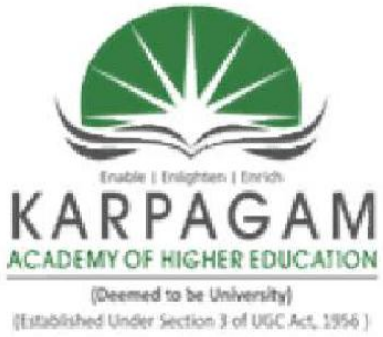
M.E. COMPUTER SCIENCE AND ENGINEERING

SYLLABI 2022-2023

(CHOICE BASED CREDIT SYSTEM)

Department of Computer Science and Engineering

FACULTY OF ENGINEERING



KARPAGAM ACADEMY OF HIGHER EDUCATION

(Deemed to be University)

(Established Under Section 3 of UGC Act 1956)

(Accredited with A+ Grade by NAAC in Second Cycle)

Pollachi Main Road, Eachanari Post

Coimbatore-641021.

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Coimbatore – 641 021. INDIA

FACULTY OF ENGINEERING

POST–GRADUATE PROGRAMME
REGULAR PROGRAMME
REGULATIONS 2022-2023
CHOICE BASED CREDIT SYSTEM

These Regulations are effective from the academic year 2022-2023 and applicable to the students admitted to M. E. / M. Tech. Programmes during the academic year 2022-2023 and onwards.

1.PROGRAMMES OFFERED, MODE OF STUDY AND ADMISSION REQUIREMENTS.

1.1 PROGRAMMES OFFERED:

M. E. and M. Tech.

The various P.G. Programmes offered by the Karpagam academy of Higher Education are listed in Table 1.

1.2 MODE OF STUDY:

1.2.1 Full–Time:

Candidates admitted under 'Full–Time' should be available in the Karpagam academy of Higher Education during the complete working hours for curricular, co–curricular and extra–curricular activities assigned to them.

1.2.2 Change from full time mode of study to part time mode is not permitted**.**

1.2.3 Change from one programme to another programme is not permitted.

1.3 ADMISSION REQUIREMENTS:

Candidates for admission to the Master's Degree Programme shall be required to have passed an appropriate Degree Examination of any University accepted by the Board of Management of Karpagam academy of Higher Education as equivalent thereto. Admission shall be offered only to the candidates who possess the qualification prescribed against each course, given in the Table–2.

2 DURATION OF THE PROGRAMMES:

2.1 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. E./M. Tech.	4	8

2.2 Each semester shall normally consist of 90 working days or 360 hours for full–time mode of study. The Dean and HOD shall ensure that every teacher imparts instruction as per the number of periods specified in the syllabus and that the teacher teaches the full content of the specified syllabus for the course being taught.

2.3 The prescribed credits required for the award of degree shall be within the limits specified below.

PROGRAMME	PRESCRIBED CREDIT RANGE
M. E./M. Tech.	**65 to 75**

2.4 Credits will be assigned to the courses for different modes of study as given below:

No. of credits per lecture period per week : 1

No. of credits per tutorial period per week : 1

No. of credits for 3 periods of laboratory course per week : 2

No. of credits for 3 periods of project work per week : 2

3. STRUCTURE OF THE PROGRAMME

3.1 Every programme will have a curriculum and syllabi consisting of core theory courses, elective courses, seminars / practical courses and project work.

3.1.1 The elective courses from the curriculum are to be chosen with the approval of the Head of the Department.

3.1.2 The medium of instruction for all courses, examinations, seminar presentations and project thesis shall be English**.**

3.1.3 Choice Based Credit System is implemented offering Choice in professional core and professional Electives.

3.2 MAXIMUM MARKS

3.2.1 The maximum marks assigned to different courses shall be as given below:

Each of the theory and practical course (excluding project work) shall carry maximum of 100 marks of which 40 marks will be through Continuous Internal Assessment (CIA) and 60 marks through End Semester Examination (ESE).

3.3 PROJECT WORK

The project work for M. E./M. Tech. consists of two Phases, Phase– I and Phase – II. Phase – I is to be undertaken during III semester and Phase – II, is during IV semester.

All the students are advised to do their project work within the campus. However, as a special case, if a student is able to get a project from a government organization or private or public sector company with a turn over about Rs.50 crore, he/she may be permitted to do his/her project work in that institution/research organization/industry.

4. EVALUATION OF PROJECT WORK

The evaluation of Project Work for Phase I & Phase II shall be done independently in the respective semesters. The total marks for project work including Phase I and II are 400. The project work pertained to Phase I is evaluated through Continuous Internal Assessment only. No End Semester Examination will be conducted for the Phase I. The maximum internal marks for Phase I is 100. For Phase – II, the maximum internal mark is 120 and the maximum End Semester Examination mark is 180. The total marks for Phase – II is 300. The overall passing minimum is 50 %.

4.1 The Project Report prepared according to approved guidelines and duly signed by the supervisor(s) and the Head of the Department shall be submitted to the COE through the HOD and the Dean.

4.2 The evaluation of the Project work Phase – I will be purely internal by forming a committee by HOD/ Dean. During CIA of Phase – I, there will be a Viva–Voce Examination by a team consisting of the Supervisor, and an Internal Examiner (other

than the Supervisor). The evaluation of the Project work Phase – II will be based on the project report submitted in Phase – II and a Viva–Voce Examination by a team consisting of the Supervisor, an Internal Examiner and an External Examiner for each programme. The External Examiner shall be appointed by the Karpagam academy of Higher Education for Phase – II evaluation.

4.3 If a candidate fails to submit the project report on or before the specified deadline, he/she is deemed to have failed in the project work and shall re–enroll for the same in a subsequent semester.

4.4 If a candidate fails in the Viva–Voce examinations of Phase–I, he/she has to resubmit the project report within 30 days from the date of declaration of the results. If he/she fails in the Viva–Voce examination of Phase–II of project work, he/she shall resubmit the project report within 60 days from the date of declaration of the results. For this purpose, the same Internal and External Examiner shall evaluate the resubmitted report.

4.5 Every candidate shall publish a paper of his or her findings in a peer reviewed journal or present in an International Conference or apply for a patent out of his / her project work. Reprints of the journal publication/acceptance letter from the journal publisher or Proceedings of the International conference/ acceptance letter from the Conference Organizer or application of patentshall be attached to the report of the project work. Such acknowledgements shall be sent to the Controller of Examinations along with the evaluation marks by the team of examiners without which the thesis shall not be accepted.

4.6 A copy of the approved project report after the successful completion of Viva–Voce Examination shall be kept in the respective department as well as in the Karpagam academy of Higher Education library.

5 REQUIREMENTS FOR COMPLETION OF THE SEMESTER

5.1 A candidate will be permitted to take the End Semester Examination of any semester, if

i) the candidate secures not less than 75% of attendance during the semester and

ii) the conduct of the candidate has been satisfactory

5.2 A candidate who has secured attendance between 65% and 74% (both included), due to medical reasons (Hospitalization/Accident/Specific Illness) or due to participation in Karpagam academy of Higher Education / District / State / National / International level sports or due to participation in Seminar / Conference / Workshop / Training Programme / Voluntary Service / Extension activities or similar programmeswith prior permission from the Registrar shall be given exemption from prescribed attendance requirements and shall be permitted to take the examination on the recommendation of the concerned Head of the Department and Dean to condone the lack of attendance. The Head of the Department has to verify and certify the genuineness of the case before recommending to the Dean.

5.3 However, a candidate who has secured attendance less than 65 % in the current semester shall not be permitted to appear for the current ESE. But he/she will be permitted to appear for his/her arrear examination if any and he/she has to re do the course by rejoining the semester in which attendance is less than 65% with proper approval of the "Students' Affairs Committee" and Registrar.

6 CLASS ADVISORS

To help the students in planning their courses of study and for general advice on the academic programme, the Head of the Department will attach a certain number of students to a teacher of the Department who shall function as Class Advisor for those students throughout their period of study. Such Class Advisors shall advise the students and monitor the courses undergone by the students, check the attendance and progress of the students attached to him/her and counsel them periodically. If necessary, the Class Advisor may display the cumulative attendance particulars in the Department Notice Board.

7 CLASS COMMITTEE

7.1. Every class shall have a class committee consisting of teachers of the class concerned, student representatives [two boys and two girls] and the concerned Head of the Department. It is like the 'Quality Circle' with the overall goal of improving the teaching–learning process. The functions of the class committee include

- Solving problems experienced by students in the class room and in the laboratories.
- Clarifying the regulations of the degree programme and the details of rules therein particularly Clause 2 and 3 which should be displayed on department Notice–Board.
- Informing the student representatives, the details of Regulations regarding weightage used for each assessment.

- Informing the student representatives, the academic schedule including the dates of assessments and the syllabus coverage for each assessment.
- In the case of practical courses (laboratory/project work, etc.) the breakup of marks for each experiment/exercise /module of work, should be clearly discussed in the class committee meeting and informed to the students.
- Analyzing the performance of the students of the class after each test and finding the ways and means of solving problems, if any.
- Identifying the weak students, if any, and requesting the teachers concerned to provide some additional academic support to them.

7.2 The class committee shall be constituted within the first week of each semester.

7.3 At least 4 student representatives (usually 2 boys and 2 girls) shall be included in the class committee.

7.4 The Chairperson of the Class Committee may convene the meeting of the class committee.

7.5 The Dean may participate in any Class Committee of the Faculty.

7.6 The Chairperson is required to prepare the minutes of every meeting, submit the same to Dean within two days of the meeting and arrange to circulate it among the students and teachers concerned. If there are some points in the minutes requiring action by the Management, the same shall be brought to the notice of the Registrar by the HOD through the Dean.

7.7 The first meeting of the Class Committee shall be held within one week from the date of commencement of the semester, in order to inform the students about the nature and weightage of assessments within the framework of the regulations. Two or three subsequent meetings may be held in a semester at suitable intervals. During these meetings the student members representing the entire class, shall meaningfully interact and express their opinions and suggestions of the other students of the class in order to improve the effectiveness of the teaching–learning process.

8. COURSE COMMITTEE FOR COMMON COURSES

Each common theory course offered to more than one discipline or group, shall have a "Course Committee" comprising all the teachers handling the common course with one of them nominated as Course Coordinator. The nomination of the Course Coordinator shall be

made by the Dean depending upon whether all the teachers teaching the common course belong to a single department or to several departments. The 'Course Committee' shall meet in order to arrive at a common scheme of evaluation for the test and shall ensure a uniform evaluation of the tests. Where ever feasible, the Course Committee may also prepare a common question paper for the Internal Assessment test(s).

9. PROCEDURE FOR AWARDING MARKS FOR INTERNAL ASSESSMENT

9.1 Every teacher is required to maintain an 'ATTENDANCE AND ASSESSMENT RECORD' which consists of attendance marked in each theory or practical or project work class, the test marks and the record of class work (topic covered), separately for each course.

9.2 Continuous Internal Assessment (CIA):

The performance of students in each subject will be continuously assessed by the respective teachers as per the guidelines given below:

THEORY COURSES:

S. No.	CATEGORY	MAXIMUM MARKS
1.	Paper Presentation *****	15
2.	Attendance	5
3.	Test – I #	10
4.	Test – II #	10
	TOTAL	40

***** One refereed journal paper related to the subject and approved by the teacher should be critically presented. The Paper Presentation should be evaluated by a committee and marks should be entered in Automation software on or before 60th working day of the semester.

The test scripts should be evaluated and marks should be entered in Automation software on or before 4th working day after the last test.

PATTERN OF TEST QUESTION PAPER:

INSTRUCTION	REMARKS
Maximum Marks	60
Duration	2 Hours
Part- A	1 to 9 Two Mark Questions, uniformly covering the two units of the syllabus. All the 9 Questions are to be answered. **(9 x 2 =18Marks)**.

Part- B	Question 10 to 12 will be of either-or type, covering two units of the syllabus. Each Question may have subdivision. **(3 x 14 =42 Marks)**.

PRACTICAL COURSES:

S. No	CATEGORY	MAXIMUM MARKS
1.	Attendance	5
2.	Observation work	5
3.	Record work	5
4.	Model examination	15
5.	Viva – voce [Comprehensive]	10
	TOTAL	40

Every practical exercise / experiment shall be evaluated based on the conduct of exercise/ experiment and records maintained.

9.3 ATTENDANCE

MARKS DISTRIBUTION FOR ATTENDANCE

S. No.	Attendance %	Marks
1	91 and above	5.0
2	86-90	4.0
3	81-85	3.0
4	75-80	2.0
5	Less than 75	0

10. REQUIREMENTS FOR APPEARING FOR END SEMESTER EXAMINATION (ESE)

A candidate shall normally be permitted to appear for the ESE of any semester commencing from I semester if he/she has satisfied the semester completion requirements (Subject to Clause 5) and has registered for examination in all courses of the semester. Registration is mandatory for Semester Examinations as well as supplementary examinations failing which the candidate will not be permitted to move to the higher semester.

A candidate already appeared for a subject in a semester and passed the examination is not entitled to reappear in the same subject for improvement of grade.

11. END SEMESTER EXAMINATION

ESE will be held at the end of each semester for each subject, for 100 marks, later scaled down to 60 marks.

PATTERN OF ESE QUESTION PAPER:

INSTRUCTION	REMARKS
Maximum Marks	100
Duration	3 Hours
Part - A	Part A will be online Examination. 20 Objective type Questions. Covering all the 5 units. **20*1= 20 Marks (Online Examination)**
Part- B	21 to 25 Two Mark Questions, uniformly covering the Five units of the syllabus. All the 5 Questions are to be answered. (**5 *2= 10Marks)**.
Part- C	Question 26 to 30 will be of either-or type, covering Five units of the syllabus. Each Question may have subdivision. **(5*14=70 Marks)**

12. PASSING REQUIREMENTS

12.1 Passing minimum: The passing minimum for CIA is 20 (i.e. out of 40 marks). The passing minimum for End Semester Examination is 30 (i.e. out of 60 marks).

The overall passing minimum for theory/laboratory course is 50 (Sum of his/her score in internal and external examination) out of 100 marks.

12.2 If the candidate fails to secure a pass in a particular course ESE, it is mandatory that candidate shall register and reappear for the examination in that course during the subsequent semester when examination is conducted in that course. Further, the candidate should continue to register and reappear for the examination till a pass is secured in such supplementary exam within the stipulated maximum duration of the programme (Clause 2.1).

The CIA marks obtained by the candidate in his/her first or subsequent appearance where he/she secures a pass shall be retained by the office of the Controller of Examinations and considered valid for all remaining attempts till the candidate secures a pass in his/her ESE.

12.3 If a candidate fails to secure a pass in a particular course CIA, it is mandatory that candidate shall register and reappear for the CIA in that course during the subsequent semester when CIA is conducted in that course by the faculty member assigned for that particular course during that semester by the concerned HOD. Further, the candidate should

continue to register and reappear for the CIA till a pass is secured in such supplementary exam within the stipulated maximum duration of the programme (Clause 2.1).

13. AWARD OF LETTER GRADES

13.1 All assessments of a course will be done on absolute mark basis. However, for the purpose of reporting the performance of a candidate, letter grades, each carrying certain number of points, will be awarded as per the range of total marks (out of 100) obtained by the candidate in each subject as detailed below:

Letter grade	Marks Range	Grade Point	Description
O	91 - 100	10	OUTSTANDING
A+	81- 90	9	EXCELLENT
A	71-80	8	VERY GOOD
B+	66- 70	7	GOOD
B	61 – 65	6	ABOVE AVERAGE
C	55 - 60	5	AVERAGE
P	50 - 54	4	PASS
RA	<50	-	REAPPEARANCE
AB		0	ABSENT

13.2 GRADE SHEET

After results are declared, Grade sheets will be issued to each student which will contain the following details:

i) The list of courses enrolled during the semester and the grade scored.

ii) The Grade Point Average (**GPA**) for the semester and

iii) The Cumulative Grade Point Average (**CGPA**) of all courses enrolled from first semester onwards.

GPA is the ratio of the sum of the products of the number of Credits (**C**) of courses enrolled and the Grade Points (**GP**) corresponding to the grades scored in those courses, taken for all the courses to the sum of the number of credits of all the courses in the semester.

$$GPA = \frac{\text{Sum of } [C*GP]}{\text{Sum of } C}$$

CGPA will be calculated in a similar manner, considering all the courses enrolled from first semester. **RA** grade will be excluded for calculating **GPA** and **CGPA**.

