Edition, Morgan & Claypool publisher, 2017. ISBN: 9781627056939.
3. Lee Chao, "Virtualization and Private cloud with VMware cloud suite", 1st Edition, CRC Press, 2017. ISBN: 9781498784320.

OUTCOMES :

Students to complete this course will be able to

- analyze the cloud computing setup with its live migration applications using different architectures.
- apply and design suitable load balancing techniques.
- use and examine different cloud computing services.
- describe the importance of lightweight virtualization along with their technologies.
- explain the core issues of cloud computing such as security, privacy, and interoperability.
- identify the problems, and explain, analyze, and evaluate various cloud computing solutions.

OBJECTIVES:

- To teach about the fundamental ideas behind Cloud Computing, the evolution of the paradigm, its applicability; benefits, as well as current and future challenges;
- To List type of cloud services and Cite Application of Cloud strategies for SaaS, PaaS, IaaS, DBaaS and XaaS. Discuss functional implementation of each of the above-mentioned cloud delivery model
- To Recognize steps and processes used to perform an audit assessment of a cloud computing environment.
- To Compare and contrast the economic benefits delivered by various cloud models based on application requirements, economic constraints and business requirements.
- To Compare and contrast the economic benefits delivered by various cloud models based on application requirements, economic constraints and business requirements.
- To Analyze the components of cloud computing showing how business agility in an organization can be created

PREREQUISITES:

- Computer Network

MODULE I INTRODUCTION**9**

Recent trends in Computing- Evolution of cloud computing-Business driver for adopting cloud computing-Introduction to Cloud Computing (NIST Model)- Cloud service providers - Benefits of Cloud Computing-Cloud Computing Architecture -Cloud computing stack -Role of Networks in Cloud Computing-Service Models -Deployment Models

MODULE II CLOUD SERVICE MODELS**9**

Introduction to IaaS-Resource Virtualization: Server, Storage, Network-Data storage in cloud computing (storage as a service)-Platform as a Service (PaaS)-What is PaaS, Service Oriented Architecture (SOA)-Cloud Platform and Management-Software as a Service (PaaS) -Web services

MODULE III CLOUD SERVICE MANAGEMENT**9**

Service Level Agreements (SLAs)-Billing & Accounting-Comparing Scaling Hardware: Traditional vs. Cloud-Economics of scaling: Benefitting Enormously-Managing Large Scale Data Processing.

MODULE IV CLOUD SECURITY**9**

Infrastructure Security-Network level security, Host level security, Application level security -Data privacy and security Issues, Jurisdictional issues raised by Data Location-

Trust, Reputation, Risk-Authentication in cloud computing-Cloud contracting Model, Commercial and business considerations.

MODULE V DESIGN OF EXPERIMENTS

9

Analysis of Case Studies when deciding to adopt cloud computing architecture. How to decide if the cloud is right for your requirements. Cloud based service, applications and development platform deployment so as to improve the total cost of ownership (TCO)

L – 45; Total Hours : 45

REFERENCES :

1. Barrie Sosinsky” Cloud Computing Bible “;1st Edition, Wiley-India, 2010 ISBN-13: 978-0470903568
2. Rajkumar Buyya, James Broberg, Andrzej M. Goscinski” Cloud Computing: Principles and Paradigms “first edition, Wiley, 2011
3. Nikos Antonopoulos, Lee Gillam “Cloud Computing: Principles, Systems and Applications” Springer, 2012.
4. Ronald L. Krutz, Russell Dean Vines“Cloud Security: A Comprehensive Guide to Secure Cloud Computing” Wiley-India, 2010

OUTCOMES :

Students to complete this course will be able to

- Analyze the trade-offs between deploying applications in the cloud and over the local infrastructure.
- Compare the advantages and disadvantages of various cloud computing platforms.
- Classify security and privacy issues in cloud computing.
- Investigate the performance, scalability, and availability of the underlying cloud technologies and software.
- Design & develop backup strategies for cloud data based on features.
- Recognize the importance of protocols and standards in management for cloud services.

OBJECTIVES :

- To introduce the relationship, basic concepts and structures in pervasive computing.
- To study the emerging technologies in the context of wireless networks
- To learn about Human-Computer Interface and Mobile Transactions in pervasive computing environment.
- To highlight the role of sensor networks, wireless protocols in the design of pervasive applications.
- To illustrate architecture and protocols in pervasive computing and to identify the trends and latest development of the technologies in the area.
- To design successful mobile and pervasive computing applications and services.

PREREQUISITES :

- Distributed Systems
- User Interface Design

MODULE I BASIC CONCEPTS AND STRUCTURE 9

Relationship of Wireless Computing - Ubiquitous Computing - Internet Computing – Perspectives of pervasive computing – Challenges – Technology – Infrastructure and Devices – Middleware for Pervasive Computing Systems: Resource Management – User Tracking – Context Management – Service Management – Data Management – Security Management–Pervasive Computing Environments.

MODULE II CONTEXT COLLECTION AND RESOURCE MANAGEMENT 9

Context Collection and Wireless Sensor Networks – User Tracking – Context Reasoning: Evidence Theory – DSCR Model – Propagating Evidence in Sensors Layer and Object Layer – Recognizing User Activity – Evidence Selection Strategy – Performance – Resource Management in Pervasive Computing: Efficient Resource Allocation – Transparent Task Migration .

MODULE III HUMAN-COMPUTER INTERFACE AND MOBILE TRANSACTIONS 9

Overview –HCI Service and Interaction Migration – Context-Driven HCI Service Selection – A web service-based HCI Migration Framework – Mobile Transaction Framework – Context-aware Pervasive Transaction model –Dynamic Transaction Management – Format Transaction Verification -

MODULE IV LOCAL AND WIDE AREA TECHNOLOGIES 9

Local area wireless networks: IEEE 802.11 technologies - Mobile IP- Infrared technologies. Bluetooth networks (OBEX Protocol) - Messaging Systems - Personal Area Networks - Network Management - Quality of Service - Wireless protocols - Establishing Wide area wireless networks: Concept and structure of "cell"- Call establishment and maintenance.

MODULE V PROTOCOLS 9

Protocols: Networking protocols - Packet switched protocols - Routing Protocols for Sensor Networks - Data Centric Protocols - Hierarchical Protocols Location-based protocols - Multimedia Messaging Service (MMS) Protocols Wireless Application Protocol (WAP)- Applications: Mobile access to patient information in a hospital, sales support, retailing.

L – 45; Total Hours : 45

REFERENCES :

6. MinyiGuo, Jingyu Zhou, Feilong Tang, Yao Shen, “ Pervasive Computing Concepts, Technologies and Applications”, 1st Edition, CRC Press, 2016.
7. CiprianDobre and FatosXhafa, “ Pervasive Computing-Next Generation Platforms for Intelligent Data Collection”, 1st Edition, Elsevier Publication, 2016. ISBN:978-0-12-803663-1.
8. Natalia Silvis-Cividjian, ”Pervasive Computing: Engineering Smart Systems”, Springer Publishing, 2017. ISBN: 978-3-319-51655-4.

OUTCOMES :

Students to complete this course will be able to

- differentiate pervasive computing from normal computing applications.
- explain the structure and context collection of pervasive computing.
- describe how the devices (sensors and RFIDs) operate in a pervasive computing environment.
- analyze the performance of different sensor data management and routing algorithms for sensor networks.
- apply the basic techniques, algorithms, protocols of different types of networks for designing pervasive computing system.
- Identify the performance of various data dissemination techniques for mobile real-time applications.

OBJECTIVES :

- To familiarize the basic concepts of social network analysis.
- To learn the various methods of social network analysis.
- To get the knowledge of sentimental analysis in social network.
- To study the sentimental analysis of twitter analytics using R tool.
- To have the knowledge on facebook analytics using python.
- To acquire essential knowledge on applications of social network analysis.

PREREQUISITES :

- Data mining
- Networks
- Python

MODULE I	INTRODUCTION TO SOCIAL NETWORK ANALYSIS	9
	Introduction to Social network Analysis – Social Network - History of Social network analysis – Sociogram – Sociometry – Matrices and Cliques – Data collection.	
MODULE II	SOCIAL NETWORK ANALYSIS METHODS	9
	Descriptive methods of Social network analysis – Graphs and Matrix representation – Density – Centrality, Centralization and Prestige – Cliques – Structural Equivalence – Inferential Methods in Social network analysis.	
MODULE III	SENTIMENTAL ANALYSIS	9
	Sentimental Analysis in Social Networks – Key concepts of sentimental analysis - Level of analysis – Semantic Aspects - Twitter analytics – Sentimental analysis using R.	
MODULE IV	FACEBOOK ANALYTICS- PYTHON	9
	Facebook analytics – Parsing API outputs – Uncovering Brand Activity, Popularity and Emotions on Facebook.	
MODULE V	APPLICATIONS AND FUTURE TRENDS	9
	Social network analysis applications - Work and Organizations – Crime and Terrorism – Emotional and Physical health - Trends Mining on GitHubs.	

L – 45; Total Hours : 45

REFERENCES :

1. John Scott, "Social Network Analysis", 4th Edition, SAGE Publication, 2017.
2. Reda Alhajj, Jon Rokne, "Encyclopedia of Social Network Analysis and Mining", 2nd Edition, Springer New York, 2018.
3. Song Yang, Franziska B. Keller, Lu Zheng, "Social Network Analysis: Methods and Examples", 1st Edition, SAGE Publication, 2016.

4 Siddhartha Chatterjee, Michal Krystyanczuk, “Python Social Media Analytics”, 1st Edition, Packt Publishing Ltd, 2017.

5 Raghav Bali, Dipanjan Sarkar, TusharSharm, “Learning Social Media Analytics with R”, 1st Edition, Packt Publishing Ltd, 2017.

6 Federico Alberto Pozzi, ElisabettaFersini, Enza Messina, Bing Liu,” Sentiment Analysis in Social Networks”, Morgan Kaufmann Publication,2016.

OUTCOMES :

Students to complete this course will be able to

- Describe the terminologies used in social network analysis.
- Apply the various methods of social network analysis.
- Analyze the sentimental concept of any social network.
- Test the sentimental analysis of twitter characters using R tool
- Analyze the Facebook network using python programming.
- Identify the various field of applications of social network analysis.

OBJECTIVES :

- To expose fundamental concepts of cloud security.
- To analyse the different attacks of cloud computing.
- Introduce the importance of cloud storage services.
- Relate current trends of risk management in cloud computing.
- Recognize the requirements of cloud security and provide various solutions to vendors.
- Illustrate the advanced security of cloud computing and demonstrate their use.

PREREQUISITES :

- Cloud computing

MODULE I	INTRODUCTION	9
	An Overview of Computer Security – Vulnerabilities and attacks-Security Mechanisms – Data Security – Digital Signature – Virtualization Security.	
MODULE II	CLOUD STORAGE SERVICES	9
	Cloud Data Protection Models – Enforcing Access Cloud Control Policy – Data Leakage in the Cloud – Privacy and Security in Multiclouds– Desired Security and Privacy Properties – Ensuring Security, Privacy and Reliability.	
MODULE III	RISK ANALYSIS AND CLOUD INFRASTRUCTURE	9
	Risk and Trust Assessment Schemes – Managing Risk – Cloud Security Risk Management – Cloud Risk Mitigation Methods –Distributed Access Control – Cloud User Controls – Secure Cloud Architecture.	
MODULE IV	CLOUD SECURITY REQUIREMENTS	9
	Negotiating Cloud Security– Vendors – Legal Compliance Risk – Personal Data Protection Requirements – Integrity Assurance – Locking Down Cloud Servers – Third-Party Providers Integrity Secure Computing – Secure Cloud Architecture.	
MODULE V	ADVANCED CLOUD COMPUTING SECURITY	9
	Advanced Security Architectures– Side-Channel Attacks – Trusted Computing Technology – Trusted Cloud Security – Defenses on Cloud Traffic – Clouds Are Evil – Future Directions in Cloud Computing Security	

L – 45; Total Hours : 45

TEXT BOOKS :

1. John vacca "Cloud Computing Security: Foundations and Challenges",CRC Press Publisher,1st Edition,ISBN: 978-1-4822-6094-6,1st Edition,2016.
2. Tim Mather, Subra Kumaraswamy, and Shahed Latif, "Cloud Security and Privacy",

O'Reilly Media, Inc, ISBN: 978-0-596-80276-9, 1st edition, September 2009.

