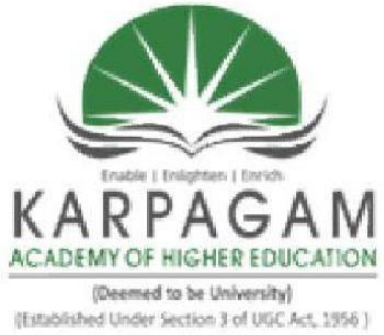
M.E. COMPUTER SCIENCE AND ENGINEERING

SYLLABI 2023-2024

(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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FACULTY OF ENGINEERING

POST–GRADUATE PROGRAMME
REGULAR PROGRAMME
REGULATIONS 2023-2024
(CHOICE BASED CREDIT SYSTEM)

These Regulations are effective from the academic year 2023-2024 and applicable to the students admitted to M. E. / M. Tech. Programmes during the academic year 2023-2024 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 Educationare listed in Table 1.

Table – 1

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

Sl. No.	Name of the Programme
DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING	
1.	M.E Computer Science and Engineering
DEPARTMENT OF CIVIL ENGINEERING	
1.	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

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 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 passedan 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.

Table – 2

M. E. / M.TECH. PROGRAMMES QUALIFICATIONS FOR ADMISSION

S. No.	Degree and branch of study	Qualification for Admission
1.	M.E Computer Science and Engineering	B.E./B. Tech. – Computer Science and Engineering/ Information Technology/ Artificial Intelligence and Data Science/ Cyber Security/ Computer Science and Business System/ Computer Science and Design
2.	M.E Structural Engineering.	B.E./B. Tech. – Civil Engineering
3.	M. E. Power Systems Engineering	B. E./B.Tech. – Electrical and Electronics Engineering / Electronics and Communication Engineering
4.	M.E VLSI Design	B.E/B.Tech. – Electrical and Electronics Engineering / Electronics and Communication Engineering
5.	M.E CAD/CAM Robotics	B.E/B.Tech Mechanical Engineering

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 modeof 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 specifiedbelow.

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 prior approval from 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 during IV semester.

All the students are advised to do their project work within the campus. However, as a specialcase, if a student is able to get a project from a government organization or private or public sector company with a turnover of 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 the 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 resubmitthe 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 patent shall 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 inKarpagam 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 programmes with 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 academicprogramme, 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 classcommittee 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 classcommittee.

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 theManagement, 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 natureand 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 inorder 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 softwareon 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 SEMESTEREXAMINATION (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 scaleddown to 60 marks.

PATTERN OF ESE QUESTION PAPER:

INSTRUCTION	REMARKS
Maximum Marks	100 marks for all Semester Examinations.
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 thecandidate 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.

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**.

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

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, Practicalexamination 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 thecurriculum 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 passedthe 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 becounted 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 Headof the Department and Dean and approved by the Registrar.

16.3.1 Notwithstanding the requirement of mandatory TEN days' notice, applications for withdrawal for special cases under extraordinary conditions will be considered on the meritof 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 oneyear 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 Clause15). 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 ofthe 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 orderthat 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.

M.E. COMPUTER SCIENCE AND ENGINEERING (REGULAR)
COURSE OF STUDY AND SCHEME OF EXAMINATIONS
(2023 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										
23MECC101	Applied Mathematics	HS	3	1	0	4	40	60	100	**1**
23MECS102	Advanced Data Structures and Algorithms	PC	3	1	0	4	40	60	100	**3**
23MECS103	Object Oriented System Engineering	PC	3	0	0	3	40	60	100	**5**
23MECS104	Advanced Data Base Technology	PC	3	1	0	4	40	60	100	**7**
23MECS105	Network Technologies	PC	3	0	0	3	40	60	100	**9**
23MECS111	Advanced Data Structures Laboratory	PC	0	0	4	2	40	60	100	**11**
23MECS112	Advanced Data base Technology Laboratory	PC	0	0	4	2	40	60	100	**12**
SEMESTER TOTAL			**15**	**3**	**8**	**22**	**280**	**420**	**700**	
SEMESTER II										
23MECS201	Internet of Things	PC	3	0	0	3	40	60	100	**14**
23MECS202	Machine Learning	PC	3	0	0	3	40	60	100	**16**
23MECS203	Advanced Software Engineering	PC	3	0	0	3	40	60	100	**18**