13.3 REVALUATION

A candidate can apply for revaluation of his/her semester examination answer paper in a theory course, within 2 weeks from the declaration of results, on payment of a prescribed fee through proper application to the Controller of Examinations through the Head of the Department and Dean. A candidate can apply for revaluation of answer scripts for not exceeding 5 subjects at a time.The Controller of Examinations will arrange for the revaluation and the results will be intimated to the candidate through the Head of the Department and Dean. Revaluation is not permitted for Supplementary examination, Practical examination and Project Work.

14. ELIGIBILITY FOR AWARD OF DEGREE

A student shall be declared to be eligible for award of Degree if he/she has

- Successfully gained required number of total credits as specified in the curriculum corresponding to his/her programme within the stipulated time.
- No disciplinary action is pending against him/her.

The award of degree must be approved by the Board of Management of Karpagam academy of Higher Education.

15. CLASSIFICATION OF THE DEGREE AWARDED

15.1 A candidate who qualifies for the award of the Degree (vide Clause 14) having passed the examination in all the courses in his/her first appearance within the specified minimum number of semesters (vide Clause 2.1) securing a CGPA of not less than 8.0 shall be declared to have passed the examination in First Class with Distinction.

15.2 A candidate who qualifies for the award of the Degree (vide Clause 14) having passed the examination in all the courses within the specified minimum number of semesters (vide Clause 2.1) plus one semester securing CGPA of not less than 6.5shall be declared to have passed the examination in First Class. For this purpose, the withdrawal from examination (vide Clause 16) will not be construed as an appearance. Further, the authorized break of study (vide Clause 18) will not be counted for the purpose of classification.

15.3 All other candidates (not covered in Clauses 15.1 and 15.2) who qualify for the award of the degree (vide Clause 14) shall be declared to have passed the examination in **Second Class**.

16. PROVISION FOR WITHDRAWAL FROM END–SEMESTER EXAMINATION

16.1 A candidate may for valid reasons and on prior application, be granted permission to withdraw from appearing for the examination of any one course or consecutive examinations of more than one course in a semester examination. Withdrawal application shall be valid only if the candidate is otherwise eligible to write the examination.

16.2 Such withdrawal shall be permitted only once during the entire period of study of the degree programme.

16.3 Withdrawal application is valid only if it is made within 10 days prior to the commencement of the examination in that course or courses and recommended by the Head of the Department and Dean and approved by the Registrar.

16.3.1 Not withstanding the requirement of mandatory TEN days' notice, applications for withdrawal for special cases under extraordinary conditions will be considered on the merit of the case.

16.4 Withdrawal shall not be construed as an appearance for the eligibility of a candidate for First Class with Distinction. This provision is not applicable to those who seek withdrawal during IV semester.

16.5 Withdrawal from the ESE is **NOT** applicable to supplementary courses.

16.6 The candidate shall reappear for the withdrawn courses during the examination conducted in the subsequent semester.

17. PROVISION FOR AUTHORISED BREAK OF STUDY

17.1 Break of Study shall be granted only once for valid reasons for a maximum of one year during the entire period of study of the degree programme. However, in extraordinary situation the candidate may apply for additional break of study not exceeding another one year by paying prescribed fee for break of study. If a candidate intends to temporarily discontinue the programme in the middle of the semester for valid reasons and to rejoin the programme in a subsequent year, permission may be granted based on the merits of the case provided he/she applies to the Registrar, but not later than the last date for registering for the ESE of the semester in question, through the Head of the Department and Dean stating the reasons thereof and the probable date of rejoining the programme.

17.2 The candidate thus permitted to rejoin the programme after the break shall be governed by the curriculum and regulations in force at the time of rejoining. Such candidates may have to do additional courses, if any as per the curriculum and regulations in force at that period of time.

17.3 The authorized break of study (for a maximum of one year) will not be counted for the duration specified for passing all the courses for the purpose of classification (vide Clause 15). However, additional break of study granted will be counted for the purpose of classification.

17.4 The total period for completion of the programme reckoned from, the commencement of the first semester to which the candidate was admitted shall not exceed the maximum period specified in Clause 2.1 irrespective of the period of break of study (vide Clause 18.1) in order that he/she may be eligible for the award of the degree.

17.5 If any student is detained for want of requisite attendance, progress and good conduct, the period spent in that semester shall not be considered as permitted 'Withdrawal' or 'Break of Study' Clause 16 and 18 respectively is not applicable for this case.

18. SPECIAL SUPPLEMENTARY ESE

After the publication of IV semester results, if a student has an arrear in any theory course of the entire programme, he/she will be permitted to apply within 15 days of the publication of results, and appear for a special supplementary examination.

19. DISCIPLINE

Every student is required to observe disciplined and decorous behavior both inside and outside the Karpagam academy of Higher Education and not to indulge in any activity which will tend to bring down the prestige of the Karpagam academy of Higher Education. The erring student will be referred to the Disciplinary Committee constituted by the Karpagam academy of Higher Education, to inquire into acts of indiscipline and recommend to the Karpagam academy of Higher Education about the disciplinary action to be taken.

If a student indulges in malpractice in any of the CIA/ESE he/she shall be liable for punitive action as prescribed by the Karpagam academy of Higher Education from time to time.

20. REVISION OF REGULATION AND CURRICULUM

The Karpagam academy of Higher Education may from time to time revise, amend or change the Regulations, Scheme of Examinations and syllabi if found necessary on the recommendations of Board of Studies, Academic Council and Board of Management of Karpagam academy of Higher Education.

Table – 1

M. E./M. TECH. DEGREE (REGULAR) PROGRAMMES

Sl. No.	Name of the Programme
DEPARTMENT OF CIVIL ENGINEERING	
1. 2.	M.E. Water Resources and Environmental Engineering. M.E Structural Engineering.
DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING	
1.	M.E. Power Systems Engineering
DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING	
1.	M.E VLSI Design
DEPARTMENT OF MECHANICAL ENGINEERING	
1.	M.E CAD/CAM Robotics

Table – 2

M. E. / M.TECH. PROGRAMMES

QUALIFICATIONS FOR ADMISSION

S. No.	Degree and branch of study	Qualification for Admission
1.	M. E. Water Resources and Environmental Engineering	B.E./B. Tech. – Civil Engineering B.E./B.Tech. – Environmental Engineering
2.	M.E Structural Engineering.	B.E./B. Tech. – Civil Engineering
3.	M. E. Power Systems Engineering	B. E./B.Tech. – Electrical Engineering/ Electrical and Electronics
4.	M.E VLSI Design	B.E/B.Tech Electrical Engineering/ Electrical and Electronics
5.	M.E CAD/CAM Robotics	B.E/B.Tech Mechanical Engineering

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FACULTY OF ENGINEERING
Department of Computer Science and Engineering
POST–GRADUATE PROGRAMME

List of PEOs, POs and PSOs

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

I. To perform well in their professional career by acquiring enough knowledge in the domain of Artificial Intelligence and Data Science.

II. To improve communication skills, follow professional ethics and involve in team work in their profession.

III. To update with evolving technology and use it for career advancement.

PROGRAMME OUTCOMES (POs)

Engineering Graduates will be able to:

a) **Engineering Knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

b) **Problem Analysis**: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

c) **Design/ Development of Solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

d) **Conduct Investigations of Complex Problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

e) **Modern Tool Usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

f) **The Engineer and Society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

g) **Environment and Sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

h) **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

i) **Individual and Team Work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

j) **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

k) **Project Management and Finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

l) **Life-long Learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAM SPECFIC OUTCOMES (PSOs):

1.The ability to apply, analyse, design and develop the application software that meet the automation needs of society and industry.

2. The ability to understand the evolutionary changes in computing, apply standard practices and strategies in software project development using open-ended programming environments to deliver a quality product for business success, real world problems and meet the challenges of the future.

MAPPING:

PEO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
PEO1	✓	✓	✓	✓	✓	✓	✓					✓	✓	✓
PEO2	✓	✓	✓	✓	✓			✓	✓	✓				✓
PEO3	✓	✓	✓		✓	✓	✓	✓		✓	✓		✓	✓

Credit Distribution:

S.No.	Course Category	Credit Distribution	Percentage
1	Humanities and Science	4	5.6
2	Professional Core	31	43.6
3	Professional Elective	15	21.1
4	Mandatory Course	3	4.2
5	Project Work	18	25.3
	Total	71	100

M.E.COMPUTER SCIENCE AND ENGINEERING (REGULAR)
COURSE OF STUDY AND SCHEME OF EXAMINATIONS
(2022 and onwards)

COURSE CODE	NAME OF THE COURSE	CATEGORY	Instruction hours/week			CREDIT(S)	Maximum Marks			PageNo.
			L	T	P		CIA	ESE	TOTAL	
SEMESTER I										
22MECC101	Applied Mathematics	HS	3	1	0	4	40	60	100	**1**
22MECS102	Advanced Data Structures and Algorithms	PC	3	1	0	4	40	60	100	**3**
22MECS103	Object Oriented System Engineering	PC	3	0	0	3	40	60	100	**5**
22MECS104	Advanced Data Base Technology	PC	3	1	0	4	40	60	100	**7**
22MECS105	Network Technologies	PC	3	0	0	3	40	60	100	**9**
22MECS111	Advanced Data Structures Laboratory	PC	0	0	3	2	40	60	100	**11**
22MECS112	Advanced Data base Technology Laboratory	PC	0	0	3	2	40	60	100	**12**
SEMESTER TOTAL			**15**	**3**	**6**	**22**	**280**	**420**	**700**	
SEMESTER II										
22MECS201	Internet of Things	PC	3	0	0	3	40	60	100	**14**

22MECS202	Machine Learning	PC	3	0	0	3	40	60	100	**16**
22MECS203	Advanced Software Engineering	PC	3	0	0	3	40	60	100	**18**
22MECS2EXX	Professional Elective I	PE	3	0	0	3	40	60	100	**26-32**
22MECS2EXX	Professional Elective II	PE	3	0	0	3	40	60	100	**34-40**
22MECS211	Machine Learning Laboratory	PC	0	0	3	2	40	60	100	**20**
22MECS212	Software Engineering Laboratory	PC	0	0	3	2	40	60	100	**22**
SEMESTER TOTAL			**15**	**0**	**6**	**19**	**280**	**420**	**700**	
SEMESTER III										
22MECS301	Research Methodology and IPR	MC	3	0	0	3	40	60	100	**23**
22MECS3EXX	Professional Elective III	PE	3	0	0	3	40	60	100	**42-48**
22MECS3EXX	Professional Elective IV	PE	3	0	0	3	40	60	100	**50-56**
22MECS3EXX	Professional Elective V	PE	3	0	0	3	40	60	100	**58-64**
22MECS391	Project Work - Phase I	PW	0	0	12	6	40	60	100	**67**
SEMESTER TOTAL			**12**	**0**	**12**	**18**	**200**	**300**	**500**	
SEMESTER IV										
22MECS491	Project Work - Phase II	PW	0	0	24	12	40	60	100	**68**

SEMESTER TOTAL	**0**	**0**	**24**	**12**	**40**	**60**	**100**	
TOTAL	**42**	**3**	**42**	**71**	**800**	**1200**	**2000**	

LIST OF PROFESSIONAL ELECTIVES

COURSECODE	NAME OF THE COURSE	CATEGORY	Instruction hours/week			Credit(s)	MaximumMarks			Page No.
			L	T	P		CIA	ESE	TOTAL	
Professional Electives I										
22MECS2E01	Advanced Operating System	PE	3	0	0	3	40	60	100	**26**
22MECS2E02	Agile Technologies	PE	3	0	0	3	40	60	100	**28**
22MECS2E03	Foundations of Data Science	PE	3	0	0	3	40	60	100	**30**
22MECS2E04	Information Retrieval Techniques	PE	3	0	0	3	40	60	100	**32**
Professional Elective II										
22MECS2E05	Network and Information Security	PE	3	0	0	3	40	60	100	**34**
22MECS2E06	Performance Analysis of Computer Systems	PE	3	0	0	3	40	60	100	**36**
22MECS2E07	Social Networks Analysis	PE	3	0	0	3	40	60	100	**38**
22MECS2E08	High performance Computing for	PE	3	0	0	3	40	60	100	**40**

	Bigdata									
Professional Elective III										
22MECS3E01	Web Analytics	PE	3	0	0	3	40	60	100	**42**
22MECS3E02	Big Data Mining and Analytics	PE	3	0	0	3	40	60	100	**44**
22MECS3E03	Data Visualization Techniques	PE	3	0	0	3	40	60	100	**46**
22MECS3E04	Optimizations For Machine Learning	PE	3	0	0	3	40	60	100	**48**
Professional Elective IV										
22MECS3E05	Robotics	PE	3	0	0	3	40	60	100	**50**
22MECS3E06	Natural Language Processing	PE	3	0	0	3	40	60	100	**52**
22MECS3E07	GPU Computing	PE	3	0	0	3	40	60	100	**54**
22MECS3E08	Devops and Microservices	PE	3	0	0	3	40	60	100	**56**
Professional Elective V										
22MECS3E09	Bio informatics	PE	3	0	0	3	40	60	100	**58**
22MECS3E010	Full Stack Web Application Development	PE	3	0	0	3	40	60	100	**60**
22MECS3E011	Software Quality Assurance	PE	3	0	0	3	40	60	100	**62**
22MECS3E012	Deep Learning	PE	3	0	0	3	40	60	100	**64**

22MECC101 **APPLIED MATHEMATICS** **4H-4C**

Instruction Hours/week: L:3 T:1 P:0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

COURSE OBJECTIVES:

The goal of this course is for the students :

- To encourage students to develop a working knowledge of the central ideas of Linear systems.
- To enable students to understand the concepts of Linear Programming.
- To enable the students to use the concepts of graph theory.
- To understand the basics of trees and fuzzy logic.

COURSE OBJECTIVES:

Upon completion of this course the students will be able to:

- Make use of vector spaces and linear transformations associated with engineering applications.
- Solve complicated problems using linear programming.
- Apply graph theory to solve engineering problems.
- Discuss spanning tree and its applications
- Explain about fuzzy logic techniques which are needed for Engineers in physical scenario.
- Develop the capability of solving problems using linear systems and fuzzy logic

UNIT I LINEAR SYSTEMS **9**

Vector spaces and subspaces – Linear combination, Span, Linear independence and dependence – Null space, Column space and Row space – Basis and dimension of a vector space – Rank and Nullity. Linear transformation : Introduction to linear transformations – General Linear Transformations – Kernel and Range – Change of basis – Eigen values and Eigen vectors – Diagonalisation, Quadratic forms.

UNIT II LINEAR PROGRAMMING **9**

Basic concepts – Graphical and Simplex methods –Transportation problem – Assignment problem.

UNIT III GRAPH THEORY **9**

Graphs – Pats, cycles and trials – Vertex, degree and counting – Connectivity and Paths.

UNIT IV TREES **9**

Basic properties – Spanning trees and Enumeration – Optimization and trees.

UNIT V FUZZY LOGIC **9**

Classical logic – Multivalued logics – Fuzzy propositions – Fuzzy Quantifiers.

Total Hours : 45

TEXT BOOKS:

1. Dr. Grewal B.S., Higher Engineering Mathematics , Khanna Publishers, New Delhi., 2015
2. Gupta, P.K.and Hira, D.S.Problems in Operations Research S.Chand & Co., New Delhi., 2012
3. Kenneth H Rosen, Discrete Mathematics and its Applications with Combinations and Graph theory Tata McGraw - Hill Pub. Co. Ltd, New Delhi.2012
4. George J Klir and Tina A. Folger Fuzzy sets, Uncertainty and Information Prentice Hall of India Pvt Ltd., New Delhi.2007

REFERENCES:

1. Howard Anton Elementary Linear Algebra John Wiley & Sons, New Delhi. 2010
2. David C Lay, Linear Algebra and Its Applications Pearson Education, New Delhi. 2009
3. Douglas. B. West Introduction to Graph theory Prentice Hall of India Pvt Ltd., New Delhi.2007

22MECS102 ADVANCED DATA STRUCTURES AND ALGORITHMS 4H-4C

Instruction Hours/week: L:3 T:1 P:0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

COURSE OBJECTIVES:

- To provide an in-depth knowledge in problem solving techniques and data structures.
- To learn the systematic way of solving problems
- To understand the different methods of organizing large amounts of data
- To efficiently implement the different data structures
- To efficiently implement solutions for specific problems

COURSE OUTCOMES:

Upon completion of this course the students will be able to:

- Explain different hierarchical data structures to solve computing problems.
- Make use of heap data structure to solve problems.
- Demonstrate analysis of algorithm for solving computing problems.
- Apply multimedia structures for solving problems effectively.
- Explain about randomized algorithm for problem solving.
- Analyze the given scenario and choose appropriate Data Structure for solving problems.