3. Russell Dean Vines Ronald L., "Cloud Security: A Comprehensive Guide to Secure Cloud Computing", Wiley India; 1st edition, January 1, 2010.

OUTCOMES :

Students to complete this course will be able to

- Identify and address the issues in cloud computing
- Analyze the solutions for vulnerabilities and attacks in cloud security
- Describe the platform architectures that are suitable for cloud security
- Brief upon cloud security requirements prevailing across the globe.
- Categorize the different risk management and responsibilities in securecloud
- Apply the concept of defenses on cloud security in real time applications

CSDY008

DATA WAREHOUSING AND DATA MINING

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OBJECTIVES :

- To provide students with basic knowledge of tools used for data mining.
- To explore the technologies for storing and mining large databases.
- To assess the concepts and methods used for mining the data.
- To explore the strength and weakness of data mining algorithms.
- To expose the use of classification in data mining.
- To explain the application of data warehousing and data mining in real time scenario.

PREREQUISITES :

- Data Base Management Systems

MODULE I INTRODUCTION 8

Introduction to Data Mining – Need of Data Mining - Data Mining Applications – Data Mining Process - Data Mining Techniques – Data Mining and Machine Learning.

MODULE II DATA MINING TOOLS 9

Introduction to Data Mining Tools – Weka, R – Preparing Data Set – Working with Data Set – Data Preprocessing – Need for Data Preprocessing – Data Preprocessing Methods – Data Cleaning – Data Integration- Data Transformation – Data Reduction.

MODULE III CLASSIFICATION AND CLUSTERING 11

Introduction – Types of Classification- Input and Output Attributes – Guidelines – Size and Quality of Training data set – Decision Tree Classifier – Naïve Bayes Method – Metrics – Quality of Classifiers – Applications of Cluster Analysis – Desired Features of Clustering – Distance Metrics – Clustering Algorithms – Partitioning Clustering – Hierarchical Clustering Algorithms.

MODULE IV ASSOCIATION MINING AND WEB MINING 8

Introduction — Association Rule Mining – Metrics – Apriori Algorithm – Web Content Mining – Web Usage Mining – Web Structure Mining – Working of Search Engines – Page Rank Algorithm – Precision and Recall.

MODULE V DATA WAREHOUSE 9

Data Warehouse – Data Marts – Data Warehouse Schema –Online Analytical Processing – Introduction to Big data and NoSQL

Total Hours : 45

REFERENCES :

1. Parteek Bhatia, “Data Mining and Data Warehousing Principles and Practical Techniques”, 1stEdittion, Cambridge University Press, 2019, ISBN: 9781108727747

2. Jiawei Han & Micheline Kamber, "Data Mining – Concepts and Techniques", 3rd Edition, ISBN 978-0-12-381479- Morgan Kaufmann Publishers, Elsevier, 2012.
3. Pang-Ning Tan, Michael Steinbach and Vipin Kumar, "Introduction to Data Mining", 1st Edition, ISBN: 1-892095-02-5, Pearson education,2006.

OUTCOMES :

Students to complete this course will be able to

- Distinguish between database and data warehouse
- Design appropriate data warehouse multi-dimensional model.
- Perform basic data mining operations and apply standard data mining algorithms to solve real time problems
- Correlate data mining techniques to current scenarios in various fields and inculcate the ability to apply tools for mining and analysis.
- Review the various latest research activities going on in the field of Data Mining, thereby creating an interest for research
- Able to mine the data and perform predictive analysis.

OBJECTIVES :

- To provide computational environments for data scientists using python.
- To includes the ndarray for efficient storage and manipulation of dense data arrays in python
- To features the dataframe for efficient storage and manipulation of labeled/columnar data in python
- To includes capabilities for a flexible range of data visualizations in Python.
- To make decisions using applied and practical machine learning techniques.
- To learn the efficient and clean Python implementations of the most important and established machine learning algorithms

MODULE I IPYTHON: BEYOND NORMAL PYTHON 7

Shell Or Notebook - Ipython Shell - Ipython Magic Commands - Input And Output History - Ipython And Shell Commands – Shell Related Magic Commands - Errors And Debugging - Profiling And Timing Code.

MODULE II INTRODUCTION TO NUMPY 9

Understanding Data Types - The Basics Of Numpy Arrays - Computation On Numpy Arrays -Universal Functions –Aggregations - Min, Max,computation On Arrays: Broadcasting - Comparisons, Masks, And Boolean Logic - Fancy Indexing - Sorting Arrays - Structured Data: Numpy's Structured Arrays.

MODULE III DATA MANIPULATION WITH PANDA 9

Installing And Using Pandas - Introducing Pandas Objects - Data Indexing And Selection - Operating On Data In Pandas - Handling Missing Data - Hierarchical Indexing - Combining Datasets: Concat And Append - Combining Datasets: Merge And Join - Aggregation And Grouping - Pivot Tables - Vectorized String Operations - Working With Time Series - High-Performance Pandas: Eval() And Query().

MODULE IV VISUALIZATION WITH MATPLOTLIB 11

General Matplotlib Tips - Two Interfaces For The Price Of One - Simple Line Plots - Simple Scatter Plots - Visualizing Errors - Density And Contour Plots - Histograms, Binnings, And Density - Customizing Plot Legends - Customizing Colorbars - Multiple Subplots - Text And Annotation - Customizing Ticks - Customizing Matplotlib: Configurations And Stylesheets - Three-Dimensional Plotting In Matplotlib - Geographic Data With Basemap - Visualization With Seaborn.

MODULE V MACHINE LEARNING 9

Machine Learning - Introducing Scikit-Learn - Hyperparameters And Model Validation - Feature Engineering - Naive Bayes Classification - Linear Regression - Support Vector Machines -Manifold Learning - K-Means Clustering - Gaussian Mixture Models.

L – 45;**Total Hours : 45**

REFERENCES :

- 1 Jake VanderPlas, "Python Data Science Handbook" Jake. Published by O'Reilly Media, Inc., 1005 Gravenstein Highway North, Sebastopol, Copyright © 2017, ISBN-13:978-1491912050.
- 2 Allen B. Downey, "Think Python: How to Think Like a Computer Scientist", 2nd edition, Updated for Python 3, Shroff/O'Reilly Publishers, 2016, ISBN-13:978-1491939369

OUTCOMES :

Students to complete this course will be able to

- Perform powerful libraries for Machine learning applications and other scientific computations
- Describe about numpy and deal with feature like linear algebra, fourier transforms and advanced random number capabilities.
- Implement the pandas help us with munging and preparing data and also it is great for operating on and maintaining structured data, manipulating, transforming, and cleaning data
- Apply the matplotlib will let you plot different kinds of graphs and visualizing different types of data
- Describe the concepts and model of machine learning.

OBJECTIVES :

- To provide the students with different concepts and applications behind big data analytics.
- To expose big data computing technologies, machine learning techniques, and scaling up machine learning approaches.
- Understand the key issues in big data management and its associated applications in intelligent business and scientific computing.
- To expose the building blocks of Internet of Things and characteristics.
- To realize the revolution of Internet in Mobile Devices, Cloud & Sensor Networks
- To introduce the tools required to manage and analyze big data like Hadoop, Spark SQL, etc.

PREREQUISITES :

- Data Mining
- Database Management

MODULE I	DATA TO BIG DATA	9
	Data to Big Data – Analytics Techniques – Building Data Analytics a compilation – Building and Understanding – Why Data analytics – Data Analytics Process.	
MODULE II	DATA ANALYTICS AND MACHINE LEARNING	9
	Basics of Machine Learning – Supervised and Unsupervised Algorithms – Applications and Examples – Data visualization	
MODULE III	INTERNET OF THINGS	9
	Introduction – Concepts – Framework – Technology Infrastructure - Derived Qualities – Challenges – Factors – Architecture.	
MODULE IV	COMPUTING IN IOT	9
	Cloud and Fog Computing – RFID – IoT Design and Prototyping – Security Mechanisms.	
MODULE V	TOOLS AND APPLICATIONS	9
	Case Study - Hadoop – Spark, Spark SQL - Deep Dive in Apache spark – IoT and Applications.	

L – 45; Total Hours : 45

REFERENCES :

1. Soraya Sedkaoui, “Data Analytics and Big Data”, First Edition, Wiley Publications, 2018. ISBN 978-1-78630-326-4 (Module I & II)

2. Rajat Mehta, "Big Data Analytics with Java", Pact Publishing, First Edition, 2017. ISBN :978-1-78728-898-0.(Module II)
3. Qusay F. Hassan,"Internet of Things A to Z: Technologies and Applications", Wiley Publications, Second Edition,2018. ISBN: 978-1-111-945674-2. Module (III & IV)
4. VenkatAnkam, "Big Data Analytics", Pact Publishing, First Edition, 2016. ISBN: 978-1-78588-496-6.
5. NilanjanDey, Aboul Ella Hassanien, Chintan Bhatt, Amira S. Ashour, Suresh Chandra Satapathy, "Internet of Things and Big Data Analytics Toward Next-Generation Intelligence", First Edition, Springer, 2017.

OUTCOMES :

Students to complete this course will be able to

- Categorize and summarize Big Data and its importance.
- select and implement machine learning techniques and computing environment that are suitable for the applications under consideration
- Identify the technology and standards related to IoT.
- Integrate computer based systems to the physical world.
- Design lot based prototypes using big Data.
- Familiarize with tools and techniques with Apache spark, with Hadoop platform.

OBJECTIVES :

- To understand the terms and terminologies of predictive modeling.
- To study the various predictive models, their merits, demerits and application.
- To get exposure to various analytical tools available for predictive modeling.
- Develop a deep understanding of the predictive analytics life cycle.
- To have knowledge on the various issues in predictive analysis.
- To provide sufficient foundations in predictive analysis to enable further study and research.

MODULE I INTRODUCTION TO PREDICTIVE MODELING 9

Core ideas in data mining - Supervised and unsupervised learning - Classification vs Prediction -Steps in data mining- SEMMA Approach - Sampling -Pre-processing - Data cleaning - Data Partitioning - Building a model - Statistical models - Statistical models for predictive analytics.

MODULE II PREDICTIVE MODELING BASICS 9

Data splitting – Balancing- Overfitting –Oversampling –Multiple Regression - Artificial neural networks (MLP) - Variable importance- Profit/loss/prior probabilities - Model specification - Model selection - Multivariate Analysis.

MODULE III PREDICTIVE MODELS 8

Association Rules-Clustering Models –Decision Trees- Ruleset Models- KNearest Neighbors – Naive Bayes - Neural Network Model – Regression Models – Regression Trees – Classification & Regression Trees (CART) – Logistic Regression – Multiple Linear Regression Scorecards –Support Vector Machines – Time Series Models - Comparison between models - Lift chart - Assessment of a single model.