23MECS2EXX	Professional Elective I	PE	3	0	0	3	40	60	100	**26-36**
23MECS2EXX	Professional Elective II	PE	3	0	0	3	40	60	100	**39-48**
23MECS211	Machine Learning Laboratory	PC	0	0	4	2	40	60	100	**20**
23MECS212	Software Engineering Laboratory	PC	0	0	4	2	40	60	100	**22**
SEMESTER TOTAL			**15**	**0**	**8**	**19**	**280**	**420**	**700**	
SEMESTER III										
23MECS301	Research Methodology and IPR	MC	3	0	0	3	40	60	100	**23**
23MECS3EXX	Professional Elective III	PE	3	0	0	3	40	60	100	**50-60**
23MECS3EXX	Professional Elective IV	PE	3	0	0	3	40	60	100	**62-72**
23MECS3EXX	Professional Elective V	PE	3	0	0	3	40	60	100	**74-82**
23MECS391	Project Work Phase I	PW	0	0	12	6	40	60	100	**106**
SEMESTER TOTAL			**12**	**0**	**12**	**18**	**200**	**300**	**500**	
SEMESTER IV										
23MECS491	Project Work and viva voce Phase II	PW	0	0	24	12	40	60	100	**107**
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)	Maximum Marks			Page No.
			L	T	P		CIA	ESE	TOTAL	
Professional Electives I										
23MECS2E01	Advanced Operating System	PE	3	0	0	3	40	60	100	**26**
23MECS2E02	Agile Technologies	PE	3	0	0	3	40	60	100	**28**
23MECS2E03	Foundations of Data Science	PE	3	0	0	3	40	60	100	**30**
23MECS2E04	Information Retrieval Techniques	PE	3	0	0	3	40	60	100	**32**
23MECS2E05	UX/UI Design	PE	3	0	0	3	40	60	100	**34**
23MECS2E06	Neural Networks and Deep Learning	PE	3	0	0	3	40	60	100	**36**
Professional Elective II										
23MECS2E07	Network and Information Security	PE	3	0	0	3	40	60	100	**38**
23MECS2E08	Performance Analysis of Computer Systems	PE	3	0	0	3	40	60	100	**40**
23MECS2E09	Social Networks Analysis	PE	3	0	0	3	40	60	100	**42**
23MECS2E10	High performance Computing for Bigdata	PE	3	0	0	3	40	60	100	**44**
23MECS2E11	Robotic process Automation	PE	3	0	0	3	40	60	100	**46**
23MECS2E12	Social Network Security	PE	3	0	0	3	40	60	100	**48**

Professional Elective III										
23MECS3E01	Web Analytics	PE	3	0	0	3	40	60	100	**50**
23MECS3E02	Big Data Mining and Analytics	PE	3	0	0	3	40	60	100	**52**
23MECS3E03	Data Visualization Techniques	PE	3	0	0	3	40	60	100	**54**
23MECS3E04	Optimizations For Machine Learning	PE	3	0	0	3	40	60	100	**56**
23MECS3E05	Multicore Architecture and Programming	PE	3	0	0	3	40	60	100	**58**
23MECS3E06	Performance Analysis of Computer Systems	PE	3	0	0	3	40	60	100	**60**
Professional Elective IV										
23MECS3E07	Robotics	PE	3	0	0	3	40	60	100	**62**
23MECS3E08	Natural Language Processing	PE	3	0	0	3	40	60	100	**64**
23MECS3E09	GPU Computing	PE	3	0	0	3	40	60	100	**66**
23MECS3E10	Devops and Microservices	PE	3	0	0	3	40	60	100	**68**
23MECS3E11	Autonomous Systems	PE	3	0	0	3	40	60	100	**70**
23MECS3E12	Image Processing and Analysis	PE	3	0	0	3	40	60	100	**72**
Professional Elective V										
23MECS3E13	Bio informatics	PE	3	0	0	3	40	60	100	**74**
23MECS3E14	Full Stack Web Application Development	PE	3	0	0	3	40	60	100	**76**
23MECS3E15	Software Quality Assurance	PE	3	0	0	3	40	60	100	**78**
23MECS3E16	Deep Learning	PE	3	0	0	3	40	60	100	**80**
23MECS3E17	Speech Processing and Synthesis	PE	3	0	0	3	40	60	100	**82**

M.E. COMPUTER SCIENCE AND ENGINEERING **2023-2024**

SEMESTER-I

23MECC101 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 for the students is to

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

COURSE OUTCOMES

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

- Make use of vector spaces and linear transformations associated with engineeringapplications.
- Solve transportation problem 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.