UNIT I HIERARCHICAL DATA STRUCTURES 9

Binary Search Trees – Counting Binary Trees -AVL Trees – Red-Black trees – Multi-way Search Trees –B-Trees – Splay Trees – Tries.

UNIT II HEAP STRUCTURES 9

Min/Max heaps – Deaps – Leftist Heaps – Binomial Heaps – Fibonacci Heaps – Skew Heaps – Lazy-Binomial Heaps.

UIT – III ALGORITHM ANALYSIS 9

Mathematical Induction - Asymptotic Notations – Properties of Big-oh Notation – Conditional Asymptotic Notation – Algorithm Analysis – Amortized Analysis – NP-Completeness – NP-Hard – Recurrence Equations – Solving Recurrence Equations.

UNIT IV MULTIMEDIA STRUCTURES 9

Segment Trees – k-d Trees – Point Quad Trees – MX-Quad Trees – R-Trees – TV-Trees.

UNIT V ALGORITHMS 9

Huffman Coding – Convex Hull – Tree Vertex Splitting – Activity Networks – Flow Shop Scheduling – Introduction to Randomized Algorithms.

Total Hours : 45

REFERENCES:

1. Mark Allen Weiss, Data Structures and Algorithm Analysis in C++, Pearson Education, NewYork, 2014.
2. Aho,Hopcroft, Ullman, Data Structures and Algorithms, Pearson Education, New York. 2009.
3. Horowitz, Sahni, Rajasekaran Computer Algorithms Galgotia 2007.
4. Tanenbaum A.S., Langram Y, Augestien M.J Data Structures using C & C++ Prentice Hall of India, New Delhi, 2008.
5. E. Horowitz, S.Sahni and Dinesh Mehta, Fundamentals of Data structures in C++, Uiversity Press 2007.
6. E. Horowitz, S. Sahni and S. Rajasekaran, Computer Algorithms/C++, University Press, 2007.

SEMESTER-I

22MECS103 OBJECT ORIENTED SYSTEM ENGINEERING 3H-3C

Instruction Hours/week: L:3 T:0 P:0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

COURSE OBJECTIVES:

- To have a thorough knowledge of process models, analysis and system design engineering.
- To have an overview of classical paradigm
- To know about the implementation of Object oriented system engineering.
- To know the concepts of deployment and maintenance.

COURSE OUTCOMES:

Upon completion of this course the students will be able to:

- Explain about the project organization and management.
- Explain the advantages of various Software Development Lifecycle Models.
- Perform formal analysis on specifications.
- Make use of architectural styles and design patterns for project development.
- Understand software testing approaches and configuration management.
- Use commonly available object-oriented design frameworks for application development

UNIT I CLASSICAL PARADIGM **9**

System Concepts – Project Organization – Communication – Project Management

UNIT II PROCESS MODELS **9**

Life cycle models – Unified Process – Iterative and Incremental – Workflow – Agile Processes

UNIT III ANALYSIS **9**

Requirements Elicitation – Use Cases – Unified Modeling Language, Tools – Analysis Object Model (Domain Model) – Analysis Dynamic Models – Non-functional requirements – Analysis Patterns

UNIT IV DESIGN **9**

System Design, Architecture – Design Principles - Design Patterns – Dynamic Object Modeling – Static Object Modeling – Interface Specification – Object Constraint Language

UNIT V IMPLEMENTATION, DEPLOYMENT AND MAINTENANCE **9**

Mapping Design (Models) to Code – Testing - Usability – Deployment – Configuration Management – Maintenance

Total Hours : 45

REFERENCES:

1. Bernd Bruegge, Alan H Dutoit, Object-Oriented Software Engineering, Pearson Education, 2010
2. Craig Larman, Applying UML and Patterns , Pearson Education, 2005
3. Stephen Schach ,Software Engineering , McGraw-Hill, 2007
4. Ivar Jacobson, Grady Booch, James Rumbaugh, The Unified Software Development Process, Pearson Education , 2012
5. Roger S.Pressman, Software engineering A practitioner's Approach, McGraw-Hill International Edition, 2010.

22MECS104 ADVANCED DATA BASE TECHNOLOGY 4H-4C

Instruction Hours/week: L:3 T:1 P:0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

COURSE OBJECTIVES

- Describe the fundamental elements of relational database management systems
- Explain the basic concepts of relational data model, entity-relationship model, relationaldatabase design, relational algebra and SQL.
- Understand query processing in a distributed database system
- Understand the basics of XML and create well-formed and valid XML documents.
- Distinguish the different types of NoSQL databases
- To understand the different models involved in database security and their applications inreal time world to protect the database and information associated with them.

COURSE OUTCOMES:

Upon completion of this course the students will be able to:

- Express ER-model to relational tables, populate relational databases and formulateSQL queries on data.
- Illustrate distributed database architecture and open database connectivity.
- Explain about XML schema and XML query.
- Use the data control, definition, and manipulation languages of the NoSQL databases.
- Design a secure database systems.
- Apply skills on databases to optimize their performance in practice.

UNIT I RELATIONAL DATA MODEL 9

Entity Relationship Model – Relational Data Model – Mapping Entity Relationship Model to Relational Model – Relational Algebra – Structured Query Language – Database Normalization.

UNIT II DISTRIBUTED DATABASES, ACTIVE DATABASES AND OPEN DATABASE CONNECTIVITY 9

Distributed Database Architecture – Distributed Data Storage – Distributed Transactions – Distributed Query Processing – Distributed Transaction Management – Event Condition Action Model – Design and Implementation Issues for Active Databases – Open Database Connectivity.

UNIT III XML DATABASES **9**

Structured, Semi structured, and Unstructured Data – XML Hierarchical Data Model – XML Documents – Document Type Definition – XML Schema – XML Documents and Databases – XML Querying — XPath — XQuery

UNIT IV NOSQL DATABASES AND BIG DATA STORAGE SYSTEMS **9**

NoSQL – Categories of NoSQL Systems – CAP Theorem – Document-Based NoSQL Systems and MongoDB – MongoDB Data Model – MongoDB Distributed Systems Characteristics – NoSQL Key-Value Stores – DynamoDB Overview – Voldemort Key-Value Distributed Data Store – WideColumn NoSQL Systems – Hbase Data Model – Hbase Crud Operations – Hbase Storage and Distributed System Concepts – NoSQL Graph Databases and Neo4j – Cypher Query Language of Neo4j – Big Data – MapReduce – Hadoop – YARN.

UNIT V DATABASE SECURITY **9**

Database Security Issues – Discretionary Access Control Based on Granting and Revoking Privileges – Mandatory Access Control and Role-Based Access Control for Multilevel Security –SQL Injection — Statistical Database Security — Flow Control — Encryption and Public Key Infrastructures – Preserving Data Privacy – Challenges to Maintaining Database Security – Database Survivability – Oracle Label-Based Security.

Total Hours : 45

REFERENCES:

1. R. Elmasri, S.B. Navathe, “Fundamentals of Database Systems”, Seventh Edition, PearsonEducation 2016.
2. Henry F. Korth, Abraham Silberschatz, S. Sudharshan, “Database System Concepts”, Seventh Edition, McGraw Hill, 2019.
3. C.J.Date, A.Kannan, S.Swamynathan, “An Introduction to Database Systems, Eighth Edition, Pearson Education, 2006
4. Raghu Ramakrishnan , Johannes Gehrke “Database Management Systems”, Fourth Edition, McGraw Hill Education, 2015.
5. Harrison, Guy, “Next Generation Databases, NoSQL and Big Data” , First Edition, Apresspublishers, 2015
6. Thomas Cannolly and Carolyn Begg, “Database Systems, A Practical Approach to Design,Implementation and Management”, Sixth Edition, Pearson Education, 2015

SEMESTER-I

22MECS105 NETWORK TECHNOLOGIES 3H-3C

Instruction Hours/week: L:3 T:0 P:0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

COURSE OBJECTIVES:

- To understand the basic concepts of networks
- To explore various technologies in the wireless domain
- To study about 4G and 5G cellular networks
- To learn about Network Function Virtualization
- To understand the paradigm of Software defined networks

COURSE OUTCOMES:

Upon completion of this course the students will be able to:

- Explain the basic concepts of networks and IP addressing.
- Outline various wireless access techniques.
- Compare 4G and 5G cellular networks
- Demonstrate different paradigm of Software defined networks
- Explain the concept of network virtualization.
- Analyze the requirements and select the most appropriate networking architecture and technologies

UNIT I NETWORKING CONCEPTS **9**

Peer To Peer Vs Client-Server Networks. Network Devices. Network Terminology. Network Speeds. Network throughput, delay. Osi Model. Packets, Frames, And Headers. Collision And Broadcast Domains. LAN Vs WAN. Network Adapter. Hub. Switch. Router. Firewall, IP addressing.

UNIT II WIRELESS NETWORKS **9**

Wireless access techniques- IEEE 802.11a, 802.11g, 802.11e, 802.11n/ac/ax/ay/ba/be, QoS – Bluetooth – Protocol Stack – Security – Profiles – zigbee.

UNIT III MOBILE DATA NETWORKS **9**

4G Networks and Composite Radio Environment – Protocol Boosters – Hybrid 4G Wireless Networks Protocols – Green Wireless Networks – Physical Layer and Multiple Access – Channel Modelling for 4G – Concepts of 5G – channel access –air interface -Cognitive Radio-spectrum management – C-RAN architecture - Vehicular communications-protocol – Networkslicing – MIMO, mmWave, Introduction to 6G.

UNIT IV SOFTWARE DEFINED NETWORKS **9**

SDN Architecture. Characteristics of Software-Defined Networking. SDN- and NFV-Related Standards. SDN Data Plane. Data Plane Functions. Data Plane Protocols. OpenFlow Logical Network Device. Flow Table Structure. Flow Table Pipeline. The Use of Multiple Tables. Group Table. OpenFlow Protocol. SDN Control Plane Architecture. Control Plane Functions. Southbound Interface. Northbound Interface. Routing. ITU-T Model. OpenDaylight. OpenDaylight Architecture. OpenDaylight Helium. SDN Application Plane Architecture. Northbound Interface. Network Services Abstraction Layer. Network Applications. User Interface.

UNIT V NETWORK FUNCTIONS VIRTUALIZATION **9**

Motivation-Virtual Machines –NFV benefits-requirements — architecture- NFV Infrastructure - Virtualized Network Functions - NFV Management and Orchestration- NFV Use Cases- NFVand SDN –Network virtualization — VLAN and VPN.

Total Hours : 45

REFERENCES:

1. James Bernstein, “Networking made Easy”, 2018. (UNIT I)
2. HoudaLabiod, Costantino de Santis, HossamAfifi “Wi-Fi, Bluetooth, Zigbee and WiMax”,Springer 2007 (UNIT 2)
3. Erik Dahlman, Stefan Parkvall, Johan Skold, 4G: LTE/LTE-Advanced for Mobile Broadband, Academic Press, 2013 (UNIT 3)
4. Saad Z. Asif – “5G Mobile Communications Concepts and Technologies” CRC press –2019 (UNIT 3)
5. William Stallings –“Foundations of Modern Networking: SDN, NFV, QoE, IoT, and Cloud”1st Edition, Pearson Education, 2016.(Unit 4 and 5)
6. Thomas D.Nadeau and Ken Gray, SDN — Software Defined Networks, O‟ReillyPublishers, 2013.
7. Guy Pujolle, “Software Networks”, Second Edition, Wiley-ISTE, 2020

SEMESTER-I

22MECS111 ADVANCED DATA STRUCTURES LABORATORY 3H-2C

Instruction Hours/week: L:0 T:0 P:3 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

COURSE OBJECTIVES:

- To become proficient with the fundamental tools of program design using structured problem solving, data representation, software engineering principles and comparative ana lysis of algorithms.
- To develop the ability to design and write programs for implementation of such algorithms
- To learn to implement iterative and recursive algorithms.
- To learn to design and implement algorithms using hill climbing and dynamic programming techniques.
- To learn to implement shared and concurrent objects.
- To learn to implement concurrent data structures.

COURSE OUTCOMES:

Upon completion of this course the students will be able to:

- Use various non primitive data types.
- Explain the concept of logic encapsulation.
  Illustrate the differences between recursive and iterative methods.
- Develop algorithms using dynamic programming and recursive backtracking techniques.
- Develop randomized algorithms.
- Apply concurrent linked lists, stacks, and queues.

LIST OF EXPERIMENTS:

1. Linked lists
2. Multistacks
3. Double Ended Queue (Deques)& Circular Queues
4. Min Heap
5. Deaps
6. Leftist Heap
7. AVL Tree
8. B: Tree
9. Quick Sort
10. Greedy algorithm
11. Knapsack using Dynamic Programming
12. Graph coloring using backtracking

Total Hours : 45

22MECS111 ADVANCED DATABABE TECHNOLOGY LABORATORY 3H-2C

Instruction Hours/week: L:0 T:0 P:3 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

COURSE OBJECTIVES:

- Understand query processing in a distributed database system
- Understand the basics of XML and create well-formed and valid XML documents.
- Distinguish the different types of NoSQL databases
- To understand the different models involved in database security and their applications inreal time world to protect the database and information associated with them.

COURSE OUTCOMES:

Upon completion of this course the students will be able to:

- Use data definition and data manipulation language in practice.
- Develop solution using distributed database.
- Build relational database using PHP and Python
- Develop XML document using relational data base.
- Use MongoDB, DynamoDB, Voldemort Key-Value Distributed DataStore Hbase and Neo4j.
- Apply skills on databases to optimize their performance in practice.

LIST OF EXPERIMENTS:

1. Data Definition Language
   - Create, Alter and Drop
   - Enforce Primary Key, Foreign Key, Check, Unique and Not Null Constraints
   - Creating Views
2. Data Manipulation Language
   - Insert, Delete, Update
   - Cartesian Product, Equi Join, Left Outer Join, Right Outer Join and Full Outer Join
   - Aggregate Functions
   - Set Operations
   - NesteD Queries
3. Transaction Control Language
   - Commit, Rollback and Save Points
4. Distributed Database Design and Implementation
5. Row Level and Statement Level Triggers
6. Accessing a Relational Database using PHP, Python and R
7. Creating XML Documents, Document Type Definition and XML Schema
8. Using a Relational Database to store the XML documents as text
9. Using a Relational Database to store the XML documents as data element

10. Creating or publishing customized XML documents from pre-existing relational databases
11. Extracting XML Documents from Relational Databases
12. XML Querying
13. Creating Databases using MongoDB, DynamoDB, Voldemort Key-Value Distributed DataStore Hbase and Neo4j.
14. Writing simple queries to access databases created using MongoDB, DynamoDB, Voldemort Key-Value Distributed Data Store Hbase and Neo4j

Total Hours : 45

22MECS201 INTERNET OF THINGS 3H-3C

Instruction Hours/week: L:3 T:0 P:0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

COURSE OBJECTIVES:

- To understand the Architectural Overview of IoT
- To understand the IoT Reference Architecture and Real World Design Constraints
- To understand the various IoT levels
- To understand the basics of cloud architecture
- To gain experience in Raspberry PI and experiment simple IoT application on it

COURSE OUTCOMES:

Upon completion of this course the students will be able to:

- Explain various concept of the IoT and their technologies.
- Develop IoT application using different hardware platforms.
- Experiment with the various IoT Protocols.
- Explain basic principles of cloud computing.
- Develop IoT application into cloud environment.
- Develop an application for solving real word problem.