MODULE IV PREDICTIVE ANALYTICS 9

Predictive modeling and Analysis - Regression Analysis, Multicollinearity , Correlation analysis, Rank correlation coefficient, Multiple correlation, Least square, Curve fitting and goodness of fit.

MODULE V Data analytics and applications 9

Real time case study with modeling and analysis.

L – 45; Total Hours : 45

REFERENCES :

1. Alberto Cordoba, "Understanding the Predictive Analytics Lifecycle", Wiley, 2014
2. Michael Minelli, Michele Chambers, "Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Business", 1st Edition, AmbigaDhiraj, Wiley CIO Series, 2013

3. Deepti Gupta “ Applied Analytics through case studies using SAS and R:implementing predictive models and machine learning techniques”, 1st Edition, MIT press, 2015.
4. Conrad Carlberg, “Predictive Analytics: Microsoft Excel”, 1st Edition, Que Publishing, 2012.

OUTCOMES :

Students to complete this course will be able to

- Ability to apply specific statistical and regression analysis methods
- Design and analyze appropriate predictive models.
- Define the predictive models for different applications
- Learn the key and enabling technologies that help in the development predictive modeling
- Ability to apply predictive analytics to identify new trends and patterns
- Evaluate and choose the appropriate technologies, algorithms and approaches for implementation and use of different predictive modeling.

CSDY012

IOT ARCHITECTURE AND PROTOCOLS

L T P C
3 0 0 3

OBJECTIVES :

- To assess the vision and introduction of IoT.
- To Understand IoT Market perspective.
- To Implement Data and Knowledge Management and
- To study and Understand of the Security frameworks and privacy.
- To classify Real World IoT Design Constraints, Industrial Automation in IoT.

PREREQUISITES :

- Computer Networks
- Cloud Computing

MODULE I	INTRODUCTION	9
IoT definitions - An Architectural Overview – IoT Data Management and Analytics – Communication Protocols - Open IoT Architecture for IoT/Cloud Convergence- Scheduling Process and IoT Service Life Cycle - Scheduling and Resource Management – Application – Security and Privacy.		
MODULE II	IoT ENABLERS AND SOLUTIONS	9
Introduction to Programming Framework for IoT – Background Views – Survey of IoT Programming Frameworks – Virtualization on Embedded Boards - Virtualization and Real Time – Virtual Machines and Micro Virtual Machines – IoT Architecture for selected use cases.		
MODULE III	IoT DATA AND KNOWLEDGE MANAGEMENT	9
Introduction to Stream Processing in IoT Fundamentals, State Arts and Future Directions – A Framework for Distributed Data Analysis for IoT – Case Study.		
MODULE IV	IoT RELIABILITY, SECURITY AND PRIVACY	9
IoT Security Overview – Security Frameworks – Privacy in IoT Networks – Characteristics and issues – IoT Governance – TinyTO Protocols.		
MODULE V	IoT APPLICATIONS	9
Applied IoT – Sensors - Gateway – Data Transmission – Internet of vehicle and application – Basics – Characteristics and challenges – Enabling Technologies – Applications – Case Study.		

Total Hours : 45

REFERENCES :

- 1 Rajkumar Buyya and Amir Vahid Dastjerdi “IoT Principles and Paradigms”, Cloud Computing and Distributed Systems (CLOUDS) Laboratory Department of Computing and Information Systems The University of Melbourne, Australia Manjrasoft Pty Ltd, Australia., USA Copyright © 2016 Elsevier Inc. All rights reserved. ISBN: 978-0-12-

805395-9.

- 2 David Hanes, Gonzalo Salguero, Patrick Grossetete, Rob Barton, Jerome Henry,"IoT Fundamentals, Networking Technologies, Protocols, Use case for the internet of things publisher: Pearson Education (US), Cisco Press ISBN: 9781587144561, 1587144565, Edition: 2017.
- 3 BK Tripathy and J.Anuradha IoT Technology ,Applications,Challenges and Solutions Publisher: Taylor & Francis Ltd,ISBN: 9781138035003, 1138035009,CRC Press. 2018.

OUTCOMES :

Students to complete this course will be able to

- Interpret the vision of IoT from a global context.
- Determine the Market perspective of IoT.
- Compare and Contrast the use of Devices, Gateways and Data Management in IoT.
- Implement the security problems and solutions.
- Illustrate the application of IoT in Industrial Automation and identify Real World Design Constraints

OBJECTIVES :

- To elucidate the theoretical aspects of Business Analytics Process.
- To expose to the importance of resource considerations to support Business Analytics
- To accumulate knowledge of aligning resources to support Business Analytics within an organization
- To demonstrate the necessary visualizing and exploring data
- To introduce data mining concepts.
- To develop the ability to design implement and validate the forecasting Models

PREREQUISITES :

- Big data Analytics
- Statistics

MODULE I	INTRODUCTION	9
	Business Analytics Process–Relationship of BA Process and Organization Decision-Making Process .– Importance of Business Analytics – Business Analytics Personnel-Business Analytics Data.	
MODULE II	ORGANIZATION STRUCTURES AND DESCRIPTIVE ANALYTICS	9
	Organization Structures Aligning Business Analytics– Management Issues – Descriptive Statistics– Sampling and Estimation- Probability Distributions- Descriptive Analytics Step in the BA Process.	
MODULE III	PREDICTIVE ANALYTICS	9
	Predictive Modeling– Logic-Driven Models- Data-Driven Models-Data Mining – Data Mining Methodologies– Predictive Analytics Analysis- Case Study.	
MODULE IV	PRESCRIPTIVE ANALYTICS	9
	Prescriptive Modeling– Nonlinear Optimization- Marketing/Planning Case Study-Prescriptive Analysis .	
MODULE V	BUSINESS ANALYTICS CASE PROBLEM	9
	Descriptive Analytics Analysis– Developing the Forecasting Models– Selecting and Developing an Optimization Shipping Model– Business Performance Improvement– Statistical Testing- Duality and Sensitivity Analysis in Linear Programming- Simple Regression Model- Decision Theory	

L - 45 Total Hours :45

REFERENCES :

9. Jeffrey D. Camm, James J. Cochran, Michael J. Fry, Jeffrey W. Ohlmann, David R. Anderson,“Essentials of Business Analytics”, Cengage Learning, 2nd Edition, ISBN-13: 978-1-305-62773-4, 2016.
10. Marc J. Schniederjans Dara G. Schniederjans Christopher M. Starkey, “Business

Analytics Principles, Concepts, and Applications”, Pearson Education Inc, 2014, ISBN-13: 978-0-13-355218-8

11. Kush R Varshney, “Introduction to Business Analytics”, Business Analytics and Mathematical Sciences Department, IBM Thomas J Watson Research Center, IBM Corporation, 2012.

OUTCOMES :

Students who complete this course will be able to

- comprehend and compare the different concepts of business analytics.
- design models to reflect alignment of resources to support business analytics within an organization
- apply the various business analytics models.
- analyze the different forms of data.
- evaluate research articles and thus be aware of the research front in predictive analytics
- explore and use an appropriate forecasting model for real time case studies..

CSDY014

DATA ANALYTICS

L T P C

3 0 0 3

OBJECTIVES :

- To familiarize the basic data analytic techniques.
- To provide descriptive statistics on various scales.
- To visualize and summarize the data.
- To find natural groups and frequent patterns in dataset.
- To explore the predictive tasks, classification and regression.
- To provide applications of data analytics on sensitive fields.

PREREQUISITES :

- Statistics
- Data mining

MODULE I INTRODUCTION TO DATA 9

Data – Small data – Big data – Big data architectures –Big data and data science – Data analytics – KDD Process – The CRISP – DM Methodology.

MODULE II DESCRIPTIVE STATISTICS 9

Scale types – Descriptive Uni-variate analysis – Descriptive Bi variate analysis – Descriptive multi variate analysis – Location and Dispersion multivariate statistics – Infographics and Word Clouds.

MODULE III PREPROCESSING DATA AND CLUSTERING 9

Data Quality – Missing values – Redundant data – Inconsistent data – Noisy data – Data transformation – Principal and Independent Component Analysis – Independent Component Analysis – Attribute selection – Filters – Wrappers – Embedded – Clustering - Distance measures – Clustering techniques – K-means

MODULE IV PATTERN MINING AND PREDICTING THE UNKONWN 9

Frequent pattern mining – Apriori join based method – FP Growth – Association rules – Simpson's Paradox – Types of pattern – Predicting the unknown - Regression – Classification – Predictive methods.

MODULE V APPLICATIONS 9

Applications for Text, Web and Social media – Military applications of data analytics – Data analytics in government: current practices and future opportunities.

L – 45; Total Hours : 45

REFERENCES :

1. [João Moreira](#), [Andre Carvalho](#), [Tomás Horvath](#), “A General Introduction to Data Analytics”, 1st Edition, John Wiley & Sons, 2018.
2. [Herbert Jones](#), “Data Analytics: An Essential Beginners Guide to Data Mining, Data Collection, Big Data Analytics for Business, and Business Intelligence Concepts”, 1st Edition, CreateSpace Independent Publishing Platform, 2018.
3. [Soraya Sedkaoui](#), “Data Analytics and Big Data”, 1st Edition, John Wiley & Sons, 2018.
4. [Kevin Huggins](#), “Military Applications of Data Analytics [Data Analytics Applications](#)”, 1st Edition, CRC Press, 2018.
5. [Gregory Richards](#), “Big Data and Analytics Applications in Government: Current Practices and Future Opportunities [Data Analytics Applications](#)”, 1st Edition, CRC Press, 2017.

OUTCOMES :

Students to complete this course will be able to

- Acquire in depth knowledge on data and data analytics techniques.
- Analyze and apply descriptive statistics on various scales.
- Acquire skills on data quality and preprocessing and clustering techniques.
- Identify frequent pattern among the data sets.
- Predict the unknown data through classification or regression.
- Apply the data analytics in various field of applications.

OBJECTIVES :

- To elucidate the theoretical aspects of software testing.
- To demonstrate the testing design methods.
- To expose to various industrial practices on software testing and quality assurance strategies
- To explain the fundamental concepts of defect analysis
- To introduce the software quality metrics for increasing the product quality
- To develop into a software tester and quality controller

MODULE I	FOUNDATIONS OF SOFTWARE TESTING	9
	Software Testing Lifecycle - Software Quality Attributes -Software Specifications- Program Correctness and Verification- - Software Testing Taxonomy	
MODULE II	TEST DATA GENERATION	8
	Testing Plan and Design -Test Generation Concepts- Functional Criteria- Structural Criteria- Failures, Errors, and Faults	
MODULE III	TEST DEPLOYMENT AND ANALYSIS	9
	Test Oracle Design- Test Driver Design- Test Outcome Analysis- Metrics for Software Testing- Software Testing Tools- Test execution and reporting.	
MODULE IV	SOFTWARE QUALITY MANAGEMENT	10
	Software Quality Concept-Defect Management- Risk Vulnerability and Threat Management- Software Quality Expectation- Software Quality Characteristics- Information Audit- Security Policy Document -Software Reliability and Process Improvement-Software Quality metrics methodology.	
MODULE V	SOFTWARE QUALITY ENGINEERING APPLICATIONS	9
	Software Quality Engineering- Models for Quality Assessment-Risk Identification for quantifiable quality improvement.-System and Software Quality Engineering Applications- Trustworthiness of IT Systems and Services- Case Studies	

Total Hours :45**REFERENCES :**

- 1 Abu SayedMahfuz, "Software Quality Assurance: Integrating Testing, Security, and Audit", CRC Press, Taylor and Francis Group, Auerbach Publications, ISBN 978-1-498-73553-7, 2016.
- 2 Ivan Mistrik, Richard M Soley, Nour Ali, John Grundy,BedirTekinerdogan "Software Quality Assurance: in Large Scale and Complex Software intensive", 1st Edition, Elsevier Publication,ISBN :9780128023013,2016

- 3 [Ali Mili](#), [FairouzTchier](#),, “Software Testing: Concepts and Operations”, Jon Wiley & Sons Publications, ISBN: 978-1-118-66287-8,2015.
- 4 [WitoldSuryn](#), “Software Quality Engineering: A Practitioner's Approach”, IEEE Computer Society Press, Jon Wiley & Sons Publications, ISBN: 978-1-118-83018-5,2014.