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 – Assignmentproblem.

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 : 45

REFERENCES

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.
5. Howard Anton Elementary Linear Algebra John Wiley & Sons, New Delhi. 2010.
6. David C Lay, Linear Algebra and Its Applications Pearson Education, New Delhi. 2009.
7. Douglas. B. West Introduction to Graph theory Prentice Hall of India Pvt Ltd.,New Delhi,2018.

23MECS102 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

The goal of this course for the students is to

- Provide an in-depth knowledge in problem solving techniques and data structures.
- Insight knowledge in Heaps.
- Emphasis on adapting non linear data structure.
- Efficiently implement the different multimedia data structures.
- Infer solutions for specific problems.

COURSE OUTCOMES

Upon completion of this course the students will be able to

- Demonstrate asymptotic notations for solving computing problems.
- Apply heap data structure to solve a real world application.
- Build AVL tree data structures to solve computing problems.
- Illustrate R-trees for solving multimedia applications.
- Express randomized algorithm for problem solving.

UNIT – I 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 II 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 III HEAP STRUCTURES 9

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

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 : 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++, University Press 2007.
6. E. Horowitz, S. Sahni and S. Rajasekaran, Computer Algorithms/C++, University Press, 2007.

23MECS103 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

The goal of this course for the students is to

- Have a thorough knowledge of process models, analysis and system design engineering.
- Outline an overview of classical paradigm.
- Know about the implementation of Object oriented system engineering.
- Deploy the concepts of deployment and maintenance.
- Test the software against its requirements specification.

COURSE OUTCOMES

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

- Analyze project organization and management steps.
- Infer the advantages of various Software Development Lifecycle Models.
- Construct the analysis patterns on dynamic Models.
- Illustrate architectural styles and design patterns for project development.
- Identify the testing approaches and maintenance in system design.

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 : 45

REFERENCES

1. Bernd Bruegge, Alan H Dutoit, Object-Oriented Software Engineering, Pearson Education, 2010.
2. Craig Larman, Applying UML and Patterns , Pearson Education, 2015.
3. Stephen Schach ,Software Engineering , McGraw-Hill, 2011.
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.

23MECS104 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

The goal of this course for the students :is to

- Understand the fundamental elements of relational database management systems.
- Learn the basic concepts of relational data model, entity-relationshipmodel, relational database design, relational algebra and SQL.
- Summarize query processing in a distributed database system.
- Infer the basics of XML and create well-formed and valid XML documents.
- Distinguish the different types of NoSQL databases.

COURSE OUTCOMES

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

- Apply Entity relationship model for various real time problems.
- Illustrate distributed database architecture and open database connectivity.
- Illustrate XML schema and XML query.
- Apply NoSQL databases, including schema design, indexing and data modeling.
- Solve the Database security and privacy issues using access control methods.

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 ARCHITECTURE 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 andDatabases – 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 : 45

REFERENCES

1. R. Elmasri, S.B. Navathe, "Fundamentals of Database Systems", Seventh Edition, Pearson Education 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, Apress publishers, 2015.
6. Thomas Cannolly and Carolyn Begg, "Database Systems, A Practical Approach to Design, Implementation and Management", Sixth Edition, Pearson Education, 2015.

23MECS105 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

The goal of this course for the students is to

- Understand the basic concepts of networks.
- Explore various technologies in the wireless domain.
- Study about 4G and 5G cellular networks.
- Learn about Network Function Virtualization.
- Infer the paradigm of Software defined networks.

COURSE OUTCOMES

Upon completion of this course the students will be able to

- Analyze the basic concepts of networks and IP addressing.
- Illustrate various wireless access techniques.
- Compare and contrast 4G and 5G cellular networks.
- Demonstrate different paradigm of Software defined networks.
- Implement concept of network virtualization.

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 : 45

REFERENCES

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

23MECS111 ADVANCED DATA STRUCTURES LABORATORY 4H-2C

Instruction Hours/week: L:0 T:0 P:4 **Marks: Internal:40 External:60 Total:100**
End Semester Exam:3 Hours

COURSE OBJECTIVES

The goal of this course for the students is to

- Become proficient with the fundamental tools of program design using structured problem solving algorithms.
- Develop the ability to design and write programs for implementation of such algorithms.
- Implement iterative and recursive algorithms.
- Design and implement algorithms using hill climbing and dynamicprogramming techniques.
- Implement shared and concurrent objects.