UNIT I INTRODUCTION **9**

Internet of Things- Domain Specific IoTs - IoT and M2M-Sensors for IoT Applications– Structure ofIoT– IoT Map Device- IoT System Management with NETCONF-YANG

UNIT II IoT ARCHITECTURE, GENERATIONS AND PROTOCOLS **9**

IETF architecture for IoT - IoT reference architecture -First Generation – Description & Characteristics–Advanced Generation – Description & Characteristics–Integrated IoT Sensors – Description & Characteristics

UNIT III IoT PROTOCOLS AND TECHNOLOGY **9**

SCADA and RFID Protocols - BACnet Protocol -Zigbee Architecture - 6LowPAN - CoAP –Wireless Sensor Structure–Energy Storage Module–Power Management Module–RF Module–SensingModule

UNIT IV CLOUD ARCHITECTURE BASICS **9**

The Cloud types; IaaS, PaaS, SaaS.- Development environments for service development; Amazon,Azure, Google Appcloud platform in industry

UNIT V IOT PROJECTS ON RASPBERRY PI **9**

Building IOT with RASPBERRY PI- Creating the sensor project - Preparing Raspberry Pi - Clayster libraries — Hardware Interacting with the hardware - Interfacing the hardware- Internal representation of sensor values - Persisting data - External representation of sensor values - Exporting sensor data.

Total Hours : 45

REFERENCES:

1. Arshdeep Bahga, Vijay Madisetti, Internet of Things: A hands-on approach, UniversitiesPress, 2015
2. Dieter Uckelmann, Mark Harrison, Florian Michahelles (Eds), Architecting the Internet ofThings, Springer, 2011
3. Peter Waher, 'Learning Internet of Things', Packt Publishing, 2015
4. Ovidiu Vermesan Peter Friess, 'Internet of Things — From Research and Innovation toMarket Deployment', River Publishers, 2014
5. N. Ida, Sensors, Actuators and Their Interfaces: A Multidisciplinary Introduction, 2ndEditionScitech Publishers, 2014
6. Rees G.(2009) Cloud Application Architectures: Building Applications and Infrastructure in the Cloud. Sebastopol, CA: O'Reilly Media, Inc. (2009)

22MECS202 **MACHINE LEARNING** **3H-3C**

Instruction Hours/week: L:3 T:0 P:0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

COURSE OBJECTIVES:

- To understand the concepts and mathematical foundations of machine learning and types ofproblems tackled by machine learning
- To explore the different supervised learning techniques including ensemble methods
- To learn different aspects of unsupervised learning and reinforcement learning
- To learn the role of probabilistic methods for machine learning
- To understand the basic concepts of neural networks and deep learning

COURSE OUTCOMES:

Upon completion of this course the students will be able to:

- Outline problems for each type of machine learning.
- Design a Decision tree and Random forest for an application.
- Experiment Probabilistic Discriminative and Generative algorithms for an application andanalyze the results.
- Use a tool to implement typical Clustering algorithms for different types of applications.
- Design an HMM for a Sequence Model type of application.
- Identify applications suitable for different types of Machine Learning with suitable justification.

UNIT I INTRODUCTION AND MATHEMATICAL FOUNDATIONS **9**

What is Machine Learning? Need –History – Definitions – Applications - Advantages, Disadvantages& Challenges -Types of Machine Learning Problems – Mathematical Foundations - Linear Algebra & Analytical Geometry -Probability and Statistics- Bayesian Conditional Probability -Vector Calculus & Optimization - Decision Theory - Information theory.

UNIT II SUPERVISED LEARNING **9**

Introduction-Discriminative and Generative Models -Linear Regression - Least Squares -Under-fitting / Overfitting -Cross-Validation – Lasso Regression- Classification - Logistic Regression- Gradient Linear Models -Support Vector Machines –Kernel Methods -Instance based Methods - K-Nearest Neighbors - Tree based Methods –Decision Trees –ID3 — CART - Ensemble Methods –Random Forest - Evaluation of Classification Algorithms.

UNIT III UNSUPERVISED LEARNING AND REINFORCEMENT LEARNING **9**

Introduction - Clustering Algorithms -K – Means – Hierarchical Clustering - Cluster Validity - Dimensionality Reduction –Principal Component Analysis – Recommendation Systems - EM algorithm. Reinforcement Learning – Elements -Model based Learning – Temporal Difference Learning.

UNIT IV PROBABILISTIC METHODS FOR LEARNING **9**

Introduction -Naïve Bayes Algorithm -Maximum Likelihood -Maximum Apriori -Bayesian Belief Networks -Probabilistic Modelling of Problems -Inference in Bayesian Belief Networks – Probability Density Estimation - Sequence Models – Markov Models – Hidden Markov Models.

UNIT V NEURAL NETWORKS AND DEEP LEARNING **9**

Neural Networks – Biological Motivation- Perceptron – Multi-layer Perceptron – Feed Forward Network – Back Propagation-Activation and Loss Functions- Limitations of Machine Learning – Deep Learning– Convolution Neural Networks – Recurrent Neural Networks – Use cases.

Total Hours : 45

REFERENCES:

1. Stephen Marsland, "Machine Learning: An Algorithmic Perspective", Chapman & Hall/CRC,2nd Edition, 2014.
2. Kevin Murphy, "Machine Learning: A Probabilistic Perspective", MIT Press, 2012
3. Ethem Alpaydin, "Introduction to Machine Learning", Third Edition, Adaptive Computation andMachine Learning Series, MIT Press, 2014
4. Tom M Mitchell, "Machine Learning", McGraw Hill Education, 2013.
5. Peter Flach, "Machine Learning: The Art and Science of Algorithms that Make Sense of Data",First Edition, Cambridge University Press, 2012.
6. Shai Shalev-Shwartz and Shai Ben-David, "Understanding Machine Learning: From Theory toAlgorithms", Cambridge University Press, 2015
7. Christopher Bishop, "Pattern Recognition and Machine Learning", Springer, 2007.
8. Hal Daumé III, "A Course in Machine Learning", 2017 (freely available online)
9. Trevor Hastie, Robert Tibshirani, Jerome Friedman, "The Elements of Statistical Learning",Springer, 2009 (freely available online)
10. Aurélien Géron , Hands-On Machine Learning with Scikit-Learn and TensorFlow: Concepts,

` ools, and Techniques to Build Intelligent Systems 2nd Edition, o'reilly, (2017)

22MECS203 **ADVANCED SOFTWARE ENGINEERING** **3H-3C**

Instruction Hours/week: L:3 T:0 P:0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

COURSE OBJECTIVES:

- To understand the rationale for software development process models
- To understand why the architectural design of software is important;
- To understand the five important dimensions of dependability, namely,
- availability,reliability, safety, security, and resilience.
- Understand the basic notions of a web service, web service standards, and service-oriented architecture;
- To understand the different stages of testing from testing during development of a softwaresystem.

COURSE OUTCOMES:

Upon completion of this course the students will be able to:

- Identify appropriate process models based on the Project requirements
- Explain the importance of having a good Software Architecture.
- Explain five important dimensions of dependability, namely, availability, reliability,safety, security, and resilience.
- Outline the basic notions of a web service, web service standards, and service-orientedarchitecture.
- Illustrate the various levels of Software testing.
- Develop new software using software engineering principles.

UNIT I SOFTWARE PROCESS &MODELING **9**

Prescriptive Process Models – Agility and Process – Scrum – XP – Kanban – DevOps – PrototypeConstruction — Prototype Evaluation — Prototype Evolution — Modelling — Principles — Requirements Engineering – Scenario-based Modelling – Class-based Modelling – Functional Modelling — Behavioural Modelling.

UNIT II SOFTWARE DESIGN **9**

Design Concepts – Design Model – Software Architecture – Architectural Styles – Architectural Design – Component-Level Design – User Experience Design – Design for Mobility – Pattern- Based Design.

UNIT III SYSTEM DEPENDABILITY AND SECURITY **9**

Dependable Systems – Dependability Properties – Sociotechnical Systems – Redundancy and Diversity – Dependable Processes – Formal Methods and Dependability – Reliability Engineering – Availability and Reliability – Reliability Requirements – Fault-tolerant Architectures – Programming for Reliability – Reliability Measurement – Safety Engineering – Safety-critical Systems – Safety Requirements – Safety Engineering Processes – Safety Cases – Security Engineering – Security and Dependability – Safety and Organizations – Security Requirements – Secure System Design –Security Testing and Assurance – Resilience Engineering – Cybersecurity – Sociotechnical Resilience – Resilient Systems Design.

UNIT IV SERVICE-ORIENTED SOFTWARE ENGINEERING, SYSTEMS ENGINEERINGAND REAL-TIME SOFTWARE ENGINEERING
9

Service-oriented Architecture – RESTful Services – Service Engineering – Service Composition –Systems Engineering – Sociotechnical Systems – Conceptual Design – System Procurement – System Development – System Operation and Evolution – Real-time Software Engineering – Embedded System Design – Architectural Patterns for Real-time Software – Timing Analysis – Real-time Operating Systems.

UNIT V SOFTWARE TESTING AND SOFTWARE CONFIGURATION MANAGEMENT **9**

Software Testing Strategy – Unit Testing – Integration Testing – Validation Testing – System Testing – Debugging – White-Box Testing – Basis Path Testing – Control Structure Testing –Black-Box Testing – Software Configuration Management (SCM) – SCM Repository – SCM Process – Configuration Management for Web and Mobile Apps.

Total Hours : 45

REFERENCES:

1. Software Engineering: A Practitioner's Approach, 9th Edition. Roger Pressman and BruceMaxim, McGraw-Hill 2019.
2. Software Engineering, 10th Edition, Ian Somerville, Pearson Education Asia 2016.
3. Software Architecture In Practice, 3rd Edition, Len Bass, Paul Clements and Rick Kazman,Pearson India 2018
4. An integrated approach to Software Engineering, 3rd Edition, Pankaj Jalote, NarosaPublishing House, 2018
5. Fundamentals of Software Engineering, 5th Edition, Rajib Mall, PHI Learning Private Ltd,2018

M.E.COMPUTER SCIENCE AND ENGINEERING **2022-2023**

SEMESTER-II

22MECS211 **MACHINE LEARNING LABORATORY** **3H-2C**

Instruction Hours/week: L:0 T:0 P:3 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

COURSE OBJECTIVES:

- To understand the concepts and mathematical foundations of machine learning and types of problems tackled by machine learning
- To explore the different supervised learning techniques including ensemble methods
- To learn different aspects of unsupervised learning and reinforcement learning
- To learn the role of probabilistic methods for machine learning
- To understand the basic concepts of neural networks and deep learning

COURSE OUTCOME:

- Develop a model using linear regression.
- Use binary classification model for solving problems and determine the effectiveness.
- Make use of Nearest Neighbors for classification.
- Analyze between training set and validation set results.
- Make use of k-means and Naïve Bayes Classifier algorithm for problem solving
- Develop solution using classification algorithm to solve real applications.

LIST OF EXPERIMENTS:

1. Implement a Linear Regression with a Real Dataset (https://www.kaggle.com/harrywang/housing). Experiment with different features in building amodel. Tune the model's hyper parameters.
2. Implement a binary classification model. That is, answers a binary question such as "Are houses in this neighborhood above a certain price?"(use data from exercise 1). Modify the classification threshold and determine how that modification influences the model. Experiment with different classification metrics to determine your model's effectiveness.
3. Classification with Nearest Neighbors. In this question, you will use the scikit-learn's KNN classifier to classify real vs. fake news headlines. The aim of this question is for you to read the scikit-learn API and get comfortable with training/validation splits. Use California Housing Dataset
4. In this exercise, you'll experiment with validation sets and test sets using the dataset. Splita training set into a smaller training set and a validation set. Analyze deltas between training set and validation set results. Test the trained model with a

test set to determine whether your trained model is overfitting. Detect and fix a common training problem.

5. Implement the k-means algorithm using https://archive.ics.uci.edu/ml/datasets/Codon+usagedataset
6. Implement the Naïve Bayes Classifier using https://archive.ics.uci.edu/ml/datasets/Gait+Classification dataset.
7. **Project - (in Pairs) Your** project must implement one or more machine learning algorithms andapply them to some data Your project may be a comparison of several existing algorithms, or it may propose anew algorithm in which case you still must compare it to at least one other approach.
    1. You can either pick a project of your own design, or you can choose from the set ofpre-defined projects.
    2. You are free to use any third-party ideas or code that you wish as long as it is publiclyavailable.
    3. You must properly provide references to any work that is not your own in the write-up.
    4. Project proposal You must turn in a brief project proposal. Your project proposal should describe the idea behind your project. You should also briefly describe softwareyou will need to write, and papers (2-3) you plan to read.

List of Projects (datasets available)

1. Sentiment Analysis of Product Reviews
2. Stock Prediction
3. Sales Forecasting
4. Music Recommendation
5. Handwriting Digit Classification
6. Fake News Detection
7. Sports Prediction
8. Object Detection
9. Disease Prediction

Total Hours : 45

SEMESTER-II

22MECS212 SOFTWARE ENGINEERING LABORATORY 3H-2C

Instruction Hours/week: L:0 T:0 P:3 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

COURSE OBJECTIVE:

The Software Engineering Lab has been developed by keeping in mind the following objectives:

- To impart state-of-the-art knowledge on Software Engineering and UML in an interactivemanner through the Web.
- Present case studies to demonstrate practical applications of different concepts.
- Provide a scope to students where they can solve small, real-life problems.

COURSE OUTCOME:

Upon completion of this course the students will be able to:

- Outline the requirements and use cases the client wants for the software being Produced.
- Develop project plan with assessments of the project, the schedule, available resources.
- Develop project plan with risk management can model and specify the requirements of mid-range software and their architecture.
- Outline software design based on the requirement specification that the software can be implemented based on the design.
- Predict the costs of a project with the help of several different assessment methods.
- Develop new software using software engineering principles.

LIST OF EXPERIMENTS:

1. Write a Problem Statement to define a title of the project with bounded scope of project
2. Select relevant process model to define activities and related task set for assigned project
3. Prepare broad SRS (Software Requirement Specification) for the above selected projects
4. Prepare USE Cases and Draw Use Case Diagram using modelling Tool
5. Develop the activity diagram to represent flow from one activity to another for softwaredevelopment
6. Develop data Designs using DFD Decision Table & ER Diagram.
7. Draw class diagram, sequence diagram, Collaboration Diagram, State Transition Diagramfor the assigned project
8. Write Test Cases to Validate requirements of assigned project from SRS Document
9. Evaluate Size of the project using function point metric for the assigned project
10. Estimate cost of the project using COCOMO and COCOCMOII for the assigned project
11. Use CPM/PERT for scheduling the assigned project
12. Use timeline Charts or Gantt Charts to track progress of the assigned project.
13.

Total Hours : 45

SEMESTER-III

22MECS301 RESEARCH METHODOLOGY AND IPR 3H-3C

Instruction Hours/week: L:3 T:0 P:0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

COURSE OBJECTIVES:

- To study the research methodology and pedagogy
- To enable the students to get involved in research activities
- To understand the data collection for research.
- To do data analysis for report writing.
- To know the concept of IPR.
- To know the objectives and benefits of patent filing.

COURSE OUTCOMES:

Upon completion of this course the students will be able to:

- Explain the overview of research process and surveys
- Outline the sampling methods and data preparation process in research.
- Outline the process of Multivariate analysis.
- Describe the concept of IPR, types and future.
- Describe the objectives and benefits of patent and E-filing
- Demonstrate how educational research contributes to the objectives of doctoral program.

UNIT I RESEARCH DESIGN **9**

Overview of research process and design, Use of Secondary and exploratory data to answer theresearch question, Qualitative research, Observation studies, Experiments and Surveys.

UNIT II DATA COLLECTION AND SOURCES **9**

Measurements, Measurement Scales, Questionnaires and Instruments, Sampling and methods. Data - Preparing, Exploring, examining and displaying.

UNIT III DATA ANALYSIS AND REPORTING **9**

Overview of Multivariate analysis, Hypotheses testing and Measures of Association. Presenting Insights and findings using written reports and oral presentation.

UNIT IV INTELLECTUAL PROPERTY RIGHTS **9**

Intellectual Property — The concept of IPR, Evolution and development of concept of IPR, IPR development process, Trade secrets, utility Models, IPR & Biodiversity, Role of WIPO and WTO in IPR

establishments, Right of Property, Common rules of IPR practices, Types and Features of IPR Agreement, Trademark, Functions of UNESCO in IPR maintenance.

UNIT V PATENTS **9**

Patents — objectives and benefits of patent, Concept, features of patent, Inventive step, Specification, Types of patent application, process E-filing, Examination of patent, Grant of patent, Revocation, Equitable Assignments, Licenses, Licensing of related patents, patent agents, Registration of patent agents.