OUTCOMES :

Students who complete this course will be able to

- comprehend the types of Software Testing plans.
- compare the different Software Testing design for the given data.
- apply the various software testing strategies in industrial practices.
- explore and use an appropriate testing tool for real time case studies.
- analyze software quality attributes and ensure quality in IT Systems.
- design and implement software quality engineering applications and take up a career as a professional software tester

OBJECTIVES :

- To learn the basic concepts of software project management.
- To discuss various processes in software project management.
- To expose various tools and packages.
- To understand the nature of software development and software life cycle process models, agile project management and other agile practices
- To expose different project management life cycles.
- To provide tools and techniques for project monitoring.

PREREQUISITES :

- Software Engineering

MODULE I	FUNDAMENTALS OF PROJECT MANAGEMENT	9
	Defining a project- Sequence of Activities – Complex Activities – A Business focused definition - Understanding the Scope Triangle - Managing the Creeps - Importance of Classifying Projects - Fundamentals of Project Management - Introducing Project Management Life Cycles - Choosing the Best - Fit PMLC Model.	
MODULE II	PROJECT MANAGEMENT PROCESS GROUPS	9
	Defining the Five Process Groups - Nine Knowledge Areas - Mapping Knowledge Areas to Process Groups - Using Tools, Templates, and Processes to Scope a Project - Managing Client Expectations.	
MODULE III	TPM PROJECT	9
	Using Tools, Templates, and Processes to Plan a Project - Application Software Packages- Project Planning Tools – Planning and Conducting Joint Project - Building the WBS - Estimating - Constructing the Project Network Diagram - Effective Project Proposal - Launch a TPM Project- Monitor and Control a TPM Project.	
MODULE IV	COMPLEX PROJECT MANAGEMENT	9
	Understanding the Complexity/Uncertainty - Traditional Project Management - Incremental Project Management Life Cycle - Agile Project Management - Iterative Project Management Life Cycle- Adaptive Project Management Life Cycle – Adapting and Integrating the APM Toolkit.	
MODULE V	BUILDING AN EFFECTIVE PROJECT MANAGEMENT	9
	Establishing and Managing a Project Portfolio Management Process - The Project Portfolio Management Life Cycle - Establishing and Managing a Continuous Process Improvement Program - Defining Process and Practice Maturity - Using Process Improvement Tools, Templates and Processes.	

REFERENCES :

1. Robert K. Wysocki, "Effective Project Management – Traditional, Agile, Extreme", 7th Edition, Wiley Publication, 2014.
2. Günther Ruhe, Claes Wohlin, "Software Project Management in a Changing World, SpringerVerlag, 2014
3. Bob Hughes, Mike Cotterell, Rajib Mall, "Software Project Management ", 5th edition, Tata McGraw-Hill Education Pvt. 2011
4. Roger S. Pressman, "Software Engineering" 8th edition, Mc Graw Hill Education, 2018

OUTCOMES :

Students to complete this course will be able to

- Explain the software project management concepts.
- Acquire the ability to track project execution.
- Estimate the cost and prepare project plan document.
- Design a project management plan using different project management life cycles.
- Lead a team and manage the people.
- Generate project schedule and can construct, design and develop different type of Projects.

OBJECTIVES :

- To enable the student to understand the concept of Object Oriented Analysis and Design.
- To understand the design concepts.
- To design traditional components.
- To expose the relations between interaction design and users expectations.
- To develop responsive web applications.
- To acquire knowledge in mob applications.

PREREQUISITES :

- Object Oriented Programming
- Software Engineering

MODULE I UNIFIED PROCESS AND USE CASE DIAGRAMS 9

Introduction to OOAD with OO Basics – Unified Process – UML diagrams – Use Case- Class Diagram - Elaboration – Domain Model – Finding conceptual classes and description classes – Associations – Attributes – Domain model refinement – Finding conceptual class Hierarchies – Aggregation and Composition – Relationship between sequence diagrams and use cases

MODULE II DESIGN CONCEPTS 9

Design within the Context of Software Engineering - The Design Process- Design Concepts - The Design Model - Architectural Design - Software Architecture - Architectural Genres - Architectural Styles -Architectural Considerations - Architectural Decisions - Architectural Design – Assessing - Pattern-based Architecture Review - Architecture Conformance Checking - Agility and Architecture

MODULE III COMPONENT- LEVEL DESIGN 9

Component-Level Design - Designing Class-Based Components - Conducting Component-Level Design - Component-Level Design for WebApps - Component-Level Design for Mobile Apps - Designing Traditional Components - Component-Based Development.

MODULE IV USER INTERFACE DESIGN 9

The Golden Rules - Place the User in Control - User Interface Analysis and Design - Interface Analysis - Interface Design Steps - WebApp and Mobile Interface Design - Design Evaluation

MODULE V WEB APP DESIGN AND MOBILE APP DESIGN 9

WebApp Design -WebApp Design Quality - Design Goals - A Design Pyramid for WebApps - WebApp Interface Design - Aesthetic Design - Content Design - Architecture Design - Navigation Design - Component-Level Design. MobileApp Design -

REFERENCES :

1. Roger S. Pressman, “Software Engineering” 8th edition, Mc Graw Hill Education, 2018
2. Simon Bennett, Steve Mc Robb and Ray Farmer, “Object Oriented Systems Analysis and Design Using UML”, Fourth Edition, Mc-Graw Hill Education, 2010.
3. Ali Bahrami – Object Oriented Systems Development – McGraw Hill International Edition – 2012
4. Craig Larman, “Applying UML and Patterns: An introduction to Object”, Oriented Analysis and Design and Unified Process, 3rd Edition, Pearson Education, 2007.

OUTCOMES :

Students to complete this course will be able to

- Use the UML analysis and design diagrams
- Design and implement projects using OO concepts.
- Design the component level design for mob apps.
- Implement basic user interface prototypes based on the design process
- Create dynamic web applications
- Implement and deploy mobile applications using an appropriate software development environment.

OBJECTIVES :

- To provide familiarity with the notion of software architectures, their importance, and different types of architectures.
- To understand the tools and techniques for the automatic analysis and evaluation of software.
- To introduce various software design techniques.
- To acquire knowledge on the various Architectural styles and patterns.
- To get exposed to all elements of architectural design and implementation of software systems
- To gain knowledge on the challenges of advanced software design and various issues relating to software design.

PREREQUISITES :

- Software Engineering

MODULE I	INTRODUCTION	9
	Motivation - Software Architecture –importance of Software architecture- Life-Cycle Activities-Role of Architect- Architectural Design-Architectural Drivers-Design concepts Many contexts of software Architecture.	
MODULE II	QUALITY ATTRIBUTES	9
	Understanding Quality attributes- Availability-Interoperability-Modifiability-Performance - Security-Testability-Usability-Other Quality attributes-Architectural Tactics.	
MODULE III	ARCHITECTURE IN THE LIFE CYCLE	9
	Architecture in Agile Projects—Requirements gathering - Designing an Architecture- Attribute Driven Design method-Steps of ADD- Documenting Software Architecture – Notations-Views and Architectural Styles-Implementation and Testing.	
MODULE IV	ARCHITECTURAL PATTERNS	9
	Introduction; from mud to structure: Layers, Pipes and Filters, Blackboard. Distributed Systems: Broker; Interactive Systems: MVC, Presentation-Abstraction-Control	
MODULE V	DESIGN PATTERNS	9
	Introduction to Design patterns- Creational and Structural Patterns – Behavioral Design Patterns - Working with Design Patterns & Anti-patterns	

L – 45 Total Hours : 45

REFERENCES :

12. Humberto Cervantes, Rick Kazman, "Designing Software Architectures: A Practical Approach" Addison-Wesley Professional, 2016
13. Len Bass, Paul Clements, Rick Kazman, "Software Architecture in Practice, 3rd Edition, Addison-Wesley, 2012
14. Mary Shaw and David Garlan, "Software Architecture- Perspectives on an Emerging Discipline", Prentice-Hall of India, 2007.

OUTCOMES :

Students to complete this course will be able to

- Describe the essential elements of software architecture;
- Analyze the different software architectural styles and methods of documenting architecture.
- Evaluate the quality attributes of software design and architecture.
- Explore the different considerations for designing software architecture.
- Apply fundamental design principles, methods, patterns and strategies in the creation of a software system and its supporting documents.
- Select and use appropriate software design patterns.

CSDY019

FORMAL METHODS IN SOFTWARE ENGINEERING

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OBJECTIVES :

- To know and Understand the software life cycle models.
- To understand the generic techniques for analysis of software source code.
- To introduce suitable mathematical foundations: relational calculus and linear algebra of programming.
- To know and apply about as an individual and as part of a multidisciplinary team to develop and deliver architectural quality and modeling.
- To abstract the details of a software component in order to obtain a model suitable for formal verification.

PREREQUISITES :

- Software Engineering

MODULE I INTRODUCTION 9

Software Engineering-Software Process- Generic process model - Prescriptive process model - specialized, unified process - Agile development-Agile Process - Extreme Programming- Other agile Process models - Software engineering Knowledge - core Principles - Principles that guide each framework Activity.

MODULE II SOFTWARE ANALYSIS AND TESTING 9

Source Code Analysis: Scannerless and Generalised Parsing techniques - Parser Combinators - Generic Tree Traversals, Strategic Programming, Type Analysis, Data Flow Analysis, Inter-procedural Analysis, and flow control analysis. Software Quality - Source code metrics, software system metrics, empirical studies for software quality assessment, software quality models (CMMI, ISO 9126). Software Testing - Unit and functional testing; analysis of test coverage; model based testing; automatic generation of test cases.

MODULE III SPECIFICATION AND MODELING 9

Introduction: the role of formal methods in software engineering - the role of abstraction in formal modeling - propositional and first-order logic. Relational logic - syntax and semantics - modeling using relations - introduction to the relational calculus; taxonomy and relational algebra. Alloy - specification of invariants and operations using pre- and post-conditions using relational logic; idioms for modeling dynamic behaviour; semantics and type system; automatic verification techniques - comparison with other modeling languages. Specification of reactive systems - temporal logic (LTL and CTL); explicit state model checking; symbolic model checking; tools for model checking.

MODULE IV ARCHITECTURE AND CALCULATION 9

Introduction to software architecture and reactive systems - problems, concepts and methods. Foundations - Transition systems as a basic architectural design structure. Simulation, bisimulation and invariants. Weighted automata and stochastic behaviour. Introduction to the linear algebra of programming. Paradigms of architectural design Process-oriented design. Introduction to AADL. Coordination-oriented design. Introduction to Reo. Architectural analysis Structural, behavioural and performance properties. Interactive Markov chains for architectural analysis.