COURSE OUTCOMES

Upon completion of this course the students will be able to

- Summarize various non primitive data types.
- Implement linked list applications.
- Illustrate the differences between recursive and iterative methods.
- Apply algorithms using dynamic programming and recursive backtracking techniques.
- Analyze randomized algorithms.

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 : 45

23MECS111 ADVANCED DATABASE TECHNOLOGY LABORATORY **4H-2C**

Instruction Hours/week: L:0 T:0 P:4 **Marks: Internal:40 External:60 Total:100**
End Semester Exam:3 Hours

COURSE OBJECTIVES

The goal of this course for the students is to

- Provide students with hands-on experience in advanced database technologies such as NoSQL databases, big data systems, and cloud databases.
- Enable students to design and implement complex database systems using advanced database technologies.
- Introduce students to techniques for data analysis, data mining, and data visualization using advanced database technologies.
- Expose students to the latest research and development in database technologies, and encourage them to explore and innovate in this field.
- Enhance students' understanding of database security and privacy issues, and enable them to design secure and privacy-preserving database systems.

COURSE OUTCOMES

Upon completion of this course the students will be able to

- Apply data definition and data manipulation language and its syntaxes.
- Develop solution using distributed database.
- Build relational database using PHP and Python.
- Build XML application using relational data base.
- Make use of MongoDB and DynamoDB to improve the query performance.

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 : 45

23MECS201 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

The goal of this course for the students is to

- Understand the Architectural Overview of IoT.
- Learn the IoT Reference Architecture and Real World Design Constraints.
- Infer the various IoT protocol levels.
- Show the basics of cloud architecture.
- 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

- Analyze various concept of the IoT and their technologies.
- Develop IoT sensors using different hardware platforms.
- Experiment with the various IoT Protocols.
- Illustrate basic principles of cloud computing.
- Build an application using the IoT with raspberry Pi.

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–Sensing Module.

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 : 45

REFERENCES

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

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SEMESTER-II

23MECS202 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 for the students is to

- Understand the concepts and mathematical foundations of machine learning and types of problems tackled by machine learning.
- Explore the different supervised learning techniques including ensemble methods.
- Learn different aspects of unsupervised learning and reinforcement learning.
- Illustrate the role of probabilistic methods for machine learning.
- Express the basic concepts of neural networks and deep learning.

COURSE OUTCOMES

Upon completion of this course the students will be able to

- Analyze the concepts of machine learning and its types.
- Develop the ensemble methods using the supervised learning.
- Experiment Probabilistic Discriminative and Generative algorithms for an application and analyze the results.
- Summarize the sequence model for probabilistic methods for learning.
- Identify the issues in neural networks and deep learning.

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 : 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 and Machine 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, 2019.
6. Shai Shalev-Shwartz and Shai Ben-David, "Understanding Machine Learning: From Theory to Algorithms", 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, 2017 (freely available online)
10. Aurélien Géron , Hands-On Machine Learning with Scikit-Learn and Tensor Flow: Concepts, Tools, and Techniques to Build Intelligent Systems 2nd Edition, o'reilly, (2017)

23MECS203 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

The goal of this course for the students is to

- Understand the rationale for software development process models.
- Conclude why the architectural design of software is important.
- Learn 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.
- Infer the different stages of testing from testing during development of a software system.

COURSE OUTCOMES

Upon completion of this course the students will be able to

- Summarize the prescriptive process models and scenario based modeling.
- Construct the design model using the design concepts.
- Develop the system security using the security requirements.
- Illustrate the importance of having a good Software Architecture.
- Outline the various levels of Software testing.

UNIT I SOFTWARE PROCESS & MODELING 9

Prescriptive Process Models – Agility and Process – Scrum – XP – Kanban – DevOps – Prototype Construction – 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 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 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 : 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

SEMESTER-II

23MECS211 MACHINE LEARNING LABORATORY **4H-2C**

Instruction Hours/week: L:0 T:0 P:4 **Marks: Internal:40 External:60 Total:100**

End Semester Exam:3 Hours

COURSE OBJECTIVES

The goal of this course for the students is to

- Understand the concepts and mathematical foundations of machine learning and types ofproblems tackled by machine learning.
- Explore the different supervised learning techniques including ensemble methods.
- Learn different aspects of unsupervised learning and reinforcement learning.
- Infer the role of probabilistic methods for machine learning.
- Illustrate the basic concepts of neural networks and deep learning.