Total Hours : 45

REFERENCES:

1. Cooper Donald R, Schindler Pamela S and Sharma JK, "Business Research Methods", Tata McGraw Hill Education, 11e (2012).
2. Catherine J. Holland, "Intellectual property: Patents, Trademarks, Copyrights, Trade Secrets", Entrepreneur Press, 2007.
3. David Hunt, Long Nguyen, Matthew Rodgers, "Patent searching:tools &techniques", Wiley, 2007.
4. The Institute of Company Secretaries of India, Statutory body under an Act of parliament,"Professional Programme Intellectual Property Rights, Law and practice", September 2013

LIST OF

PROFESSIONAL

ELECTIVES

2MECS2E01 ADVANCED OPERATING SYSTEMS 3H-3C

Instruction Hours/week: L:3 T:0 P:0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

COURSE OBJECTIVES

- To get a comprehensive knowledge of the architecture of distributed systems.
- To understand the deadlock and shared memory issues and their solutions in distributedenvironments.
- To know the security issues and protection mechanisms for distributed environments.
- To get a knowledge of multiprocessor operating systems and database operating systems.

COURSE OUTCOMES:

Upon completion of this course the students will be able to:

- Describe the working of Theoretical Foundations of OS.
- Analyze the working principles of Distributed Deadlock Detection and resource management.
- Explain the concepts of distributed shared memory and scheduling mechanisms.
- Analyze the working of Data security.
- Compare multiprocessor operating systems and database operating systems.
- Apply advanced concepts in real time environment.

UNIT I INTRODUCTION 9

Architectures of Distributed Systems - System Architecture types - issues in distributed operating systems - communication networks – communication primitives. Theoretical Foundations - inherent limitations of a distributed system – lamport's logical clocks – vector clocks – causal ordering of messages – global state – cuts of a distributed computation – termination detection. Distributed Mutual Exclusion — introduction — the classification of mutual exclusion and associated algorithms – a comparative performance analysis.

UNIT II DISTRIBUTED DEADLOCK DETECTION AND RESOURCE MANAGEMENT 9

Distributed Deadlock Detection -Introduction - deadlock handling strategies in distributed systems issues in deadlock detection and resolution – control organizations for distributed deadlock detection – centralized and distributed deadlock detection algorithms –hierarchical deadlock detection algorithms. Agreement protocols – introduction-the system model, a classification of agreement problems, solutions to the Byzantine agreement problem, applications of agreement

algorithms. Distributed resource management: introduction-architecture – mechanism for building distributed file systems — design issues — log structured file systems.

UNIT III DISTRIBUTED SHARED MEMORY AND SCHEDULING 9

Distributed shared memory-Architecture– algorithms for implementing DSM – memory coherence and protocols – design issues. Distributed Scheduling – introduction – issues in load distributing – components of a load distributing algorithm – stability – load distributing algorithms – performance comparison – selecting a suitable load sharing algorithm – requirements for load distributing -task migration and associated issues. Failure Recovery and Fault tolerance: introduction– basic concepts – classification of failures – backward and forward error recovery, backward error recovery- recovery in concurrent systems – consistent set of checkpoints – synchronous and asynchronous checkpointing and recovery – checkpointing for distributed database systems- recovery in replicated distributed databases.

UNIT IV DATA SECURITY 9

Protection and security -preliminaries, the access matrix model and its implementations.-safety in matrix model- advanced models of protection. Data security — cryptography: Model of cryptography, conventional cryptography- modern cryptography, private key cryptography, data encryption standard- public key cryptography – multiple encryption – authentication in distributedsystems.

UNIT- MULTIPROCESSOR AND DATABASE OPERATING SYSTEM 9

Multiprocessor operating systems - basic multiprocessor system architectures – interconnectionnetworks for multiprocessor systems – caching – hypercube architecture. Multiprocessor Operating System - structures of multiprocessor operating system, operating system design issues- threads- process synchronization and scheduling. Database Operating systems :Introduction- requirements of a database operating system Concurrency control : theoretical aspects – introduction, database systems – a concurrency control model of database systems- the problem of concurrency control – serializability theory- distributed database systems, concurrency control algorithms – introduction, basic synchronization primitives, lock based algorithms-timestamp based algorithms, optimistic algorithms – concurrency control algorithms: data replication.

Total Hours : 45

REFERENCES:

1. Mukesh Singhal, Niranjan G.Shivaratri, "Advanced concepts in operating systems: Distributed, Database and multiprocessor operating systems", TMH, 2001
2. Andrew S.Tanenbaum, "Modern operating system", PHI, 2003
3. Pradeep K.Sinha, "Distributed operating system-Concepts and design", PHI, 2003.
4. Andrew S.Tanenbaum, "Distributed operating system", Pearson education, 2003.

SEMESTER-II

2MECS2E02 AGILE TECHNOLOGIES **3H-3C**

Instruction Hours/week: L:3 T:0 P:0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

OBJECTIVES:

- To learn the fundamental principles and practices associated with each of the agile development methods
- To apply the principles and practices of agile software development on a project of interestand relevance to the student.
- To provide a good understanding of software design and a set of software technologies and APIs.
- To do a detailed examination and demonstration of Agile development and testing techniques.
- To understand Agile development and testing.

COURSE OUTCOMES:

Upon completion of this course the students will be able to:

- Analyze existing problems with the team, development process and wider organization
- Apply a thorough understanding of Agile principles and specific practices
- Predict most appropriate way to improve results for a specific circumstance or need
- Identify appropriate adaptations to existing practices or processes depending uponanalysis of typical problems
- Outline likely successes and formulate plans to manage likely risks or problems.
- Apply agile methodology to develop software component.

UNIT I AGILE SOFTWARE DEVELOPMENT **9**

Basics and Fundamentals of Agile Process Methods, Values of Agile, Principles of Agile, stakeholders, Challenges . Lean Approach: Waste Management, Kaizen and Kanban, add process and products add value. Roles related to the lifecycle, differences between Agile and traditional plans, differences between Agile plans at different lifecycle phases. Testing plan links between testing, roles and key techniques, principles, understand as a means of assessing the initial status of a project/ How Agile helps to build quality

UNIT II AGILE AND SCRUM PRINCIPLES **9**

Agile Manifesto, Twelve Practices of XP, Scrum Practices, Applying Scrum. Need of scrum, working of scrum, advanced Scrum Applications, Scrum and the Organization, scrum values.

UNIT III AGILE PRODUCT MANAGEMENT **9**

Communication, Planning, Estimation Managing the Agile approach Monitoring progress, Targeting and motivating the team, Managing business involvement, Escalating issue. Quality, Risk, Metrics and Measurements, Managing the Agile approach Monitoring progress, Targeting and motivating the team, Managing business involvement and Escalating issue

UNIT IV AGILE REQUIREMENTS AND AGILE TESTING **9**

User Stories, Backlog Management. Agile Architecture: Feature Driven Development. Agile Risk Management: Risk and Quality Assurance, Agile Tools. Agile Testing Techniques, Test-Driven Development, User Acceptance Test.

UNIT V AGILE REVIEW AND SCALING AGILE FOR LARGE PROJECTS **9**

Agile Metrics and Measurements, The Agile approach to estimating and project variables, Agile Measurement, Agile Control: the 7 control parameters. Agile approach to Risk, The Agile approach to Configuration Management, The Atern Principles, Atern Philosophy, The rationale for using Atern, Refactoring, Continuous integration, Automated Build Tools. Scrum of Scrums, Team collaborations, Scrum, Estimate a Scrum Project, Track Scrum Projects, Communication in Scrum Projects, Best Practices to Manage Scrum.

Total Hours : 45

REFERENCES:

1. Robert C. Martin ,Agile Software Development, Principles, Patterns, and Practices Alan Apt Series (2011)
2. Succeeding with Agile : Software Development Using Scrum, Pearson (2010)
3. David J. Anderson and Eli Schragenheim, “Agile Management for Software Engineering: Applying the Theory of Constraints for Business Results, Prentice Hall, 2003.
4. Hazza and Dubinsky, “Agile Software Engineering, Series: Undergraduate Topics in Computer Science, Springer, 2009.
5. Craig Larman, “Agile and Iterative Development: A Managers Guide, Addison-Wesley,2004.
6. Kevin C. Desouza, “Agile Information Systems: Conceptualization, Construction, and Management, Butterworth-Heinemann, 2007.

SEMESTER-II

22MECS2E03 FOUNDATIONS OF DATA SCIENCE **3H-3C**

Instruction Hours/week: L:3 T:0 P:0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

COURSE OBJECTIVES:

- To apply fundamental algorithms to process data.
- Learn to apply hypotheses and data into actionable predictions.
- Document and transfer the results and effectively communicate the findings using visualization techniques.
- To learn statistical methods and machine learning algorithms required for Data Science
- To develop the fundamental knowledge and understand concepts to become a datascience professional.

COURSE OUTCOMES:

Upon completion of this course the students will be able to:

- Use, clean/process and transform data.
- Analyze data using an ethically responsible approach.
- Use appropriate models of analysis, assess the quality of input, derive insight from results, and investigate potential issues.
- Apply computing theory, languages and algorithms, as well as mathematical and statistical models, and the principles of optimization to appropriately formulate and use data analyses
- Use appropriate models of data analysis to solve business-related challenges.
- Apply fundamental knowledge and understand concepts to become a datascience professional.

UNIT I INTRODUCTION TO DATA SCIENCE **9**

Data science process – roles, stages in data science project – working with data from files – working with relational databases – exploring data – managing data – cleaning and sampling for modeling and validation – introduction to NoSQL.

UNIT II MODELING METHODS **9**

Choosing and evaluating models – mapping problems to machine learning, evaluating clustering models, validating models – cluster analysis – K-means algorithm, Naïve Bayes – Memorization Methods – Linear and logistic regression – unsupervised methods.

UNIT III INTRODUCTION TO R **9**

Reading and getting data into R – ordered and unordered factors – arrays and matrices – lists and data frames — reading data from files — probability distributions — statistical models in R - manipulating objects – data distribution

UNIT IV MAP REDUCE MAP REDUCE **9**

Introduction – distributed file system – algorithms using map reduce, Matrix-Vector Multiplication by Map Reduce — Hadoop - Understanding the Map Reduce architecture - Writing Hadoop MapReduce Programs - Loading data into HDFS - Executing the Map phase - Shuffling and sorting - Reducing phase execution.

UNIT V DATA VISUALIZATION **9**

Documentation and deployment – producing effective presentations – Introduction to graphical analysis – plot() function – displaying multivariate data – matrix plots – multiple plots in one window - exporting graph using graphics parameters - Case studies.

Total Hours : 45

REFERENCES:

1. Nina Zumel, John Mount, "Practical Data Science with R", Manning Publications, 2014.
2. Mark Gardener, "Beginning R - The Statistical Programming Language", John Wiley & Sons, Inc., 2012
3. W. N. Venables, D. M. Smith and the R Core Team, "An Introduction to R", 2013.
4. Tony Ojeda, Sean Patrick Murphy, Benjamin Bengfort, Abhijit Dasgupta, "Practical Data Science Cookbook", Packt Publishing Ltd., 2014.
5. Nathan Yau, "Visualize This: The FlowingData Guide to Design, Visualization, and Statistics", Wiley, 2011.
6. Boris Lublinsky, Kevin T. Smith, Alexey Yakubovich, "Professional Hadoop Solutions",John Wiley & Sons Inc., 2013.

22MECS2E04 INFORMATION RETRIEVAL TECHNIQUES 3H-3C

Instruction Hours/week: L:3 T:0 P:0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

COURSE OBJECTIVES:

- To understand the basics of information retrieval with pertinence to modeling, query operations and indexing
- To get an understanding of machine learning techniques for text classificationand clustering.
- To understand the various applications of information retrieval giving emphasisto multimedia IR, web search
- To get an understanding of machine learning techniques for text classificationand clustering.
- To understand the concepts of digital libraries

COURSE OUTCOMES:

- Build an Information Retrieval system using the available tools.
- Identify the various components of an Information Retrieval system.
- Categorize the different types of IR Models.
- Apply machine learning techniques to text classification and clustering which isused for efficient Information Retrieval.
- Design an efficient search engine and analyze the Web content structure.

UNIT I INTRODUCTION: MOTIVATION **9**

Basic Concepts – Practical Issues - Retrieval Process – Architecture - Boolean Retrieval –Retrieval Evaluation – Open-Source IR Systems–History of Web Search – Web Characteristics–The impact of the web on IR —IR Versus Web Search–Components of a Search engine.

UNIT II MODELING **9**

Taxonomy and Characterization of IR Models – Boolean Model – Vector Model - Term Weighting –Scoring and Ranking –Language Models – Set Theoretic Models - Probabilistic Models – Algebraic Models – Structured Text Retrieval Models – Models for Browsing

UNIT III INDEXING **9**

Static and Dynamic Inverted Indices — Index Construction and Index Compression. Searching - Sequential Searching and Pattern Matching. Query Operations -Query Languages — Query Processing - Relevance Feedback and Query Expansion - Automatic Local and Global Analysis –

Measuring Effectiveness and Efficiency

UNIT IV EVALUATION AND PARALLEL INFORMATION RETRIEVAL 9

Traditional Effectiveness Measures – Statistics in Evaluation – Minimizing Adjudication Effect – Nontraditional Effectiveness Measures – Measuring Efficiency – Efficiency Criteria – Queueing Theory — Query Scheduling — Parallel Information Retrieval — Parallel Query Processing — MapReduce

UNIT V SEARCHING THE WEB 9

Searching the Web –Structure of the Web –IR and web search – Static and Dynamic Ranking – Web Crawling and Indexing – Link Analysis - XML Retrieval Multimedia IR: Models and Languages – Indexing and Searching Parallel and Distributed IR – Digital Libraries.

Total Hours : 45

REFERENCES:

1. Christopher D. Manning, Prabhakar Raghavan, Hinrich Schutze "Introduction toInformation Retrieval, Cambridge University Press, First South Asian Edition, 2008
2. Stefan Buttcher, Implementing and Evaluating Search Engines, The MIT Press, Cambridge, Massachusetts London, England, 2016.
3. Ricardo Baeza — Yates, Berthier Ribeiro — Neto, "Modern Information Retrieval: Theconcepts and Technology behind Search (ACM Press Books), Second Edition, 2011.
4. Stefan Buttcher, Charles L. A. Clarke, Gordon V. Cormack, "Information Retrieval

22MECS2E05 NETWORK AND INFORMATION SECURITY **3H-3C**

Instruction Hours/week: L:3 T:0 P:0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

COURSE OBJECTIVES:

- To understand the principles of encryption algorithms; conventional and public key cryptography. To have a detailed knowledge about authentication, hash functions and application level security mechanisms.
- To know the methods of conventional encryption.
- To understand the concepts of public key encryption and number theory
- To know the network security tools and applications.
- To understand the system level security used

COURSE OUTCOMES:

Upon completion of this course the students will be able to:

- Explain conventional and modern encryption algorithms.
- Apply RSA encryption algorithm**.**
- Compare different authentication protocols.
- Outline the importance of Electronic mail security.
- Describe the process involved system security
- Apply the security principles in real scenario.

UNIT I INTRODUCTION **9**

Attacks – Services – Mechanisms – Conventional Encryption – Classical and Modern-Techniques – Encryption Algorithms – Confidentiality

UNIT II PUBLIC KEY ENCRYPTION **9**

RSA – Elliptic Curve Cryptography – Number Theory Concepts

UNIT III MESSAGE AUTHENTICATION **9**

Hash Functions – Digest Functions – Digital Signatures – Authentication Protocols.

UNIT IV NETWORK SECURITY PRACTICE **9**

Authentication, Applications – Electronic Mail Security – IP Security – Web Security.

UNIT V SYSTEM SECURITY **9**

Intruders – Viruses – Worms – Firewalls Design Principles – Trusted Systems.

Total Hours : 45

REFERENCES:

1. William Stallings, Cryptography & Network Security, Pearson Education, 2013.
2. Man Young Rhee**,** Internet Security, Wiley, New York**,** 2013.
3. Bruce Schneier, Niels Ferguson, Practical Cryptography, Wiley Dreamtech, India Pvt Ltd, New Delhi, 2003.
4. Pfleeger & Pfleeger, Security in Computing , Pearson Education, Asia, 2003.