MODULE V FORMAL VERIFICATION 9

Theorem proving: introduction to the interactive construction of proofs. First order theories: employing SMT solvers. Deductive verification: program logics; verification condition generation; behavioral interface specification languages and design by contract. Tools covered: Dafny; Frama-C; SPARK. Model Checking: symbolic model checking - partial order reduction - bounded model checking. Tool covered: SMV. Software Model Checking - bounded model checking of software - existential abstraction mechanisms - predicate abstraction; abstraction refinement. Tools covered: CBMC; BLAST.

L – 45; Total Hours : 45

REFERENCES :

- 1 Roger S, “Software Engineering – A Practitioner’s Approach”, seventh edition, Pressman, 2010.
- 2 Generative Programming - Methods, Tools, and Applications, Krzysztof Czarnecki and UlrichW. Eisenecker, Addison-Wesley, June 2000
- 3 Daniel Jackson. Software abstractions: logic, language, and analysis. Revised edition, MIT Press, 2012. Christel Baier and Joost-Pieter Katoen. Principles of model checking. MIT Press, 2008.
- 4 A. Aldini, M. Bernardo, and F. Corradini. A Process Algebraic Approach to Software Architecture. SpringerVerlag, 2010.
- 5 Michael Huth and Mark Ryan. 2004. Logic in Computer Science: Modelling and Reasoning about Systems. Cambridge University Press, New York, NY, USA.

OUTCOMES :

Students to complete this course will be able to

- Demonstrate an understanding of and apply current theories, models, and techniques that provide a basis for the software lifecycle.
- Develop automatic tools for software quality analysis based on software metrics.
- An ability to work in one or more significant application domains
- How to apply the software engineering lifecycle by demonstrating competence in communication, planning, analysis, design, construction, and deployment
- To apply automatic software verification tools based on model checking.

OBJECTIVES :

- To familiarize with the basic software development life cycle models.
- To learn about Agile methodology as a practice to promote continuous iteration of development and testing throughout SDLC.
- To learn the basics about development cycles, IT Operations & faster innovation.
- To learn about Continuous Integration (CI) and Continuous Delivery (CD) for quicker & continuous software release/delivery.
- To give knowledge of how DevOps could help reduce complexity in developing and deploying code.
- To create reports and dashboard for effective project management.

PREREQUISITES :

- Software Engineering
- Cloud Computing

MODULE I SOFTWARE DEVELOPMENT MODELS 9

Software Process – Software development Life cycle models (SDLC) – Basic Software development Life cycle models - Water fall model – V model – Matrix based model – Prototyping.

MODULE II INTRODUCTION TO AGILE 9

Design thinking – History of Agile – Agile principles – Benefits of agile – Agile Vs Waterfall - Agile Methodology Overview - Agile Approaches on Large Projects in Large Organizations.

MODULE III AGILE SOFTWARE DEVELOPMENT 9

Agile frameworks – Extreme programming - Rational Unified Process (RUP) - Test Driven Development (TDD) – Feature Drive Development (FDD) - Scrum - Kanban Methodology – Agile and Devops - Software Development using Extreme Programming and Scrum Framework.

MODULE IV DEVOPS 9

Introduction to DevOps – DevOps vs Agile – DevOps Principles and Life Cycle – Introduction to CI / CD & DevOps Tools– Version Control – Build Automation – Configuration Management – Containerization – Continuous Deployment – Continuous Integration – Continuous Testing – Continuous Monitoring.

MODULE V AGILE SOFTWARE DEVELOPMENT WITH JIRA 9

JIRA Ecosystem – Getting started with JIRA - Managing work items – Running project in JIRA – Working with Reports – Issue searching and filtering – Dashboard and widgets

L – 45;**Total Hours : 45****REFERENCES :**

- 1 [Brian Hobbs, Yvan Petit](#), “Agile Approaches on Large Projects in Large Organizations”, 1st Edition, Project Management Institute, 2017.
- 2 [Ralf Kneuper](#),” Software Processes and Life Cycle Models: An Introduction to Modelling, Using and Managing Agile, Plan-Driven and Hybrid Processes”, 1st Edition, Springer, 2018.

- 3 [Joakim Verona](#), "Practical DevOps, Second Edition: Implement DevOps in your organization by effectively building, deploying, testing, and monitoring code", 2nd Edition, Packt Publishing Ltd, 2018.
- 4 [Oleg Skrynnik](#), "DevOps - A Business Perspective", 1st Edition, Oleksandra Spiegler, Van Haren, 2018.
- 5 [David Harned](#), "Hands-On Agile Software Development with JIRA: Design and manage software projects using the Agile methodology", 1st Edition, Packt Publishing Ltd, 2018.
- 6 Kallori Vikram, "Introduction to DevOps", 1st Edition, Kallori Vikram Publication, 2016.

OUTCOMES :

Students to complete this course will be able to

- Identify the problems and challenges in Software development lifecycle models.
- Implement agile software methodology for faster development of quality software.
- Describe how to unify processes and improve collaboration between development and operations.
- Implement Automated Installations and Deployments.
- Identify tools and practices for implementing CI, testing, and continuous deployment
- Work with tools/technologies - Git, Maven, Puppet, Junit, Jenkins, Docker & Nagios, JIRA.

CSDY021	SOFTWARE ENGINEERING PROCESS, TOOLS AND METHODS	L	T	P	C
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OBJECTIVES :

- To enable the students to identify the role of requirement engineering in software engineering.
- To introduce various software design techniques
- To study fundamental concepts in software testing, including software testing objectives, process, criteria, strategies, and methods.
- To effectively log and manage identified defects.
- To equip participants with basic knowledge and skills about computer hardware and software maintenance and troubleshooting of common problems.
- To demonstrate the software maintenance processes and tools for maintenance.

PREREQUISITES :

- Data Mining
- Database Management

MODULE I	SOFTWARE PROCESS	9
	Software Engineering – Framework – CMMI - Process- Models – Agile Development – System Engineering.	
MODULE II	REQUIREMENTS ENGINEERING	9
	Tasks – requirements Process – Eliciting Requirements – Use Cases – Analysis Model – Negotiating & Validating – Requirements analysis.	
MODULE III	DESIGN	9
	Design Process – Concepts – Model – Pattern Based Design – Architectural Design – Class Based Components - User Interface Design.	
MODULE IV	TESTING	9
	Testing Strategies – Techniques - Testing Web Applications – Risk Identification – SCM Process.	
MODULE V	ESTIMATION	9
	Project Estimation – Decomposition Techniques – Estimation Models - SLIM (Software Life Cycle Management) Tools	

L – 45; Total Hours : 45

REFERENCES :

1. Roger. S. Pressman, “Software Engineering A Practitioners Approach”, Eight Edition, Mc Graw Hill, 2016.ISBN-0-07-285318.

2. Ian Sommerville, "Software Engineering", 10th Edition, Pearson Education India, ISBN: 978-0-1339-4303-0, 2015.
3. Karl E Wieggers , Joy Beatty , "Software Requirements", 3rd Edition, Microsoft, ISBN: 978-0-7356-7966-5, 2012.

OUTCOMES :

Students to complete this course will be able to

- Explore the requirements process and its relationships to the rest of the software development life cycle.
- Develop different design solutions to a given problem and recommend the best one within limitations of cost, time, knowledge, existing systems and organizations.
- Understand and identify various software testing problems, and solve these problems by designing and selecting software test models, criteria, strategies, and methods.
- Apply software testing techniques and identify the inputs and deliverables of testing.
- Critically evaluate different software development environments and contexts with respect to the application of appropriate standards and models
- Analyze the types of Estimation Model and apply them to various real time applications.

OBJECTIVES :

- To provide a broad overview of the state of wireless and mobile ad hoc networking.
- To discuss physical, networking and architectural issues of mobile ad hoc networks.
- To elaborate the functions of various routing protocols under unicast, multicast and transport layer protocols.
- To give a knowledge about issues in QoS, energy management of mobile ad hoc networks
- To learn the various security mechanism used in mobile adhoc networks.
- To study the current technology trends for the implementation and deployment of mobile ad hoc networks.

MODULE I INTRODUCTION 9

Introduction – Fundamentals of wireless communication technology – The Electromagnetic spectrum – Radio propagation mechanisms – Characteristics of the wireless channel – IEEE 802.11a,b standard – Origin of Ad hoc: Packet radio networks – Technical challenges – Architecture of PRNETs – Components of packet radios – Adhoc wireless networks – Heterogeneity in mobile devices– Wireless sensor networks – Traffic profiles – Types of Ad hoc mobile communications – Types of mobile host movements – Challenges facing Ad hoc mobile networks – Ad hoc wireless internet.

MODULE II ROUTING PROTOCOLS 9

Introduction – Issues in designing a routing protocol for Ad hoc wireless networks – Classifications of routing protocols – Table-Driven routing protocols– Destination Sequenced Distance Vector (DSDV) – Source-Initiated On-Demand approaches – Ad hoc On-Demand Distance Vector Routing (AODV)– Dynamic Source Routing (DSR) – Temporally Ordered Routing Algorithm (TORA) –Location–Aided Routing (LAR) – Power-Aware Routing (PAR) – Zone Routing Protocol (ZRP)..

MODULE III MULTICASTING AND SECURITY PROTOCOLS 9

Introduction – Issues in designing a multicast routing protocol – Operation of multicast routing protocols –Classifications of multicast routing protocols – Tree-Based multicast routing protocols – Mesh-based multicast routing protocols. Security in Ad hoc wireless networks – Network security requirements – Issues and challenges in security provisioning – Network security attacks – Key management – Secure routing in Ad hoc wireless networks.

MODULE IV TRANSPORT LAYER PROTOCOLS 9

Introduction – Issues in designing a transport layer protocol for Ad hoc wireless networks – Design goals of a transport layer protocol for Ad hoc wireless networks – Classification of transport layer solutions – TCP over Ad hoc wireless networks – Other transport layer protocols for Ad Hoc wireless networks.

MODULE V QOS AND ENERGY MANAGEMENT 9

Introduction – Issues and challenges in providing QoS in Ad hoc wireless networks – Classifications of QoS solutions – MAC layer solutions – Network layer solutions– Introduction – Need for energy management in Ad hoc wireless networks – Classification of energy management schemes – Battery management schemes – Transmission power management schemes – System power management schemes.

L – 45; Total Hours : 45

REFERENCES :

1. C.Siva Ram Murthy and B.S.Manoj, "Ad hoc Wireless Networks Architectures and Protocols", 2nd Edition, Pearson Education, ISBN-13: 9780133007060, 2012.
2. Stefano Basagni, Marco Conti, Silvia Giordano and Ivan Stojmenovic " Mobile Ad Hoc Networking: The Cutting Edge Directions", 2nd Edition, Wiley-IEEE Press, ISBN: 978-1-118-08728-2, 2013.
3. Jonathan Loo, Jaime LloretMauri, Jesús Hamilton Ortiz, "Mobile Ad Hoc Networks: Current Status and Future Trends" CRC Press, ISBN 9781439856505 ,2012.

OUTCOMES :

Students who complete this course will be able to

- Identify the issues in wireless networks and how they can be addressed. Assess the platform architectures that are suitable for Mobile Adhoc networks.
- An ability to understand and analyze the routing concept of mobile ad hoc network
- Examine the various security threats to ad hoc networks and propose the solutions.
- Analyze the issues in designing the multicasting and security protocols for Mobile Adhoc networks
- Comprehend the design issues in TCP and other transport layer protocols
- An ability to understand the solutions to improve the quality of service in mobile adhoc network

**CSDY023 HACKING TECHNIQUES AND DIGITAL FORENSICS L T P C
3 0 0 3**

OBJECTIVES :

- To get in depth knowledge on basics of hacking.
- To learn the various hacking techniques.
- To build web server using Kali linux.