COURSE OUTCOMES

Upon completion of this course the students will be able to

- Develop a model using linear regression.
- Summarize binary classification model for solving problems and determine the effectiveness.
- Apply Nearest Neighbors for classification.
- Analyze between training set and validation set results.
- Build k-means and Naïve Bayes Classifier algorithm for problem solving.

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 and apply 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 of pre-defined projects.
    2. You are free to use any third-party ideas or code that you wish as long as it is publicly available.
    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 software you will need to write, and papers (2-3) you plan toread.

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 : 45

SEMESTER-II

23MECS212 SOFTWARE ENGINEERING LABORATORY 4H-2C

Instruction Hours/week: L:0 T:0 P:4 **Marks: Internal:40 External:60 Total:100**

End Semester Exam:3 Hours

COURSE OBJECTIVES

The goal of this course for the students is to

- To impart state-of-the-art knowledge on Software Engineering and UML in an interactive manner 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.
- Understand the basic notions of a web service, web service standards, and service-oriented architecture.
- Infer the different stages of testing from testing during development of a software system

COURSE OUTCOMES

Upon completion of this course the students will be able to

- Outline the requirements and use cases the client wants for the software beingProduced.
- Develop project plan with assessments of the project, the schedule, available resources.
- Build project plan with risk management can model and specify the requirements of mid-range software and their architecture.
- Infer 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 assessmentmethods.

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 software development
6. Develop data Designs using DFD Decision Table & ER Diagram.
7. Draw class diagram, sequence diagram, Collaboration Diagram, State Transition Diagram for 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.

Total : 45

SEMESTER-III

23MECS301 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

The goal of this course for the students is to

- Study the research methodology and pedagogy.
- Enable the students to get involved in research activities.
- Understand the data collection for research.
- Do data analysis for report writing.
- Infer the objectives and benefits of patent filing.

COURSE OUTCOMES

Upon completion of this course the students will be able to

- Analyze qualitative research process and surveys.
- Outline the sampling methods and data preparation process in research.
- Summarize the process of Multivariate analysis.
- Describe the concept of IPR, types and future.
- Illustrate the objectives and benefits of patent and E-filing.

UNIT I RESEARCH DESIGN 9

Overview of research process and design, Use of Secondary and exploratory data to answer the research 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 : 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

23MECS2E01 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

The goal of this course for the students is to

- Understand the design and implementation of modern operating systems.
- Learn the key concepts of distributed systems, including distributed algorithms, consistency, and fault tolerance.
- Infer the principles of virtualization and containerization.
- Illustrate the concepts of resource management and scheduling in operating systems.
- Implement the concepts of file systems, storage management, and caching.

COURSE OUTCOMES

Upon completion of this course the students will be able to

- Describe the working of Theoretical Foundations of OS.
- Illustrate the working principles of Distributed Deadlock Detection and resource management.
- Analyze the concepts of distributed shared memory and scheduling mechanisms.
- Summarize the working of Data security.
- Compare multiprocessor operating systems and database operating systems.

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 check pointing and recovery – check pointing 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 distributed systems.

UNIT- MULTIPROCESSOR AND DATABASE OPERATING SYSTEM 9

Multiprocessor operating systems - basic multiprocessor system architectures – interconnection networks 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 : 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, 2014.
4. Andrew S.Tanenbaum, "Distributed operating system", Pearson education, 2017.

SEMESTER-II

23MECS2E02 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

COURSE OBJECTIVES

The goal of this course for the students is to

- Learn the fundamental principles and practices associated with each of the agile development methods
- Apply the principles and practices of agile software development on a project of interest and relevance to the student.
- Provide a good understanding of software design and a set of software technologies and APIs.
- Do a detailed examination and demonstration of Agile development and testing techniques.
- Understand Agile development and testing.

COURSE OUTCOMES

Upon completion of this course the students will be able to

- Analyze software engineering principles involved in building large software programs and process of requirements specification and requirements validation.
- Illustrate system models for design patterns.
- Identify the importance of software maintenance and complexities involved in software evolution.
- Apply estimation techniques, schedule project activities and compute pricing.
- Apply agile practices and plan for agility for agile software development.