22MECS2E06 PERFORMANCE ANALYSIS OF COMPUTER SYSTEMS **3H-3C**

Instruction Hours/week: L:3 T:0 P:0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

COURSE OBJECTIVES:

- To understand the mathematical foundations needed for performance evaluation of computer systems
- To understand the metrics used for performance evaluation
- To understand the analytical modeling of computer systems
- To enable the students to develop new queuing analysis for both simple and complexsystems
- To appreciate the use of smart scheduling and introduce the students to analytical techniques for evaluating scheduling policies

COURSE OUTCOMES:

Upon completion of this course, the students should be able to:

- Identify the need for performance evaluation and the metrics used for it
- Distinguish between open and closed queuing networks
- Apply Little‘e law and other operational laws to open and closed systems
- Use discrete-time and continuous-time Markov chains to model real world systems
- Develop analytical techniques for evaluating scheduling policies
- Make use of evaluation process in computer system.

UNIT I OVERVIEW OF PERFORMANCE EVALUATION **9**

Need for Performance Evaluation in Computer Systems – Overview of Performance Evaluation Methods – Introduction to Queuing – Probability Review – Generating Random Variables for Simulation – Sample Paths, Convergence and Averages – Little‘s Law and other Operational Laws Modification for Closed Systems.

UNIT II MARKOV CHAINS AND SIMPLE QUEUES **9**

Discrete-Time Markov Chains – Ergodicity Theory – Real World Examples – Google, Aloha – Transition to Continuous-Time Markov Chain – M/M/1.

UNIT III MULTI-SERVER AND MULTI-QUEUE SYSTEMS **9**

Server Farms: M/M/k and M/M/k/k – Capacity Provisioning for Server Farms – Time Reversibility and Burke‘s Theorem – Networks of Queues and Jackson Product Form – Classed and Closed Networks of Queues.

UNIT IV REAL-WORLD WORKLOADS **9**

Case Study of Real-world Workloads – Phase-Type Distributions and Matrix-Alalytic Methods – Networks with Time-Sharing Servers — M/G/1 Queue and the Inspection Paradox — Task Assignment Policies for Server Farms.

UNIT V SMART SCHEDULING IN THE M/G/1 **9**

Performance Metrics – Scheduling Non-Preemptive and Preemptive Non-Size-Based Policies - . Scheduling Non-Preemptive and Preemptive Size-Based Policies — Scheduling - SRPT and Fairness.

Total Hours : 45

REFERENCES:

1. K. S. Trivedi, “Probability and Statistics with Reliability, Queueing and Computer Science Applications‖, John Wiley and Sons, 2001.
2. Krishna Kant, “Introduction to Computer System Performance Evaluation‖, McGraw-Hill.
3. Lieven Eeckhout, “Computer Architecture Performance Evaluation Methods‖, Morgan and Claypool Publishers, 2010.
4. Mor Harchol - Balter, “Performance Modeling and Design of Computer Systems — Queueing Theory in Action‖, Cambridge University Press, 2013.
5. Paul J. Fortier and Howard E. Michel, “Computer Systems Performance Evaluation and Prediction‖, Elsevier, 2003.
6. Raj Jain, “The Art of Computer Systems Performance Analysis: Techniques forExperimental Design, Measurement, Simulation and Modeling‖, Wiley-Interscience.
7. Raj Jain, Art of Computer Systems Performance Analysis: Techniques For Experimental Design Measurements Simulation and Modeling,2nd edition, wiley, 2015

SEMESTER-II

22MECS2E07 SOCIAL NETWORKS ANALYSIS **3H-3C**

Instruction Hours/week: L:3 T:0 P:0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

COURSE OBJECTIVES:

- To understand the components of the social network
- To model and visualize the social network
- To mine the users in the social network
- To understand the evolution of the social network
- To mine the interest of the user

COURSE OUTCOMES:

Upon completion of this course the students will be able to:

- Explain the key concepts in network analysis
- Make use of Visualization techniques
- Explain community detection and mining process
- Outline Algorithms and Systems for Expert Location in Social Networks
- Illustrate the text mining process in social networks
- Apply concepts in social networking and utilizing these concepts for solving real-world social network issues

UNIT I INTRODUCTION **9**

Introduction to Web - Limitations of current Web – Development of Semantic Web – Emergence of the Social Web – Statistical Properties of Social Networks -Network analysis - Development of Social Network Analysis - Key concepts and measures in network analysis - Discussion networks - Blogs and online communities - Web-based networks

UNIT II MODELING AND VISUALIZATION **9**

Visualizing Online Social Networks - A Taxonomy of Visualizations - Graph Representation - Centrality- Clustering - Node-Edge Diagrams - Visualizing Social Networks with Matrix-Based Representations- Node-Link Diagrams - Hybrid Representations - Modelling and aggregating social network data – Random Walks and their Applications –Use of Hadoop and Map Reduce - Ontological representation of social individuals and relationships.

UNIT III MINING COMMUNITIES **9**

Aggregating and reasoning with social network data, Advanced Representations - Extracting evolution of Web Community from a Series of Web Archive - Detecting Communities in Social Networks - Evaluating Communities – Core Methods for Community Detection & Mining - Applications of Community Mining Algorithms - Node Classification in Social Networks.

UNIT IV EVOLUTION **9**

Evolution in Social Networks – Framework - Tracing Smoothly Evolving Communities - Models and Algorithms for Social Influence Analysis - Influence Related Statistics - Social Similarity and Influence - Influence Maximization in Viral Marketing - Algorithms and Systems for Expert Location in Social Networks - Expert Location without Graph Constraints- with Score Propagation – Expert Team Formation - Link Prediction in Social Networks - Feature based Link Prediction - Bayesian Probabilistic Models - Probabilistic Relational Models

UNIT V TEXT AND OPINION MINING **9**

Text Mining in Social Networks -Opinion extraction – Sentiment classification and clustering - Temporal sentiment analysis - Irony detection in opinion mining - Wish analysis - Product review mining – Review Classification – Tracking sentiments towards topics over time

Total Hours : 45

REFERENCES:

1. Charu C. Aggarwal, "Social Network Data Analytics", Springer; 2011
2. Peter Mika, "Social Networks and the Semantic Web", Springer, 1st edition, 2007.
3. Borko Furht, "Handbook of Social Network Technologies and Applications", Springer, 1st, edition, 2010.
4. Guandong Xu , Yanchun Zhang and Lin Li, "Web Mining and Social Networking – Techniques and applications", Springer, 1st edition, 2011.
5. Giles, Mark Smith, John Yen, "Advances in Social Network Mining and Analysis", Springer, 2010.
6. Ajith Abraham, Aboul Ella Hassanien, Václav Snášel, "Computational Social NetworkAnalysis: Trends, Tools and Research Advances", Springer, 2009.
7. Toby Segaran, "Programming Collective Intelligence", O'Reilly, 2012

22MECS2E08 HIGH PERFORMANCE COMPUTING FOR BIGDATA **3H-3C**

Instruction Hours/week: L:3 T:0 P:0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

COURSE OBJECTIVES:

- To learn the fundamental concepts of High Performance Computing.
- To learn the network & software infrastructure for high performance computing.
- To understand real time analytics using high performance computing.
- To learn the different ways of security perspectives and technologies used in HPC.
- To understand the emerging big data applications.

COURSE OUTCOMES:

Upon completion of the course, the student should be able to:

- Explain the basics concepts of High Performance computing systems.
- Apply the concepts of network and software infrastructure for high performance computing
- Use real time analytics using high performance computing.
- Apply the security models and big data applications in high performance computing
- Explain the emerging big data applications.
- Use tools and software to compare large data-processing tasks using cloud-computing services.

UNIT I INTRODUCTION **9**

The Emerging IT Trends- IOT/IOE-Apache Hadoop for big data analytics-Big data into big insights and actions – Emergence of BDA discipline – strategic implications of big data – BDA Challenges –HPC paradigms – Cluster computing – Grid Computing – Cloud computing – Heterogeneous computing – Mainframes for HPC - Supercomputing for BDA – Appliances for BDA.

UNIT II NETWORK & SOFTWARE INFRASTRUCTURE FOR HIGH PERFORMANCE BDA 9

Design of Network Infrastructure for high performance BDA – Network Virtualization – Software Defined Networking – Network Functions Virtualization – WAN optimization for transfer of big data started with SANs- storage infrastructure requirements for storing big data – FC SAN – IP SAN – NAS – GFS – Panasas – Luster file system – Introduction to cloud storage.

UNIT III REAL TIME ANALYTICS USING HIGH PERFORMANCE COMPUTING 9

Technologies that support Real time analytics – MOA: Massive online analysis – GPFS: General parallel file system – Client case studies – Key distinctions – Machine data analytics – operationalanalytics – HPC Architecture models – In Database analytics – In memory analytics

UNIT IV SECURITY AND TECHNOLOGIES 9

Security, Privacy and Trust for user – generated content: The challenges and solutions – Role of real time big data processing in the IoT – End to End Security Framework for big sensing data streams — Clustering in big data.

UNIT V EMERGING BIG DATA APPLICATIONS 9

Deep learning Accelerators — Accelerators for clustering applications in machine learning - Accelerators for classification algorithms in machine learning – Accelerators for Big data Genome Sequencing

Total Hours : 45

REFERENCES:

1. Pethuru Raj, Anupama Raman, Dhivya Nagaraj and Siddhartha Duggirala, "High-Performance Big-Data Analytics: Computing Systems and Approaches", Springer, 1st Edition, 2015.
2. "Big Data Management and Processing", Kuan-Ching Li , Hai Jiang, Albert Y. Zomaya, CRC Press,1st Edition,2017.
3. "High Performance Computing for Big Data: Methodologies and Applications", Chao wang ,CRC Press,1st Edition,2018
4. "High-Performance Data Mining And Big Data Analytics" , Khosrow Hassibi, Create Space Independent Publishing Platform,!st Edition,2014
5. "High performance computing: Modern systems and practices", Thomas Sterling, Matthew Anderson, Morgan Kaufmann publishers,1st Edition,2017

WEB REFERENCES:

1. https://www.hpcwire.com/

ONLINE RESOURCES:

1. http://hpc.fs.uni-lj.si/sites/default/files/HPC_for_dummies.pdf
2. https://www.nics.tennessee.edu/computing-resources/what-is-hpc

SEMESTER-III

22MECS3E01 WEB ANALYTICS 3H-3C

Instruction Hours/week: L:3 T:0 P:0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

COURSE OBJECTIVES:

- To understand the Web analytics platform, and their evolution.
- To learn about the various Data Streams Data.
- To learn about the benefits of surveys and capturing of data
- To understand Common metrics of web as well as KPI related concepts.
- To learn about the various Web analytics versions.

COURSE OUTCOMES

Upon completion of this course, the students should be able to:

- Explain Web analytics platform, and their evolution
- Use various Data Streams Data.
- Describe how the survey of capturing of data will benefit.
- Explain Common metrics of web as well as KPI related concepts.
- Apply various Web analytics versions in existence.
- Apply various analytics methods in web environment..

UNIT I INTRODUCTION **9**

Definition, Process, Key terms: Site references, Keywords and Key phrases; building block terms: Visit characterization terms, Content characterization terms, Conversion metrics; Categories: Offsite web, on site web; Web analytics platform, Web analytics evolution, Need for web analytics, Advantages, Limitations.

UNIT II DATA COLLECTION **9**

Click stream Data: Web logs, Web Beacons, JavaScript tags, Packet Sniffing; Outcomes Data: E-commerce, Lead generation, Brand/Advocacy and Support; Research data: Mindset, Organizational structure, Timing; Competitive Data: Panel-Based measurement, ISP-based measurement, Search Engine data.

UNIT III QUALITATIVE ANALYSIS **9**

Heuristic evaluations: Conducting a heuristic evaluation, Benefits of heuristic evaluations; Site Visits: Conducting a site visit, Benefits of site visits; Surveys: Website surveys, Post-visit surveys, creating and running a survey, Benefits of surveys. Capturing data: Web logs or JavaScript's tags, Separate data serving and data capture, Type and size of data, Innovation, Integration, Selecting optimal web analytic tool, Understanding click stream data quality, Identifying unique page definition, Using cookies, Link coding issues.

UNIT IV WEB METRICS **9**

Common metrics: Hits, Page views, Visits, Unique visitors, Unique page views, Bounce, Bounce rate, Page/visit, Average time on site, New visits; Optimization (e-commerce, non e- commerce sites): Improving bounce rates, Optimizing adwords campaigns; Real time report, Audience report, Traffic source report, Custom campaigns, Content report, Google analytics, Introduction to KPI, characteristics, Need for KPI, Perspective of KPI, Uses of KPI. Relevant Technologies: Internet & TCP/IP, Client / Server Computing, HTTP (Hypertext Transfer Protocol), Server Log Files & Cookies, Web Bugs.

UNIT V WEB ANALYTICS 2.0 **9**

Web analytics 1.0, Limitations of web analytics 1.0, Introduction to analytic 2.0, Competitive intelligence analysis : CI data sources, Toolbar data, Panel data ,ISP data, Search engine data, Hybrid data, Website traffic analysis: Comparing long term traffic trends, Analyzing competitive site overlap and opportunities. Google Analytics: Brief introduction and working, Adwords, Benchmarking, Categories of traffic: Organic traffic, Paid traffic; Google website optimizer, Implementation technology, Limitations, Performance concerns, Privacy issues**.**

Total Hours : 45

REFERENCES:

1. Clifton B., Advanced Web Metrics with Google Analytics, Wiley Publishing, Inc.2nd ed, 2012.
2. Kaushik A., Web Analytics 2.0, The Art of Online Accountability and Science ofCustomer Centricity, Wiley Publishing, Inc. 1st ed, 2010.
3. Sterne J., Web Metrics: Proven methods for measuring web site success, John Wiley andSons, 2002

22MECS3E02 **BIG DATA MINING AND ANALYTICS** **3H-3C**

Instruction Hours/week: L:3 T:0 P:0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

COURSE OBJECTIVES:

- To understand the computational approaches to Modeling, Feature Extraction
- To understand the need and application of Map Reduce
- To understand the various search algorithms applicable to Big Data
- To analyze and interpret streaming data
- To learn how to handle large data sets in main memory and learn the various clusteringtechniques applicable to Big Data

COURSE OUTCOMES:

Upon completion of this course, the students will be able to

- Design algorithms by employing Map Reduce technique for solving Big Data problems.
- Design algorithms for Big Data by deciding on the apt Features set .
- Design algorithms for handling petabytes of datasets
- Design algorithms and propose solutions for Big Data by optimizing main memory consumption
- Design solutions for problems in Big Data by suggesting appropriate clustering techniques.
- Apply mining methods in solving real word problems.

UNIT I DATA MINING AND LARGE SCALE FILES **9**

Introduction to Statistical modeling – Machine Learning – Computational approaches to modeling – Summarization – Feature Extraction – Statistical Limits on Data Mining - Distributed File Systems – Map-reduce – Algorithms using Map Reduce – Efficiency of Cluster Computing Techniques.

UNIT II SIMILAR ITEMS **9**

Nearest Neighbor Search – Shingling of Documents – Similarity preserving summaries – Locality sensitive hashing for documents – Distance Measures – Theory of Locality Sensitive Functions – LSHFamilies – Methods for High Degree of Similarities.

UNIT III MINING DATA STREAMS **9**

Stream Data Model – Sampling Data in the Stream – Filtering Streams – Counting Distance Elements in a Stream – Estimating Moments – Counting Ones in Window – Decaying Windows.

UNIT IV LINK ANALYSIS AND FREQUENT ITEMSETS **9**

Page Rank –Efficient Computation - Topic Sensitive Page Rank – Link Spam – Market Basket Model – A-priori algorithm – Handling Larger Datasets in Main Memory – Limited Pass Algorithm – Counting Frequent Item sets.

UNIT V CLUSTERING **9**

Introduction to Clustering Techniques – Hierarchical Clustering –Algorithms – K-Means – CURE – Clustering in Non -– Euclidean Spaces – Streams and Parallelism – Case Study: Advertising on the Web — Recommendation Systems.