- To perform penetration testing using python.
- To learn the fundamentals of digital forensics.
- To analyze forensics and expose hacking on digital forensics.

PREREQUISITES :

- Linux and Python
- Attacks and Security

MODULE I	BASICS OF HACKING	9
Hacking – Types of hacking – Phases of hacking – Ports & Protocols – Virtualization – Foot printing – Scanning.		
MODULE II	PERFORMING THE HACK	9
Hacking into System – System cracking – Password cracking - Trojans & Backdoors – Viruses & Worms – Spoofing – Spam – Malware – Sniffing, Packet Analysis and Session Hijacking - Social Engineering – Cryptography.		
MODULE III	ADVANCE HACKING TECHNIQUES	9
Denial of Service – Web application - Build Web server using Kali Linux – Penetration testing using python – Information Gathering – SQL Mapping – Vulnerability analysis.		
MODULE IV	DIGITAL FORENSICS	9
Digital Forensics Goals – Cyber Crime – Digital Forensic Categories- Investigation types – Digital Evidences – Essential technical concepts.		
MODULE V	FORENSIC ANALYSIS	9
Acquiring digital Evidence – Analyzing digital evidence – Windows Forensics analysis- Web Browser and E-mail Forensics – Anti-forensics techniques – Digital forensics Report - Hacking Exposed Computer Forensics.		

L – 45; Total Hours : 45

REFERENCES :

1. Jacob Hatcher, "Hacking: Hacking For Beginners and Basic Security: How To Hack", 2nd Edition, Lulu.com, 2016.
2. Nihad A. Hassan, "Digital Forensics Basics: A Practical Guide Using Windows OS", 1st Edition, Apress, 2019.
3. Harsh Bothra, "Hacking: Be a Hacker with Ethics", 1st Edition, Khanna Publishing, 2017
4. Sanjib Sinha, "Beginning Ethical Hacking with Kali Linux: Computational Techniques for Resolving Security Issues", 1st Edition, Apress, 2018
5. David Cowen, "Hacking Exposed Computer Forensics, Third Edition: Secrets & Solutions", 3rd Edition, McGraw-Hill Education, 2016.
6. Joakim Kävrestad, "Guide to Digital Forensics: A Concise and Practical Introduction", 1st Edition, Springer, 2017.

OUTCOMES :

Students to complete this course will be able to

- Describe the fundamental concepts of hacking.

- Perform various basic and advance hacking techniques.
- Apply hacking techniques using programming tools such as Kali linux and python.
- Explain the basic concepts of digital forensics.
- Analyze digital forensics techniques on various platforms.
- Expose hacking techniques on digital forensics.

OBJECTIVES :

- To provide an understanding of principal concepts, major issues, technologies and basic approaches in information security
- To know the legal, ethical and professional issues in Information Security
- To familiarize with the aspects of risk management.
- To know the technological aspects of implementation of Information Security
- To focus on physical security and understand the access models.
- To highlight the salient features of implementation and maintenance of security.

PREREQUISITES :

- Computer Networks

MODULE I INTRODUCTION 9

Introduction-History of Information Security-Need for security-CNSS security model-Components of an information system-Balancing information security and access-System development life cycle-security systems development life cycle- threats-attacks-secure software development-software attacks-Technical hardware failure or errors.

MODULE II PLANNING FOR SECURITY 9

Introduction-Information security planning and governance- Information security policy, standards and practices-Cryptographic tools-protocols for secure communications-Attacks on cryptosystems-Legal, Ethical and Professional issues in Information Security -Laws and Ethics in Information Security.

MODULE III RISK MANAGEMENT 9

Introduction- Risk identification- assessment- control strategies- selecting a risk control strategy – quantitative versus qualitative risk control practices.

MODULE IV SECURITY TECHNOLOGY AND PHYSICAL SECURITY 9

Security Technology - Access Controls, Firewalls and VPNs- Intrusion Detection and prevention systems. Physical Security -Introduction-Physical access controls-Fire Security and safety-Failure of supporting utilities and structural collapse-Interception of Data-Remote computing security.

MODULE V INFORMATION SECURITY IMPLEMENTATION AND MAINTENANCE 9

Information security project management-technical aspects of implementation-non technical aspects of implementation- Positioning and staffing the security function. Security Management Maintenance Models-Digital Forensics.

L – 45; Total Hours : 45

REFERENCES :

1. Michael E. Whitman and Herbert J. Mattor., "Principles of Information Security: 6th Edition, Cengage Learning, 2017.

2. John R.Vacca, "Computer and Information Security Handbook", 3rd Edition, Morgan Kaufmann Publishers,2017.
3. Jason Andress,"The Basics of Information Security", 2nd edition, Syngress Press, Elsevier Publications, 2014.

OUTCOMES :

Students to complete this course will be able to

- Identify the major types of threats to information security and the associated attacks.
- Describe the major components of security and analyze planning, governance, legal and ethical issues of information security.
- Assess risks and illustrate the different aspects of risk management
- Describe firewall technology and the various approaches to firewall implementation and.
- Emphasize the relationship between information security and physical security.
- Enumerate the organizational considerations to be addressed in a project plan and describe the maintenance issues of security.

CSDY025	MOBILE AND WIRELESS NETWORK SECURITY	L	T	P	C
		3	0	0	3

OBJECTIVES :

- To introduce the concepts of wireless and mobile network security
- To Provide security for mobile telecommunication networks
- To have a broad overview of the Wifi and Bluetooth security
- To learn the security issues in IP based mobile networks
- To discuss the security mechanism followed in adhoc and sensor networks
- To expose students to emerging technologies of mobile and wireless networks

MODULE I INTRODUCTION 8

Introduction to Mobile and Wireless Networks-Mobile cellular networks-IEEE wireless networks-Mobile Internet networks.- Vulnerabilities of Wired and Wireless Networks-Security in the digital age-Threats and risks to telecommunications systems-From wireline vulnerabilities to vulnerabilities in wireless communications

MODULE II WIFI AND BLUE TOOTH SECURITY 9

Wi-Fi Security Dedicated Architectures-Hot spot architecture: captive portals-Wireless intrusion detection systems (WIDS)- Wireless honeypots-Bluetooth Security-Bluetooth technical specification-Bluetooth security-Wi-Fi Security-Attacks on wireless networks-Security in the IEEE 802.11 standard-. Security in 802.1x-Security in 802.11i-- Authentication in wireless networks-WiMAX Security

MODULE III SECURITY IN MOBILE TELECOMMUNICATION NETWORKS 9

Signaling-Security in the GSM-GPRS security-3G security-Network interconnection-Security of Downloadable Applications

MODULE IV EMERGING TECHNOLOGIES 9

Security in Next Generation Mobile Networks.-SIP-. VoIP-IP Multimedia Subsystem (IMS)- 4G security-Confidentiality-Security of IP-Based Mobile Networks .- Security in Ad Hoc Networks.- Wireless Sensor Network Security

MODULE V RESEARCH DIRECTIONS IN SECURITY AND PRIVACY FOR MOBILE AND WIRELESS NETWORKS 9

Security and Privacy in 4G/LTE Network-Security for 5G Mobile Wireless Networks- Attacks and Security Services in 5G Wireless Networks-Security Services in 5G Wireless Networks --State-of-the-Art Solutions in 5G Wireless Security-Security for Technologies Applied to 5G Wireless Network Systems--Challenges and Future Directions for 5G Wireless Security

L – 45; Total Hours : 45

REFERENCES :

1. Georgios Kambourakis , Felix Gomez Marmol and GuojunWang,Security and Privacy in Wireless and Mobile Networks, Future Internet,MDPI, 2018

2. Dongfeng Fang, Yi Qian,,RoseQingyang Hu,, Security for 5G Mobile Wireless Networks-IEEE Access, 2017
3. HakimaChaouchiMaryline Laurent-Maknavicius, “Wireless and Mobile Network Security Security Basics, Security in On-the-shelf and Emerging Technologies”, Wiley, 2009
4. S. Kami Makki,Peter Reiher,Kia Makki,Niki Pissinou,ShamilaMakki,,” Mobile and Wireless Network Security and Privacy “, Springer, 2007
5. Lei Chen Jiahuang Ji Zihong Zhang, Wireless Network Security Theories and Applications, Springer, 2013
6. NourMoustafa, JiankunHu,Security and Privacy in 4G/LTE Network, Research Gate, 2018

OUTCOMES :

Students to complete this course will be able to

- Gain knowledge on the concepts of wireless and mobile network security
- Analyze the different security threats in Wifi, Bluetooth and wimax
- Identify the various security risks in mobile telecommunication networks
- Investigate the solutions for security threats to ad hoc networks and sensor networks
- Know how to secure 4G and 5G wireless networks from various attacks
- Get the knowledge on different attacks and security services in future generation mobile wireless and mobile networks

WIRELESS NETWORKS

CSDY026

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3 0 0 3

OBJECTIVES

- To study the various wireless technologies and various access technologies such as 3G, 4G
- To understand the architectures of Wireless LAN technology.
- To understand issues and various Wi-Fi protocols.
- To study the fundamentals and protocols of PAN
- To analyze the various 802.15 protocols
- To study and compare various wireless protocols

MODULE I WIRELESS SYSTEM & RANDOM ACCESS PROTOCOLS

9

Introduction - First and Second Generation Cellular Systems - Cellular Communications from 1G to 3G - Wireless 4G systems - The Wireless Spectrum - Random Access Methods: Pure ALOHA - Slotted ALOHA - Carrier Sense Multiple Access (CSMA), Carrier Sense Multiple Access with Collision Detection (CSMA/CD) - Carrier Sense Multiple Access with Collision Avoidance (CSMA/CA).

MODULE II WIRELESS LANS

9

Introduction - Importance of Wireless LANs - WLAN Topologies - Transmission Techniques: Wired Networks - Wireless Networks - comparison of wired and Wireless LANs - WLAN Technologies: Infrared technology -UHF narrowband technology, Spread Spectrum technology.

MODULE III IEEE 802.11 STANDARD FOR WIRELESS LANS

9

Network Architecture - Physical layer - The Medium Access Control Layer; MAC Layer issues: Hidden Terminal Problem - Reliability - Collision avoidance - Congestion avoidance- Congestion control- Security - The IEEE 802.11e MAC protocol.

MODULE IV WIRELESS PANS

9

Introduction - Importance of Wireless PANS - The Bluetooth technology: Bluetooth Characteristics - the Bluetooth Architecture – Protocol stack – Core and Adapted Protocols - Bluetooth Usage Models - RFID Technology - RFID Definition - Historical Background - RFID vs. Barcodes - Fundamentals of RFID - RFID Tags - Passive Transponders - Passive RFID

WiMAX: WiMAX Concept - WiMAX Protocol - WiMAX Architecture - IEEE 802.15.3 - The IEEE 802.15.4 - ZigBee Technology - ZigBee components and network topologies - The IEEE 802.15.4 LR-WPAN Device architecture: Physical Layer - Data Link Layer - The Network Layer - Applications; IEEE 802.15.3a Ultra wideband.