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 : 45

REFERENCES

1. Robert C. Martin ,Agile Software Development, Principles, Patterns, and Practices Alan Apt Series (2022).
2. “Succeeding with Agile : Software Development Using Scrum”, Pearson (2019).
3. David J. Anderson and Eli Schragenheim, “Agile Management for Software Engineering: Applying the Theory of Constraints for Business Results, Prentice Hall, 2016.
4. Hazza and Dubinsky, “Agile Software Engineering, Series: Undergraduate Topics in Computer Science, Springer, 2020.
5. Craig Larman, “Agile and Iterative Development: A Managers Guide, Addison-Wesley,2021.
6. Kevin C. Desouza, “Agile Information Systems: Conceptualization, Construction, and Management, Butterworth-Heinemann, 2011.

SEMESTER-II

23MECS2E03 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:

The goal of this course for the students is to

- Understand fundamental algorithms to process data.
- Apply hypotheses and data into actionable predictions.
- Document and transfer the results and effectively communicate the findings usingvisualization techniques.
- Infer statistical methods and machine learning algorithms required for Data Science.
- Develop the fundamental knowledge and understand concepts to become a data science professional.

COURSE OUTCOMES

Upon completion of this course the students will be able to

- Apply data visualization in big-data analytics.
- Build EDA, inference and regression techniques.
- Analyze Matrix decomposition techniques to perform data analysis.
- Apply data pre-processing techniques to a social media applications.
- Apply Basic Machine Learning Algorithms to perform data visualization.

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 DISTRIBUTED FILE SYSTEM **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 : 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.

SEMESTER-II

23MECS2E04 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

The goal of this course for the students is to

- Understand the basics concepts of information retrieval process.
- Infer machine learning models.
- Learn pattern matching using indexing methods.
- Get an understandingof machine learning techniques for text classification and clustering.
- Understand the concepts of digital libraries.

COURSE OUTCOMES

- Illustrate Boolean retrieval and retrieval evaluation process in IR systems.
- Use different retrieval models, such as Boolean, vector space, and probabilistic models, to search and rank relevant documents.
- Compare the sequential searching and pattern matching methods in IR systems.
- Apply traditional effectiveness measures in the parallel information retrieval systems.
- 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 : 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.

SEMESTER-II

23MECS2E05 UI AND UX DESIGN 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 for the students is to

- Provide a sound knowledge in UI & UX.
- Understand the need for UI and UX design principles and patterns.
- Understand the various Research Methods used in Design.
- Explore the various Tools used in UI & UX.
- Create a wireframe and prototype.

COURSE OUTCOMES

On completion of the course, the students will be able to

- Develop the Brain storming and game storming in UI and UX Design.
- Analyze the Interaction Behaviors and Principles in UI Design.
- Summarize the UX design process and its Methodologies.
- Outline the synthesizing test findings in the UI design.
- Identify the appropriate research methods available in the UI design phase.

UNIT I FOUNDATIONS OF DESIGN 9

UI vs. UX Design - Core Stages of Design Thinking - Divergent and Convergent Thinking - Brainstorming and Game storming - Observational Empathy

UNIT II FOUNDATIONS OF UI DESIGN 9

Visual and UI Principles - UI Elements and Patterns - Interaction Behaviors and Principles – Branding Style Guides

UNIT III FOUNDATIONS OF UX DESIGN 9

Introduction to User Experience - Why You Should Care about User Experience - Understanding User Experience -Defining the UX Design Process and its Methodology - Research in User Experience Design - Tools and Method used for Research - User Needs and its Goals - Know about Business Goals

UNIT IV WIREFRAMING, PROTOTYPING AND TESTING 9

Sketching Principles - Sketching Red Routes - Responsive Design – Wireframing - Creating Wireflows- Building a Prototype - Building High-Fidelity Mockups - Designing Efficiently with Tools- Interaction Patterns – Conducting Usability Tests - Other Evaluative User Research Methods - Synthesizing Test Findings - Prototype Iteration

UNIT V RESEARCH, DESIGNING, IDEATING, & INFORMATION ARCHITECTURE 9

Identifying and Writing Problem Statements - Identifying Appropriate Research Methods - Creating Personas - Solution Ideation - Creating User Stories - Creating Scenarios - Flow Diagrams - Flow Mapping - Information Architecture

Total: 45

REFERENCES

1. Joel Marsh, “UX for Beginners”, O’Reilly , 2022.
2. Jon Yablonski, “Laws of UX using Psychology to Design Better Product & Services” O’Reilly 2021.
3. Jenifer Tidwell, Charles Brewer, Aynne Valencia, “Designing Interface” 3 rd Edition , O’Reilly 2020 Steve Schoger, Adam Wathan “Refactoring UI”, 2018.
4. Steve Krug, “Don't Make Me Think, Revisited: A Commonsense Approach to Web &Mobile”, Third Edition, 2015.