Total Hours : 45

REFERENCES:

1. Jure Leskovec, AnandRajaraman, Jeffrey David Ullman, “Mining of Massive Datasets”,Cambridge University Press, 3rd Edition, 2020.
2. Jiawei Han, MichelineKamber, Jian Pei, “Data Mining Concepts and Techniques”, MorganKaufman Publications, Third Edition, 2012.
3. Ian H.Witten, Eibe Frank “Data Mining – Practical Machine Learning Tools and Techniques”,Morgan Kaufman Publications, Third Edition, 2011.
4. David Hand, HeikkiMannila and Padhraic Smyth, “Principles of Data Mining”, MIT PRESS,2001

WEB REFERENCES:

1. https://swayam.gov.in/nd2_arp19_ap60/preview
2. https://nptel.ac.in/content/storage2/nptel_data3/html/mhrd/ict/text/106104189/lec1.pdf

ONLINE RESOURCES:

1. https://examupdates.in/big-data-analytics/
2. https://www.tutorialspoint.com/big_data_analytics/index.htm
3. https://www.tutorialspoint.com/data_mining/index.htm

SEMESTER-III

22MECS3E03 DATA VISUALIZATION TECHNIQUES 3H-3C

Instruction Hours/week: L:3 T:0 P:0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

COURSE OBJECTIVES:

- To develop skills to both design and critique visualizations.
- To introduce visual perception and core skills for visual analysis.
- To understand technological advancements of data visualization
- To understand various data visualization techniques
- To understand the methodologies used to visualize large data sets

COURSE OUTCOMES:

Upon completion of this course the students will be able to:

- Explain the basics of data visualization.
- Outline the Visualization stages and visual variables..
- Apply the visualization techniques in physical sciences, computer science, applied mathematics and medical sciences.
- Apply the visualization techniques for research projects.
- Identify appropriate data visualization techniques given particular requirements imposed bythe data
- Apply the visualization techniques to design information dashboard.

UNIT I INTRODUCTION AND DATA FOUNDATION **9**

Basics - Relationship between Visualization and Other Fields -The Visualization Process - Pseudo code Conventions - The Scatter plot. Data Foundation - Types of Data - Structure within and between Records - Data Preprocessing - Data Sets.

UNIT II FOUNDATIONS FOR VISUALIZATION **9**

Visualization stages - Semiology of Graphical Symbols - The Eight Visual Variables — Historical Perspective - Taxonomies - Experimental Semiotics based on Perception Gibson‘s Affordance theory – A Model of Perceptual Processing.

UNIT III VISUALIZATION TECHNIQUES **9**

Spatial Data: One-Dimensional Data - Two-Dimensional Data – Three Dimensional Data - Dynamic Data - Combining Techniques. Geospatial Data : Visualizing Spatial Data - Visualization of Point Data -Visualization of Line Data - Visualization of Area Data — Other Issues in Geospatial Data Visualization Multivariate Data : Point-Based Techniques - LineBased Techniques - Region-Based

Techniques - Combinations of Techniques – Trees Displaying Hierarchical Structures – Graphics and Networks- Displaying Arbitrary Graphs/Networks.

UNIT IV INTERACTION CONCEPTS AND TECHNIQUES **9**

Text and Document Visualization: Introduction - Levels of Text Representations - The Vector Space Model - Single Document Visualizations -Document Collection Visualizations — Extended Text Visualizations Interaction Concepts: Interaction Operators - Interaction Operands and Spaces - A Unified Framework. Interaction Techniques: Screen Space - Object-Space –Data Space - Attribute Space- Data Structure Space - Visualization Structure — Animating Transformations - Interaction Control.

UNIT V RESEARCH DIRECTIONS IN VISUALIZATIONS **9**

Steps in designing Visualizations – Problems in designing effective Visualizations- Issues of Data. Issues of Cognition, Perception, and Reasoning. Issues of System Design Evaluation , Hardware and Applications

Total Hours : 45

REFERENCES:

1. Matthew Ward, Georges Grinstein and Daniel Keim, “Interactive Data Visualization Foundations, Techniques, Applications”, 2010
2. Colin Ware, “Information Visualization Perception for Design”, 4th edition, Morgan Kaufmann Publishers, 2021.
3. Robert Spence “Information visualization – Design for interaction”, Pearson Education, 2nd Edition, 2007.
4. Alexandru C. Telea, “Data Visualization: Principles and Practice,” A. K. Peters Ltd, 2008.

SEMESTER-III

22MECS3E04 OPTIMIZATIONS FOR MACHINE LEARNING 3H-3C

Instruction Hours/week: L:3 T:0 P:0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

COURSE OBJECTIVES:

The goal of this course is for the student is:

- To recognize classes of optimization problems in machine learning and related disciplines.
- To understand the mathematical underpinnings of optimization methods via examples drawn from machine learning, computer vision, engineering, and data analysis.
- To understand foundational optimization ideas including gradient descent, stochastic gradient methods, higher-order methods, and more advanced optimization algorithms.
- To classify optimization problems by their tractability, difficulty, and compatibility with existing software.
- To impart advanced models and optimizations.

COURSE OUTCOMES:

Upon completion of the course, the student should be able to:

- Distinguish the fundamental knowledge of optimization methods for machine learning.
- Use optimization techniques and numerical methods of optimization.
- Enumerate fundamentals of optimization methods and apply different techniques to solve various optimization problems arising from machine learning.
- Explain about Optimization Methods
- Discuss about Parallel and Distributed Optimization Algorithms and applications
- Analyze various methods of optimizations for machine learning and choose best approaches to improve machine learning performance.

UNIT I **9**

Introduction: Optimization and Machine Learning–Convex Optimization with Sparsity-Inducing Norms–Interior-Point Methods for Large-Scale Cone Programming–Incremental Gradient, Sub-gradient, and Proximal Methods for Convex Optimization

UNIT II **9**

Stochastic and Online Variants of mentioned methods–Coordinate Descent–Frank-Wolfe–Accelerated Methods– Cutting-Plane Methods in Machine Learning–Introduction to Dual Decomposition for Inference.

UNIT III **9**

Augmented Lagrangian Methods for Learning, Selecting, and Combining Features–The Convex Optimization Approach to Regret Minimization–Projected Newton-type Methods in Machine Learning

UNIT IV **9**

Robust Optimization in Machine Learning–Improving First and Second-Order Methods by Modeling Uncertainty–Optimization Methods for Sparse Inverse Covariance Selection.

UNIT V **9**

A Pathwise Algorithm for Covariance Selection–Advanced models: GANs, adversarial optimization, robust optimization, cycle consistency–Parallel and Distributed Optimization Algorithms

Total Hours : 45

TEXT BOOKS:

1. Suvrit Sra, Sebastian Nowozin, and Stephen J. Wright, "Optimization for Machine Learning", MIT Press, First Edition,2013
2. Stephen Boyd and LievenVandenberghe, "Convex Optimization", Cambridge University Press, First Edition2009

REFERENCE BOOKS:

1. Nocedal. J and Wright. S.J," Numerical Optimization", Springer Publishers, First Edition,, 2006
2. SébastienBubeck, "Convex Optimization: Algorithms and Complexity", Now Publishers Inc, First Edition2015
3. Cong Fang, Huan Li, and Zhouchen Lin, "Accelerated Optimization for Machine Learning", Springer Publishers, First Edition, 2020

SEMESTER-III

22MECS3E05 ROBOTICS **3H-3C**

Instruction Hours/week: L:3 T:0 P:0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

COURSE OBJECTIVES:

- To Introduce the concepts of Robotic systems
- To understand the concepts of Instrumentation and control related to Robotics
- To understand the kinematics and dynamics of robotics
- To explore robotics in Industrial applications

COURSE OUTCOMES:

Upon completion of this course the students will be able to:

- Describe the fundamentals of robotics
- Explain the concept of kinematics and dynamics in robotics.
- Discuss robot control techniques
- Explain basis of intelligence in robotics and task planning
- Discuss the industrial applications of robotics
- Apply robot mechanism to meet kinematics requirements and to write simple programs.

UNIT I INTRODUCTION TO ROBOTICS **9**

Robotics -History - Classification and Structure of Robotic Systems - Basic components -Degrees of freedom - Robot joints coordinates- Reference frames - workspace- Robot languages- Robotic sensors- proximity and range sensors, ultrasonic sensor, touch and slip sensor.

UNIT II ROBOT KINEMATICS AND DYNAMICS **9**

Kinematic Modelling: Translation and Rotation Representation, Coordinate transformation, DH parameters, Forward and inverse kinematics, Jacobian, Dynamic Modelling: Forward and inverse dynamics, Equations of motion using Euler-Lagrange formulation, Newton Euler formulation.

UNIT III ROBOTICS CONTROL **9**

Control of robot manipulator - state equations - constant solutions -linear feedback systems, single-axis PID control - PD gravity control -computed torque control, variable structure control and impedance control.

UNIT IV ROBOT INTELLIGENCE AND TASK PLANNING **9**

Artificial Intelligence - techniques - search problem reduction - predicate logic means and end analysis -problem solving -robot learning - task planning - basic problems in task planning - AI in robotics and Knowledge Based Expert System in robotics

UNIT V INDUSTRIAL ROBOTICS **9**

Robot cell design and control - cell layouts - multiple robots and machine interference - work cell design - work cell control - interlocks — error detection deduction and recovery - work cell controller robot cycle time analysis. Safety in robotics, Applications of robot and future scope.

Total Hours: 45

REFERENCES:

1. John J. Craig, 'Introduction to Robotics (Mechanics and Control)', Addison-Wesley, 2nd Edition, 2004.
2. Richard D. Klafter, Thomas A. Chmielewski, Michael Negin, 'Robotics Engineering: AnI ntegrated Approach', PHI Learning, New Delhi, 2009.
3. K.S.Fu, R.C.Gonzalez and C.S.G.Lee, 'Robotics Control, Sensing, Vision and Intelligence',Tata McGraw Hill, 2nd Reprint,2008.
4. Reza N.Jazar, 'Theory of Applied Robotics Kinematics, Dynamics and Control', Springer,1st Indian Reprint, 2010.
5. Mikell. P. Groover, Michell Weis, Roger. N. Nagel, Nicolous G.Odrey, 'Industrial RoboticsTechnology, Programming and Applications ', McGraw Hill, Int 2012.

SEMESTER-III

22MECS3E06 NATURAL LANGUAGE PROCESSING 3H-3C

Instruction Hours/week: L:3 T:0 P:0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

COURSE OBJECTIVES:

- To understand basics of linguistics, probability and statistics
- To study statistical approaches to NLP and understand sequence labeling
- To outline different parsing techniques associated with NLP
- To explore semantics of words and semantic role labeling of sentences
- To understand discourse analysis, question answering and chatbots

COURSE OUTCOMES:

Upon completion of this course the students will be able to:

- Explain the basics of linguistics, probability and statistics associated with NLP
- Demonstrate Part-of-Speech Tagger
- Apply a sequence labeling problem for a given domain
- Apply semantic processing tasks and simple document indexing and searching system using the concepts of NLP
- Develop a simple chatbot using dialogue system concepts
- Apply a Statistical Methods for Real World Applications and explore deep learning based NLP.

UNIT I INTRODUCTION **9**

Natural Language Processing – Components - Basics of Linguistics and Probability and Statistics – Words-Tokenization-Morphology-Finite State Automata

UNIT II STATISTICAL NLP AND SEQUENCE LABELING **9**

N-grams and Language models –Smoothing -Text classification- Naïve Bayes classifier — Evaluation - Vector Semantics — TF-IDF - Word2Vec- Evaluating Vector Models -Sequence Labeling – Part of Speech – Part of Speech Tagging -Named Entities –Named Entity Tagging

UNIT III CONTEXTUAL EMBEDDING **9**

Constituency –Context Free Grammar –Lexicalized Grammars- CKY Parsing – Earley's algorithm-Evaluating Parsers -Partial Parsing — Dependency Relations- Dependency Parsing -Transition Based - Graph Based.

UNIT IV COMPUTATIONAL SEMANTICS **9**

Word Senses and WordNet – Word Sense Disambiguation – Semantic Role Labeling – Proposition Bank- FrameNet- Selectional Restrictions - Information Extraction - Template Filling

UNIT V DISCOURSE ANALYSIS AND SPEECH PROCESSING **9**

Discourse Coherence – Discourse Structure Parsing – Centering and Entity Based Coherence – Question Answering –Factoid Question Answering – Classical QA Models – Chatbots and Dialogue systems – Frame-based Dialogue Systems – Dialogue–State Architecture

Total Hours : 45

REFERENCES:

1. Daniel Jurafsky and James H.Martin, "Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech Recognition" (Prentice Hall Series in Artificial Intelligence), 2020
2. Jacob Eisenstein. "Natural Language Processing ", MIT Press, 2019
3. Samuel Burns "Natural Language Processing: A Quick Introduction to NLP with Python and NLTK, 2019
4. Christopher Manning, "Foundations of Statistical Natural Language Processing", MIT Press,2009.

SEMESTER-III

22MECS3E07 GPU COMPUTING 3H-3C

Instruction Hours/week: L:3 T:0 P:0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

COURSE OBJECTIVES:

- To understand the basics of GPU architectures
- To understand CPU GPU Program Partitioning
- To write programs for massively parallel processors
- To understand the issues in mapping algorithms for GPUs
- To introduce different GPU programming models

COURSE OUTCOMES:

Upon completion of this course the students will be able to:

- Describe GPU Architecture
- Develop programs using CUDA, identify issues and debug them
- Apply efficient algorithms in GPUs for common application kernels, such asmatrix multiplication
- Build simple programs using OpenCL
- Identify efficient parallel programming patterns to solve problems
- Build non-trivial GPU programs for graphics as well as computation.

UNIT I GPU ARCHITECTURE **9**

Evolution of GPU architectures - Understanding Parallelism with GPU –Typical GPU Architecture - CUDA Hardware Overview - Threads, Blocks, Grids, Warps, Scheduling - Memory Handling with CUDA: Shared Memory, Global Memory, Constant Memory and Texture Memory.

UNIT II CUDA PROGRAMMING **9**

Using CUDA - Multi GPU - Multi GPU Solutions - Optimizing CUDA Applications: Problem Decomposition, Memory Considerations, Transfers, Thread Usage, Resource Contentions

UNIT III PROGRAMMING ISSUES **9**

Common Problems: CUDA Error Handling, Parallel Programming Issues, Synchronization, Algorithmic Issues, Finding and Avoiding Errors.

UNIT IV OPENCL BASICS **9**

OpenCL Standard – Kernels – Host Device Interaction – Execution Environment – Memory Model – Basic OpenCL Examples.

UNIT V ALGORITHMS ON GPU **9**

Parallel Patterns: Convolution, Prefix Sum, Sparse Matrix - Matrix Multiplication - Programming Heterogeneous Cluster

Total Hours : 45

REFERENCES:

1. Shane Cook, CUDA Programming: ―A Developer's Guide to Parallel Computing with GPUs (Applications of GPU Computing), First Edition, Morgan Kaufmann, 2012.
2. David R. Kaeli, Perhaad Mistry, Dana Schaa, Dong Ping Zhang, ―Heterogeneous computing with OpenCL, 3rd Edition, Morgan Kauffman, 2015.
3. Nicholas Wilt, ―CUDA Handbook: A Comprehensive Guide to GPU Programming, Addison Wesley, 2013
4. Jason Sanders, Edward Kandrot, ―CUDA by Example: An Introduction to General Purpose GPU Programming, Addison - Wesley, 2010.
5. David B. Kirk, Wen-mei W. Hwu, Programming Massively Parallel Processors - A Hands-on Approach, Third Edition, Morgan Kaufmann, 2016
6. http://www.nvidia.com/object/cuda_home_new.html
7. http://www.openCL.org

SEMESTER-III

22MECS3E08 DEVOPS AND MICROSERVICES 3H-3C

Instruction Hours/week: L:3 T:0 P:0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

COURSE OBJECTIVES:

- To learn the basic concepts and terminology of DevOps
- To gain knowledge on Devops platform
- To understand building and deployment of code
- To be familiar with DevOps automation tools
- To learn basics of MLOps

COURSE OUTCOMES:

- Explain modern software Engineering process.
- Make use of DevOps platform.
- Build, test and deploy code.
- Outline DevOps tools.
- Relate MLOps concepts with real time examples.
- Apply DevOps methodology over other software development processes.