REFERENCES

1. Clint Smith, Daniel Collins, "Wireless Networks", McGraw-Hill Education, 3 edition 2014.
2. Vijay K.Garg, "Wireless Communications and Networking", Morgan Kaufmann Publishers, 2009.
3. KavehPahlaram, Prashant Krishnamurthy, "Wireless Networks", PHI, 2002.
4. Marks Ciampor, JeorgeOlenewa, "Wireless Communication", Cengage Learning, 2007.
5. Gordon Colbach, "Wireless Networking: Introduction to Bluetooth and WiFi", 2018

OUTCOMES

Students who complete this course will be able to

- Describe latest wireless technologies and trends in the communication field.
- Acquire the knowledge on Network Architecture and Applications of Ad-hoc and Wireless Sensor Networks.
- Analyze the protocol design issues of Ad-hoc Networks.
- Recognize the importance of RFID Technology and application in real world.
- Familiarity with CSMA mobile standards. •
- Describe different types of networks – LANs, PANs, WANs, Gigabit networks,WLANs,WiMax etc.

OBJECTIVES :

- To understand how to work with various mobile application development frameworks
- To understand the basics of Android devices and Platform.
- To acquire knowledge on basic building blocks of Android programming required for App development.
- To expose the Knowledge on Xcode Project and how its transformed to app
- Develop skills and devise strategies to build versatile and flexible apps that meet changing business requirements
- To identify the complete end-to-end mobile device management.

PREREQUISITES :

- Programming Language
- Open Source

MODULE I	INTRODUCTION	9
	Introduction to mobile application development, trends, introduction to various platforms. Android – Getting Started – Android Development tools –Applications and Activities and Fragments.	
MODULE II	SWIFT LANGUAGE	9
	The Architecture of Swift: The structure of Swift File, Design – Functions: Function Parameters and Return Value, External Parameter Names, Closures, Curried Functions – Variables and simple types: Variable Scope and Life Time, Build – In simple Types.	
MODULE III	SWIFT : OBJECT TYPES, FLOW CONTROL	9
	Object Types: Declarations and Features, Enums, Structs, Classes, Polymorphism, Protocols, Extensions, Umbrella Types, Collection Types – Flow Control: Flow control, Privacy, Memory Management.	
MODULE IV	XCODE	9
	Anatomy of an Xcode Project – Nib Management – Life cycle of a project - Create an application using Xcode	
MODULE V	LEAN TO BUILDING MOBILE APPS	9
	Challenges and applying to lean to building Mobile Apps, An Agile Workflow in a Nutshell: An Agile workflow, Epic, Stories, and Tasks, Tool that can use	
		L – 45; Total Hours :45

REFERENCES :

1. Reto Meier and Ian Lake, "Professional Android", 4th Edition, Wrox A Wiley Brand, ISBN: 9781118949528, 2017.
2. Matt Neuburg, "iOS 12 Programming Fundamentals with Swift Swift, Xcode, and Cocoa basics", 5th Edition, O'Reilly, USA 2018.
3. Hazem Saleh, Ethan Holmes, Tom Bray, Sani Yusuf, "Mobile Application Development:

JavaScript Frameworks”, 1st Edition, Pack Publishing Ltd, UK, ISBN: 978-1-78712-995-5, 2016.

4. Mike van Drongelen, Adam Dennis, Richard Garabedian, Alberto Gonzalez, Arvind Krishnaswamy, “Lean Mobile App Development”, 1st Edition, Pack Publishing Ltd, UK, 2017.

OUTCOMES :

Students to complete this course will be able to

- Design and Implement various mobile applications using emulators
- Deploy applications to hand-held devices
- Develop the user interface using Swift on iOS
- Deploy with platform specific application on iOS
- Adopt the lean startup methodologies to develop iOS and Android apps that shine in the App Store
- Deploy with platform specific application on android and iOS

OBJECTIVES :

- To Understand the basic building blocks of RFID.
- Familiarize the different kinds of RFID, usage, and deployment details.
- Understand the key factors for RFID deployment.
- To learn 8051 microcontroller.
- To develop real time applications based on microcontrollers
- Analyze different case studies.

MODULE I INTRODUCTION OF RFID 9

Automatic Identification Systems – A Classification of ID systems – Components of an RFID System- Features of RFID systems - Layer by Layer-OSI Model and the RFID Interface.

MODULE II RFID APPLICATIONS 9

Short range RFID applications- access control - personal identification - Transportation ticketing- blood, tissue and organ identification- fleet management- personal identification- car body production-passport security. Long range RFID applications- supply chain management- Mail and shipping- Clothing Tags.

MODULE III MICROCONTROLLERS 8051 9

Intel 8051 - architecture- memory organization- special function registers timing and control- port operation- memory interfacing - I/O interfacing Programming the 8051 resources- interrupts- Measurement of frequency, period and pulse width of a signal- power down operation.

MODULE IV INTEL 8051 MICROCONTROLLER - INSTRUCTION SET AND PROGRAMMING 9

Programmers model of Intel-Operand types- Operand addressing- Data transfer instructions- Arithmetic Instructions - Logic instructions- Control transfer instructions.- 8051 Interfacing and applications.

MODULE V CASE STUDIES

Reading RFID cards using 8051- RFID in the supply chain- Vehicles parking using RFID- library management system- electronic toll payment smart shipping containers- fleet monitoring and management.

L – 45; Total Hours : 45

REFERENCES :

1. Ali Miri, "Advanced Security and Privacy for RFID Technologies", 1st Edition, IGI Global Publisher, 2013.
2. Klaus Finkenzeller, "RFID Handbook", 3rd Edition, John Wiley & Sons, 2010.
3. Ajit Pal, "Microcontrollers- principles and applications", Prentice hall of India, 2011.

4. Dennis E. Brown , " RFID implementation" Tata McGraw - Hill, 2007
5. Syed Ashon Mohammed Ilyas, "RFIDHANDBOOKApplications, Technology", Security, and Privacy, CRC Press 2008.
6. Steven Shepard, "RFID: Radio frequency and Identification", Tata McGraw - Hill.
7. Krishna Kant. " Microprocessors and Microcontrollers", Prentice hall of India,2011
8. www.circuitstoday.com/interfacing-rfid-module-to-8051.

OUTCOMES :

Students to complete this course will be able to

- Understand the basic components and applications of RFID systems.
- Identify how to evaluate a RFID project and create estimation with deployment plans.
- Describe Interfacing mechanism and frequency ranges of RFID systems.
- Explore the data transformation procedure with microcontroller.
- Evaluate the key factors for RFID deployment and business process adaption.
- Discuss how RFID is being used today across the world.

CSDY029	KNOWLEDGE ENGINEERING AND EXPERT SYSTEMS	L	T	P	C
		3	0	0	3

OBJECTIVES :

- To Identify the knowledge of engineering.
- To learn the concepts of knowledge base and information management.
- To solve the constructive problem.
- To discuss the expert systems.
- To explaining architecture of expert system.
- To understanding the programming language with expert systems.

MODULE I INTRODUCTION OF KNOWLEDGE ENGINEERING 9

Trends in Knowledge of Engineering: Introduction to knowledge engineering, Limitations and Possibilities of knowledge engineering, Business Management Styles, Management Styles and Information Technology, Management Source of Information, Information Processing, Multidimensional Management Systems (MMS), Computer-Aided Decision-Making (CAD), Organization Marketing, Virtual Management, Computer-Aided Management and Communications

MODULE II ISSUES IN KNOWLEDGE ENGINEERING AND EXPERT SYSTEM 9

Problem solving strategies, Knowiedgewux Information Engineering Workbench, The Systematic-Intuitive Approach, Information Engineering Workbench, Language and Perceptual Models, Standards of expert system, Inference, Reasoning, and Knowledge Acquisition.

MODULE III PROBLEM SOLVING PROCESS 9

Rule Based Systems – Heuristic Classifications – Constructive Problem Solving.

MODULE IV EXPERT SYSTEMS 9

Tools For Building Expert Systems - Case Based Reasoning – Semantic Of Expert Systems – Modeling Of Uncertain Reasoning – Applications Of Semiotic Theory; Designing For Explanation.

MODULE V EXPERT SYSTEM ARCHITECTURE AND PROGRAMMING 9

Expert System Architectures - High Level Programming Languages – Logic Programming For Expert Systems.

L – 45; Total Hours : 45

REFERENCES :

1. By Thomas B. Cross, “Knowledge Engineering 2017 The Uses of Artificial Intelligence in Business”, TECHtionary Corporation, 2017.
2. Peter Jackson, “Introduction to Expert Systems”, 3rd Edition, Pearson Education 2007.
3. Jean-Louis Ermine, “Expert Systems: Theory and Practice”, 4th printing, Prentice-Hall of India, 2001.

4. Padhy N.P, "Artificial Intelligence and Intelligent Systems", 4th impression, Oxford University Press, 2007.
5. Robert I. Levine, Diane E. Drang, Barry Edelson: "AI and Expert Systems: a comprehensive guide, C language", 2nd edition, McGraw-Hill 1990.

OUTCOMES :

Students to complete this course will be able to

- Apply knowledge in logical form and construct ontology for different domains.
- Identified the knowledge engineering issues and implement the workbench process.
- Knowledge gathered in expert systems.
- Analyze the classification and constructive problem solution.
- Tools identification of expert system.
- Understand the flow of expert system architecture and programming logic in expert system.

OBJECTIVES:

1. To provide basic knowledge of employing intelligent agents in solving complex problems.
2. To give the awareness of the building blocks of agents and working of different types of agents.
3. To analyze the reasons for uncertainty and ability to design agents to handle them.
4. To represent knowledge in first order and predicate logic.
5. To learn about machine learning and planning agent.
6. To study the employment of artificial intelligence in recent technologies.

PREREQUISITES:

- Artificial Intelligence

MODULE I INTRODUCTION**9**

Introduction to Artificial Intelligence – Problem solving with AI – Uninformed search – General search algorithms – Informed search – Memory bounded heuristic search – Local search algorithms and optimization problems.

MODULE II INTELLIGENT AGENT**9**

Intelligent Agent – rational agent – task environment and its properties – Types of Agent – Constraint Satisfaction Problem – Backtracking search for CSP – Forward checking – Intelligent backtracking.

MODULE III KNOWLEDGE BASED AGENTS**9**

Knowledge Representation – Logic – Propositional logic – Predicate logic -First Order Logic – Unification and lifting – Representation of knowledge using rules – Uncertain knowledge and reasoning – Probabilistic reasoning.

MODULE IV PLANNING AND LEARNING**9**

Planning Problem – Planning Agent – Planning language – Hierarchic Knowledge based planning – Multi agent planning – Learning – Scop learning – Learning Methods and models – Artificial Neural Network based I agent based Learning.

MODULE V RECENT TRENDS WITH ARTIFICIAL INTELLIGENCE**9**

Architecture of expert system – Knowledge Acquisition – Natural Language Processing – Fuzzy and hybrid Intelligence system –Cloud Computing and Intelligent agents – Business Intelligence and analytics – Big Data and sensory Processing.

Total Hours: 45**REFERENCES:**

1. ParagKulkarni, Prachi Joshi, "Artificial Intelligence: Building Intelligent Systems, 1st Edition, PHI,2015.
2. Stuart Russell and Peter Norvig, "Artificial Intelligence: A Modern Approach", 3rd Edition, Prentice Hall, 2010.
3. NgocThanhNguyaaen, Lakhmi C. Jain, "Intelligent Agents in the Evolution of Web and Applications", 4th Edition, Springer, 2009. .
4. ZiliZhang,Chengqi Zhang, "Agent-Based Hybrid Intelligent Systems: An Agent-Based Framework for Complex Problem Solving", 1st Edition, Springer-Verlag New York, LLC , 2004.