SEMESTER-II

23MECS2E06 NEURAL NETWORKS AND 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

The goal of this course for the students is

- Understand the basics in deep neural networks.
- Learn the basics of associative memory and unsupervised learning networks.
- Apply CNN architectures of deep neural networks.
- Analyze the key computations underlying deep learning, then use them to build and train deep neural networks for various tasks.
- Illustrate auto encoders and generative models for suitable applications.

COURSE OUTCOMES

- Apply artificial Neural Network for image Processing.
- Illustrate bidirectional Associative Memory concepts used in the Deep Learning.
- Apply CNN and its variants for suitable applications.
- Analyze the key computations underlying deep learning and use them to build and train deep neural networks for various tasks.
- Infer auto encoders and generative models for real time applications.

UNIT I INTRODUCTION 9

Neural Networks-Application Scope of Neural Networks-Artificial Neural Network: An Introduction- Evolution of Neural Networks-Basic Models of Artificial Neural Network- Important Terminologies of ANNs-Supervised Learning Network.

UNIT II ASSOCIATIVE MEMORY AND UNSUPERVISED LEARNING NETWORKS 9

Training Algorithms for Pattern Association-Auto associative Memory Network-Hetero associative Memory Network-Bidirectional Associative Memory (BAM)-Hopfield Networks-Iterative Auto associative Memory Networks-Temporal Associative Memory Network-Fixed Weight Competitive Nets-Kohonen Self-Organizing Feature Maps-Learning Vector Quantization-Counter propagation Networks-Adaptive Resonance Theory Network.

UNIT III THIRD-GENERATION NEURAL NETWORKS 9

Spiking Neural Networks-Convolutional Neural Networks-Deep Learning Neural Networks-Extreme Learning Machine Model-Convolutional Neural Networks: The Convolution Operation – Motivation – Pooling – Variants of the basic Convolution Function – Structured Outputs – Data Types – Efficient Convolution Algorithms – Neuro scientific Basis – Applications: Computer Vision, Image Generation,Image Compression.

UNIT IV DEEP FEED FORWARD NETWORKS 9

History of Deep Learning- A Probabilistic Theory of Deep Learning- Gradient Learning – Chain Ruleand Backpropagation - Regularization: Dataset Augmentation – Noise Robustness -Early Stopping, Bagging and Dropout - batch normalization- VC Dimension and Neural Nets.

UNIT V RECURRENT NEURAL NETWORKS 9

Recurrent Neural Networks: Introduction – Recursive Neural Networks – Bidirectional RNNs – Deep Recurrent Networks – Applications: Image Generation, Image Compression, Natural Language Processing. Complete Auto encoder, Regularized Autoencoder, Stochastic Encoders and Decoders, Contractive Encoders.

Total: 45

REFERENCES

1. Ian Goodfellow, Yoshua Bengio, Aaron Courville, "Deep Learning", MIT Press, 2016.
2. Francois Chollet, "Deep Learning with Python", Second Edition, Manning Publications,2021.
3. Aurélien Géron, "Hands-On Machine Learning with Scikit-Learn and Tensor Flow", Oreilly, 2018.
4. Josh Patterson, Adam Gibson, "Deep Learning: A Practitioner's Approach", O'Reilly Media, 2017.
5. Charu C. Aggarwal, "Neural Networks and Deep Learning: A Textbook", Springer International Publishing, 1st Edition, 2018.
6. Learn Keras for Deep Neural Networks, Jojo Moolayil, Apress,2018
7. Deep Learning Projects Using Tensor Flow 2, Vinita Silaparasetty, Apress, 2020.
8. Deep Learning with Python, FRANÇOIS CHOLLET, MANNING SHELTER ISLAND,2017.
9. S Rajasekaran, G A Vijayalakshmi Pai, "Neural Networks, FuzzyLogic and Genetic Algorithm, Synthesis and Applications", PHI Learning, 2017.
10. Pro Deep Learning with Tensor Flow, Santanu Pattanayak, Apress,2017.
11. James A Freeman, David M S Kapura, "Neural Networks Algorithms, Applications, and Programming Techniques", Addison Wesley, 2003.