UNIT I INTRODUCTION **9**

Software Engineering - traditional and Agile process models - DevOps -Definition - Practices - DevOps life cycle process - need for DevOps –Barriers

UNIT II DEVOPS PLATFORM AND SERVICES **9**

Cloud as a platform - IaaS, PaaS, SaaS - Virtualization - Containers –Supporting Multiple Data Centers - Operation Services - Hardware provisioning- software Provisioning - IT services - SLA - capacity planning - security - Service Transition - Service Operation Concepts.

UNIT III BUILDING , TESTING AND DEPLOYMENT **9**

Microservices architecture - coordination model - building and testing - Deployment pipeline - Development and Pre-commit Testing -Build and Integration Testing - continuous integration - monitoring - security - Resources to Be Protected - Identity Management

UNIT IV DEVOPS AUTOMATION TOOLS **9**

Infrastructure Automation- Configuration Management - Deployment Automation - Performance Management - Log Management –Monitoring

UNIT V MLOPS **9**

MLOps - Definition - Challenges -Developing Models - Deploying to production - Model Governance - Real world examples.

Total Hours : 45

REFERENCES:

1. Len Bass, Ingo Weber and Liming Zhu, ―"DevOps: A Software Architect's Perspective", Pearson Education, 2016
2. Joakim Verona - "Practical DevOps" - Packet Publishing , 2016
3. Viktor Farcic -"The DevOps 2.1 Toolkit: Docker Swarm" - Packet Publishing, 2017
4. Mark Treveil, and the Dataiku Team-"Introducing MLOps" - O'Reilly Media- 2020

22MECS3E09 BIO INFORMATICS 3H-3C

Instruction Hours/week: L:3 T:0 P:0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

COURSE OBJECTIVES:

- Exposed to the need for Bioinformatics technologies
- Be familiar with the modeling techniques
- Learn microarray analysis
- Exposed to Pattern Matching and Visualization
- To know about Microarray Analysis

COURSE OUTCOMES:

Upon completion of this course the students will be able to:

- Explain different Data formats.
- Develop machine learning algorithms.
- Develop models for biological data.
- Apply pattern matching techniques to bioinformatics data – protein data genomic data.
- Apply micro array technology for genomic expression study
- Apply methods to characterize and manage the different types of Biological data.

UNIT I INTRODUCTION **9**

Need for Bioinformatics technologies — Overview of Bioinformatics technologies Structural bioinformatics – Data format and processing – Secondary resources and applications – Role of Structural bioinformatics – Biological Data Integration System

UNIT II DATAWAREHOUSING AND DATAMINING IN BIOINFORMATICS **9**

Bioinformatics data – Data warehousing architecture – data quality – Biomedical data analysis – DNA data analysis – Protein data analysis – Machine learning – Neural network architectureand applications in bioinformatics.

UNIT III MODELING FOR BIOINFORMATICS **9**

Hidden Markov modeling for biological data analysis — Sequence identification — Sequence classification – multiple alignment generation – Comparative modeling –Protein modeling – genomic modeling – Probabilistic modeling – Bayesian networks – Boolean networks – Molecular modeling – Computer programs for molecular modeling.

UNIT IV PATTERN MATCHING AND VISUALIZATION **9**

Gene regulation – motif recognition – motif detection – strategies for motif detection – Visualization – Fractal analysis – DNA walk models – one dimension – two dimension – higher dimension – Game representation of biological sequences – DNA, Protein, Amino acid sequences.

UNIT V MICROARRAY ANALYSIS **9**

Microarray technology for genome expression study – image analysis for data extraction – preprocessing – segmentation – gridding – spot extraction – normalization, filtering – cluster analysis – gene network analysis – Compared Evaluation of Scientific Data Management Systems – Cost Matrix – Evaluation model – Benchmark – Tradeoffs.

Total Hours : 45

REFERENCES:

1. Yi-Ping Phoebe Chen (Ed), "BioInformatics Technologies", First Indian Reprint, Springer Verlag, 2007
2. Bryan Bergeron, "Bio Informatics Computing", Second Edition, Pearson Education, 2015.
3. Arthur M Lesk, "Introduction to Bioinformatics", Second Edition, Oxford University Press, 2019

SEMESTER-III

22MECS3E010 FULL STACK WEB APPLICATION DEVELOPMENT 3H-3C

Instruction Hours/week: L:3 T:0 P:0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

COURSE OBJECTIVES:

- Develop Type Script Application
- Develop Single Page Application (SPA)
- Able to communicate with a server over the HTTP protocol
- Learning all the tools need to start building applications with Node.js
- Implement the Full Stack Development using MEAN Stack

COURSE OUTCOMES:

Upon completion of this course the students will be able to:

- Explain basic programming skills using Javascript
- Build a front-end web application using Angular.
- Develop modules to organise the server
- Build RESTful APIs with Node, Express and MongoDB with confidence.
- Make use of complex, relational data in MongoDB using Mongoose
- Develop a fully functioning application and deploy on a web server.

UNIT I FUNDAMENTALS & TYPESCRIPT LANGUAGE **9**

Server-Side Web Applications. Client-Side Web Applications. Single Page Application. About TypeScript. Creating TypeScript Projects. TypeScript Data Types. Variables. Expression and Operators. Functions. OOP in Typescript. Interfaces. Generics. Modules. Enums. Decorators. Enums. Iterators. Generators.

UNIT II ANGULAR **9**

About Angular. Angular CLI. Creating an Angular Project. Components. Components Interaction. Dynamic Components. Angular Elements. Angular Forms. Template Driven Forms. Property, Style,Class and Event Binding. Two way Bindings. Reactive Forms. Form Group. Form Controls. About Angular Router. Router Configuration. Router State. Navigation Pages. Router Link. Query Parameters. URL matching. Matching Strategies. Services. Dependency Injection. HttpClient. Read Data from the Server. CRUD Operations. Http Header Operations. Intercepting requests and responses.

UNIT III NODE.js **9**

About Node.js. Configuring Node.js environment. Node Package Manager NPM. Modules.Asynchronous Programming. Call Stack and Event Loop. Callback functions. Callback errors. Abstracting callbacks. Chaining callbacks. File System. Synchronous vs. asynchronous I/O. Path and directory operations. File Handle. File Synchronous API. File Asynchronous API. File Callback API. Timers. Scheduling Timers. Timers Promises API. Node.js Events. Event Emitter. EventTarget and Event API. Buffers. Buffers and TypedArrays. Buffers and iteration. Using buffers for binary data. Flowing vs. non-flowing streams. JSON.

UNIT IV EXPRESS.Js **9**

Express.js. How Express.js Works. Configuring Express.js App Settings. Defining Routes. Starting the App. Express.js Application Structure. Configuration, Settings. Middleware. body-parser. cookie-parser. express-session. response-time. Template Engine. Jade. EJS. Parameters. Routing. router.route(path). Router Class. Request Object. Response Object. Error Handling. RESTful.

UNIT V MONGODB **9**

Introduction to MongoDB. Documents. Collections. Subcollections. Database. Data Types. Dates. Arrays. Embedded Documents. CRUD Operations. Batch Insert. Insert Validation. Querying The Documents. Cursors. Indexing. Unique Indexes. Sparse Indexes. Special Index and Collection Types. Full-Text Indexes. Geospatial Indexing. Aggregation framework.

Total Hours : 45

REFERENCES:

1. Adam Freeman, Essential TypeScript, Apress, 2019
2. Mark Clow, Angular Projects, Apress, 2018
3. Alex R. Young, Marc Harter,Node.js in Practice, Manning Publication, 2014
4. Pro Express.js, Azat Mardan, Apress, 2015
5. MongoDB in Action, Kyle Banker, Peter Bakkum, Shaun Verch, Douglas Garrett, Tim Hawkins, Manning Publication, Second edition, 2016

SEMESTER-III

22MECS3E011 SOFTWARE QUALITY ASSURANCE 3H-3C

Instruction Hours/week: L:3 T:0 P:0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

COURSE OBJECTIVES:

- Be exposed to the software quality factors, Quality Assurance (SQA) architecture and SQA components.
- Understand the integration of SQA components into the project life cycle.
- Be familiar with the software quality infrastructure.
- Be exposed to the management components of software quality.
- Be familiar with the Quality standards, certifications and assessments

COURSE OUTCOMES:

Upon completion of this course the students will be able to:

- Make use of the concepts of SQA in software development life cycle
- Demonstrate their capability to adopt quality standards.
- Explain the quality of software products.
- Apply the concepts in preparing the quality plan & documents.
- Outline whether the product meets company's quality standards and client's expectations and demands
- Apply software quality and assurance software systems development process to solve recall time applications.

UNIT I INTRODUCTION TO SOFTWARE QUALITY & ARCHITECTURE 9

Need for Software quality – Software quality assurance (SQA) – Software quality factors- McCall'squality model – SQA system components – Pre project quality components – Development and quality plans.

UNIT II SQA COMPONENTS AND PROJECT LIFE CYCLE 9

Integrating quality activities in the project life cycle – Reviews – Software Testing – Quality of software maintenance components – Quality assurance for external participants contribution – CASE tools forsoftware quality Management.

UNIT III SOFTWARE QUALITY INFRASTRUCTURE 9

Procedures and work instructions – Supporting quality devices - Staff training and certification - Corrective and preventive actions – Configuration management – Software change control – Configuration management audit -Documentation control.

UNIT IV SOFTWARE QUALITY MANAGEMENT & METRICS 9

Project process control – Software quality metrics – Cost of software quality – Classical quality costmodel – Extended model – Application and Problems in application of Cost model

UNIT V STANDARDS, CERTIFICATIONS & ASSESSMENTS 9

Quality management standards – ISO 9001 and ISO 9000-3 –Capability Maturity Models – CMM and CMMI assessment methodologies - Bootstrap methodology – SPICE Project – SQA project processstandards – Organization of Quality Assurance – Role of management in SQA – SQA units and otheractors in SQA systems.

Total Hours : 45

REFERENCES:

1. Daniel Galin, “Software Quality Assurance”, Pearson Publication, 2009.
2. Alan C. Gillies, “Software Quality: Theory and Management”, International Thomson Computer Press, 2011.
3. Kshirasagar Naim and Priyadarshi Tripathy,” Software Testing and Quality Assurance Theory and Practice”, John Wiley & Sons Inc., 2008
4. Mordechai Ben-Menachem “Software Quality: Producing Practical Consistent Software”, International Thompson Computer Press, 2014

SEMESTER-III

22MECS3E012 DEEP LEARNING 3H-3C

Instruction Hours/week: L:3 T:0 P:0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

COURSE OBJECTIVES:

- Develop and Train Deep Neural Networks.
- Develop a CNN, R-CNN, Fast R-CNN, Faster-R-CNN, Mask-RCNN for detection and recognition
- Build and train RNNs, work with NLP and Word Embeddings
- The internal structure of LSTM and GRU and the differences between them
- The Auto Encoders for Image Processing

COURSE OUTCOMES:

Upon completion of this course the students will be able to:

- Feature Extraction from Image and Video Data.
- Implement Image Segmentation and Instance Segmentation in Images.
- Implement image recognition and image classification using a pre trained network (Transfer Learning).
- Traffic Information analysis using Twitter Data.
- Auto encoder for Classification & Feature Extraction.
- Apply different deep learning models to solve engineering problems.

UNIT I DEEP LEARNING CONCEPTS **9**

Fundamentals about Deep Learning. Perception Learning Algorithms. Probabilistic modelling. Early Neural Networks. How Deep Learning different from Machine Learning. Scalars. Vectors. Matrixes, Higher Dimensional Tensors. Manipulating Tensors. Vector Data. Time Series Data. Image Data. Video Data

UNIT II NEURAL NETWORKS **9**

About Neural Network. Building Blocks of Neural Network. Optimizers. Activation Functions. Loss Functions. Data Pre-processing for neural networks, Feature Engineering. Overfitting and Underfitting. Hyperparameters.

UNIT III CONVOLUTIONAL NEURAL NETWORK **9**

About CNN. Linear Time Invariant. Image Processing Filtering. Building a convolutional neural network. Input Layers, Convolution Layers. Pooling Layers. Dense Layers. Backpropagation Through the Convolutional Layer. Filters and Feature Maps. Backpropagation Through the Pooling Layers. Dropout Layers and Regularization. Batch Normalization. Various Activation Functions. Various

Optimizers. LeNet, AlexNet, VGG16, ResNet. Transfer Learning with Image Data. Transfer Learning using Inception Oxford VGG Model, Google Inception Model, Microsoft ResNet Model. R-CNN, Fast R-CNN, Faster R-CNN, Mask-RCNN, YOLO

UNIT VI NATURAL LANGUAGE PROCESSING USING RNN **9**

About NLP & its Toolkits. Language Modeling . Vector Space Model (VSM). Continuous Bag of Words (CBOW). Skip-Gram Model for Word Embedding. Part of Speech (PoS) Global Co- occurrence Statistics–based Word Vectors. Transfer Learning. Word2Vec. Global Vectors for Word Representation GloVe. Backpropagation Through Time. Bidirectional RNNs (BRNN) . Long Short Term Memory (LSTM). Bi-directional LSTM. Sequence-to-Sequence Models (Seq2Seq). Gated recurrent unit GRU.

UNIT V DEEP REINFORCEMENT & UNSUPERVISED LEARNING **9**

About Deep Reinforcement Learning. Q-Learning. Deep Q-Network (DQN). Policy Gradient Methods. Actor-Critic Algorithm. About Autoencoding. Convolutional Auto Encoding. Variational Auto Encoding. Generative Adversarial Networks. Autoencoders for Feature Extraction. Auto Encoders for Classification. Denoising Autoencoders. Sparse Autoencoders

Total Hours : 45

REFERENCES:

1. Deep Learning A Practitioner's Approach Josh Patterson and Adam Gibson O'Reilly Media,Inc.2017
2. Learn Keras for Deep Neural Networks, Jojo Moolayil, Apress,2018
3. Deep Learning Projects Using TensorFlow 2, Vinita Silaparasetty, Apress, 2020
4. Deep Learning with Python, FRANÇOIS CHOLLET, MANNING SHELTER ISLAND,2017
5. Pro Deep Learning with TensorFlow, Santanu Pattanayak, Apress,2017.

PROJECT WORK

SEMESTER IV

22MECS391 **PROJECT WORK – PHASE I** **12H-6C**

Instruction Hours/week: L:0 T:0 P:12 **Marks: 100**

PRE- REQUISITES: None

COURSE OBJECTIVES:

- Identification of a real life problem in thrust areas
- Proposing different solutions for the problems based on literature survey
- Developing a mathematical model for solving the above problem
- Finalization of system requirements and specification
- Future trends in providing alternate solutions
- Consolidated report preparation of the above

COURSE OUTCOMES:

Upon completion , the students will be able to:

- Apply and analyze the engineering concepts to solve the identified research work through literature survey and function effectively as an individual to engage in independent learning.
- Identify the list of available engineering tools, and select the tool for implementing the identified research work
- Design systems using hardware components/software tools considering health, safety and societal need and validate the results of the identified work leading to publications
- Explain about professional ethics and meet societal and environmental needs
- Perform in the team, contribute to the team, Communicate effectively through presentation and demonstration of the project and preparation of the report and video
- Apply the principles of project management and finance during the implementation of the project

SEMESTER IV

22MECS491 PROJECT WORK & VIVA VOCE – PHASE II 24H-12C

Instruction Hours/week: L:0 T:0 P:24 Marks:100

COURSE OBJECTIVES:

- The objective of the project work is to enable the students in convenient groups of not more than members on a project involving theoretical and experimental studies related to the branch of study. Every project work shall have a guide who is the member of the faculty of the institution. Twenty four periods per week shall be allotted in the time table and this time shall be utilized by the students to receive the directions from the guide, on library reading, laboratory work, computer analysis or field work as assigned by the guide and also to present in periodical seminars on the progress made in the project.
- Each student shall finally produce a comprehensive report covering background information, literature survey, problem statement, project work details and conclusion. This final report shall be typewritten form as specified in the guidelines.

COURSE OUTCOMES:

Upon completion , the students will be able to:

- Apply and analyze the engineering concepts to solve the identified research work through literature survey and function effectively as an individual to engage in independent learning.
- Identify the list of available engineering tools, and select the tool for implementing the identified research work
- Design systems using hardware components/software tools considering health, safety and societal need and validate the results of the identified work leading to publications
- Explain about professional ethics and meet societal and environmental needs
- Perform in the team, contribute to the team, Communicate effectively through presentation and demonstration of the project and preparation of the report and video
- Apply the principles of project management and finance during the implementation of the project