OUTCOMES:

Students who complete this course will be able to

differentiate the types of agents and learn how to apply them in different problem based on requirements.

design knowledge based agents for challenging environment.

explain the basic knowledge representation, problem solving, and learning methods of Artificial Intelligence.

explore the scenarios of uncertainty and design planning agents to handle them.

ability to apply knowledge representation, reasoning, and machine learning techniques to real-world problems.

applyArtificial Intelligence techniques in the cutting edge technologies such as cloud computing and Big data.

OBJECTIVES :

- To introduce the basic architecture and statistical approaches for spoken language processing.
- To illustrate how these models are applied to speech recognition and speaker verification.
- To provide knowledge on training the networks constructed based on the mathematical models.
- To introduce Deep Neural Network for modeling complex patterns of speech.
- To learn the fundamental issues in speech recognition.
- To provide an overview on advanced deep models for speech recognition.

PREREQUISITES:

- Computer Network

MODULE I SPEECH TECHNOLOGY 9

Introduction–Reproducing Speech-Recognizing Speech -Scope of Speech Technology
Human Factors-Automatic speech Recognition-Basic Architecture.

MODULE II TRAINING NETWORK 9

Neural Networks – Architecture -Parameter Estimation – Practical Considerations
Restricted Boltzmann Techniques -Deep Belief Network –Discriminative Pretraining-
Hybrid and Dropout Pretraining

MODULE III NETWORK MODEL 9

DNN-HMM Hybrid System -Key components – Training and Decoding Speedup
Sequence Discriminative Training Criteria-Practical Considerations -Noise Estimation

MODULE IV REPRESENTATION OF LEARNING NETWORK 9

Feature Representation Learning in Deep Neural Network –Deep Neural Network
Fuse Deep Neural Network -Gaussian Mixture Model Systems-Adaptation of Deep
Neural Networks.

MODULE V ADVANCED DEEP MODELS 9

Representation Sharing and Transfer -Multiobjective Training of Neural Network for
speech recognition-Multilingual and Cross Lingual Speech Recognition-Robust Speech
Recognition Exploiting – Recurrent Neural Network-Related Models – Computational
Network.

L – 45; Total Hours : 45

REFERENCES :

1. Dong Yu, Li Deng, “Automatic Speech Recognition: A Deep Learning Approach”, Springer, ISBN: 978-1-4471-5778-6, 2015.
2. Jack Hollingum, Graham Cassford, “Speech Technology at Work”, Springer, ISBN: 978-3-662-13012-4, 2013.

3. Tuomas Virtanen, Rita Singh, Bhiksha Raj, "Techniques for Noise Robustness in Automatic Speech Recognition", Wiley, ISBN: 978-1-11997088-0, 2013.

OUTCOMES:

Students to complete this course will be able to

- Apply appropriate mathematical model for the processing the speech.
- Perform various decompositions and modifications of speech signals.
- Build a complete speech recognition system using the various techniques.
- Apply speech recognition system in areas like military, healthcare, etc.
- Resolve the issues in speech recognition using the various methods.
- Authenticate the identity of the speaker using deep neural network models.

OBJECTIVES :

- To learn the concepts of speech processing and synthesis
- To gain knowledge on syntax and semantics in NLP
- To explain various statistical methods for language processing.
- To describe the Machine translation approaches.
- To explore the language processing in real world application.
- To trace the statistical approaches used in natural language processing.

PREREQUISITES :

- Data Mining

MODULE I	WORD AND SPEECH	9
	Regular Expressions and Automata - Words and Transducers - N-grams - Part of Speech Tagging - Hidden Markov and Maximum Entropy Models.	
MODULE II	SYNTAX, SEMANTICS AND PRAGMATICS	9
	Formal Grammars of English - Syntactic Parsing - Statistical Parsing - Features and Unification - Language and Complexity - The Representation of Meaning - Computational Semantics - Lexical Semantics- Computational Lexical Semantics	
MODULE III	N-GRAMS	9
	N-grams Models of Syntax - Counting Words - Unsmoothed N-grams - Smoothing Backoff - Deleted Interpolation - Entropy - English Word Classes - Tagsets for English - Part of Speech Tagging - Rule-Based Part of Speech Tagging - Stochastic Part of Speech Tagging - Transformation-Based Tagging.	
MODULE IV	Statistical Alignment and machine	9
	Text Alignment- Word Alignment - Statistical Machine Translation	
MODULE V	MODULE V APPLICATIONS of NLP	9
	.Clustering - Information Retrieval - Text Categorization.	

L – 45; Total Hours : 45

REFERENCES :

1. Nitin Indurkha, Fred J. Damerau, "Handbook of Natural Language Processing", 2nd Edition", CRC Press, ISBN: 9781420085921, 2010.
2. Daniel Jurafsky and James H. Martin, "Speech and Language Processing", 2nd Edition, Prentice Hall, ISBN: 100131873210, ISBN: 9780262133609,

2009.

3. Christopher D. Manning and Hinrich Schütze, "Foundations of Statistical Natural Language Processing", MIT Press. Cambridge, 1999.
4. Imed Zitouni, "Natural language processing of semantic language ", Springer, ISBN :97836424535588, 2014.

OUTCOMES :

Students to complete this course will be able to

- Identify the different linguistics components of given sentences.
- Design a tagger to semantically tag words using word tag.
- Implement a parser by providing suitable grammar and words.
- Analyze the statistical machine translation techniques.
- List the various applications of language processing.
- Apply the NLP techniques to real world problems

OBJECTIVES :

- To introduce the functional elements of Robotics
- To impart knowledge on setting software and hardware construction of the robot.
- To introduce the concepts Robot design process
- To educate on various path planning techniques
- To Learn about planning and reasoning artificial intelligence.
- To Solve the risk in artificial intelligence.

PREREQUISITES :

- Engineering Mathematics
- Database Management

MODULE I INTRODUCTION 9

Principle of robotics and AI – Advanced robotics techniques – Development environment – System and decision making framework – The robot control system.

MODULE II SETTING UP ROBOTS 9

Robot Anatomy – Subsumption architecture – software setup – Hardware – Use case – Story board.

MODULE III ROBOT DESIGN PROCESS 9

Image recognition process – Neural network – Picking up the toys: Task Analysis, Teaching the robot arm, Other robot arm machine learning approaches – Teaching a Robot to listen: Robot Speech recognition.

MODULE IV ALGORITHM 9

Decision trees, Entropy, Random forest, Grid searching and A* algorithm, GPS path finding.

MODULE V AI IN ROBOTICS 9

Robotic perception, localization, mapping- configuring space, planning uncertain movements, dynamics and control of movement, Ethics and risks of artificial intelligence in robotics.

L – 45; Total Hours : 60

REFERENCES :

1. Francis X. Govers, “Artificial Intelligence for robotics”, 1st Edition, Packt publishing Ltd, UK, ISBN :978-1-78883-544-2, 2018
2. Peter Sincak, Pitoyo Hartono, Maria Vircikova, Jan Vascak, Rudolf Jaksa, “Emerging Trends in Robotics and Intelligent Systems”, 1st Edition, Springer Cham Heidelberg New York Dordrecht London, 2015, ISBN : 978-3-319-10783-7.
3. Stuart Russell and Peter Norvig, “Artificial Intelligence: A Modern Approach”, 3rd Edition, Pearson, ISBN: 9780136042594, 2010.

OUTCOMES :

Students to complete this course will be able to

- Ability to understand basic concept of robotics.
- To analyze Instrumentation systems and their applications to various
- To know about the various design process.
- To know about the various path planning techniques
- Implement basic AI algorithms.
- Design and carry out an empirical evaluation of different algorithms on problem formalization.

OBJECTIVES :

- To teach about the information retrieval systems.
- To introduce the students to design, implementation, and evaluation of information retrieval systems, such as Web search engines.
- To expose the students to emerging technologies to build the next generation of intelligent and personalized search tools and Web information systems.
- To describe the students to underlying retrieval models, algorithms, and system implementations, such as vector-space and probabilistic retrieval models, as well as the PageRank algorithm used by Google.
- To expose the students to intelligent information retrieval and filtering, particularly on the World Wide Web, including techniques for document categorization, automatic concept discovery, recommender systems, discovery and analysis of online communities and social networks, and personalized search.

PREREQUISITES :

- Data structures

MODULE I OVERVIEW AND BACKGROUND 9

Overview of Information Retrieval Systems – Boolean Retrieval Dictionaries - Indexes.

MODULE II COMPUTING SCORES IN A SEARCH SYSTEM 9

Efficient scoring and ranking - Inexact top K document retrieval - Index elimination - Champion lists -- Static quality scores and ordering - Impact ordering - Cluster pruning - Components of an information retrieval system- Tiered indexes - Query-term proximity - Designing parsing and scoring functions - Vector space scoring and query operator interaction

MODULE III EVALUATION IN INFORMATION RETRIEVAL 9

Information retrieval system evaluation- Standard test collections - Evaluation of unranked retrieval sets - Evaluation of ranked retrieval results - Assessing relevance- Critiques and justifications of the concept of relevance

MODULE IV RETRIEVAL MODELS AND CLUSTERING 9

Similarity Measures and Ranking – Boolean Matching – Vector Space Models- Probabilistic Models. Relevance Feedback – User Profiles – Collaborative Filtering – Document and Term Clustering – Document Categorization.

MODULE V FILTERING TECHNIQUES AND CLUSTERING 9

Information Retrieval Systems and the WWW – PageRank and Hyperlink Analysis – Search Personalization – Web Mining and Its Applications.

L – 45; Total Hours : 45

REFERENCES :

1. Christopher Manning, Prabhakar Raghavan and Hinrich Schutze, "Introduction to Information Retrieval" ,Cambridge University Press, 2009.[Available online: <https://nlp.stanford.edu/IR-book/>]
2. Grossman, David A., Frieder, and Ophir, "Information Retrieval", Algorithms and Heuristics, ISBN:978-1-4020-3005-5, 2004.

3. Online course material : <http://facweb.cs.depaul.edu/mobasher/classes/csc575/lecture.html>
4. <https://nlp.stanford.edu/IR-book/pdf/irbookonlinereading.pdf>

OUTCOMES :

Students to complete this course will be able to

- Apply the basic concepts and techniques of Information Retrieval in various related fields.
- Develop skills in problem solving using basic retrieval techniques
- Apply document indexing to real world problems by learning the indexing models.
- Analyze different information retrieval techniques in various application areas.
- Evaluate the use of filtering techniques and clustering in various applications areas.
- Illustrate the use of information retrieval techniques in World Wide Web.

1. Samir Roy, "Introduction to Soft Computing: Neuro-Fuzzy and Genetic Algorithms", Pearson, 2013.
2. S.Rajasekaran, G.A.VijayalakshmiPai, "Neural Networks, Fuzzy Logic and Genetic Algorithm, Synthesis and Applications ", PHI Learning Pvt. Ltd., 2017.
3. N.P.Padhy, S.P.Simon, "Soft Computing with MATLAB Programming", Oxford University Press, 2015.
4. S.N.Sivanandam , S.N.Deepa, "Principles of Soft Computing", Wiley India Pvt. Ltd., 2nd Edition, 2011
5. Asa Bensten , " Genetic Algorithms in Applications ", Scitus Academics LLC, 2016

OUTCOMES :

Students to complete this course will be able to

- Apply suitable soft computing techniques for various applications.
- Apply neural networks to pattern classification and regression problems
- Apply fuzzy logic and reasoning to handle uncertainty and solve engineering problems.
- Demonstrate some applications of Genetic Algorithms.
- Discuss the neural networks and supervised and unsupervised learning networks.
- Evaluate and compare solutions by various soft computing approaches for a given problem.