SEMESTER-II

23MECS2E07 NETWORK ANDINFORMATION 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

The goal of this course for the students is to

- Understand the principles of encryption algorithms; conventional and public key cryptography.
- Have a detailed knowledge about authentication, hash functions and application level security mechanisms.
- Infer the methods of conventional encryption.
- Analyze the concepts of public key encryption and number theory.
- Learn the network security tools and applications.

COURSE OUTCOMES

Upon completion of this course the students will be able to

- Analyze conventional and modern encryption algorithms.
- Apply RSA encryption algorithm to an application**.**
- Compare different authentication protocols.
- Outline the importance of Electronic mail security.
- Describe the process involved system security

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 :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.

SEMESTER-II

23MECS2E08 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

The goal of this course for the students is to

- Understand the mathematical foundations needed for performance evaluationof computer systems.
- Learn the metrics used for performance evaluation.
- Illustrate the analytical modeling of computer systems.
- Enable the students to develop new queuing analysis for both simple and complex systems.
- 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.
- Compare and contrast between Markov chains and simple queues works.
- Apply Little‘e law and other operational laws to open and closed systems.
- Implement M/G/1 Queue and the Inspection Paradox to model real world systems.
- Develop analytical techniques for evaluating scheduling policies.

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 : 45

REFERENCES

1. K. S. Trivedi, “Probability and Statistics with Reliability, Queueing and Computer Science Applications‖, John Wiley and Sons, 2020.
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 for ExperimentalDesign, 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

23MECS2E09 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

The goal of this course for the students is to

- Understand the components of the social network.
- Model and visualize the social network.
- Mine the users in the social network.
- Infer the evolution of the social network.
- Analyze the interest of the user in opinion mining.

COURSE OUTCOMES

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

- Analyze the key concepts in network analysis.
- Implement Visualization techniques to a social network application.
- Infer community detection and mining process.
- Outline Algorithms and Systems for Expert Location in Social Networks.
- Illustrate the text mining process in social networks.

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 : 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

23MECS2E10 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

The goal of this course for the students is to

- Learn the fundamental concepts of High Performance Computing.
- Understand the network & software infrastructure for high performance computing.
- Analyze real time analytics using high performance computing.
- Examine the different ways of security perspectives and technologies used in HPC.
- Create awareness on 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 performancecomputing.
- Describe 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.

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 – operational analytics – 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 : 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.

SEMESTER-II

23MECS2E11 ROBOTIC PROCESS AUTOMATION 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 for the students is to

- Understand the basic concepts of Robotic Process Automation.
- Expose to the key RPA design and development strategies and methodologies.
- Learn the fundamental RPA logic and structure.
- Explore the Exception Handling, Debugging and Logging operations in RPA.
- Learn to deploy and Maintain the software bot.

COURSE OUTCOMES

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

- Analyze the basics of RPA technology, its history, and its application in business processes.
- Apply the kknowledge of the tools and platforms used for building RPA bots and automation workflows.
- Develop RPA bots using industry-standard development methodologies and practices.
- Implement common RPA use cases and best practices to handle exceptions.
- Evaluate business processes for automation potential and develop automation strategies.

UNIT I INTRODUCTION TO ROBOTIC PROCESS AUTOMATION 9

Emergence of Robotic Process Automation (RPA), Evolution of RPA, Differentiating RPA from Automation - Benefits of RPA - Application areas of RPA, Components of RPA, RPA Platforms. Robotic Process Automation Tools - Templates, User Interface, Domains in Activities, Workflow Files.

UNIT II AUTOMATION PROCESS ACTIVITIES 9

Sequence, Flowchart & Control Flow: Sequencing the Workflow, Activities, Flowchart, Control Flow for Decision making. Data Manipulation: Variables, Collection, Arguments, Data Table, Clipboard management, File operations Controls: Finding the control, waiting for a control, Act on a control, Ui Explorer, Handling Events.

UNIT III APP INTEGRATION, RECORDING AND SCRAPING 9

App Integration, Recording, Scraping, Selector, Workflow Activities. Recording mouse and keyboardactions to perform operation, Scraping data from website and writing to CSV. Process Mining.

UNIT IV EXCEPTION HANDLING AND CODE MANAGEMENT **9**

Exception handling, Common exceptions, Logging- Debugging techniques, Collecting crash dumps, Error reporting. Code management and maintenance: Project organization, Nesting workflows, Reusability, Templates, Commenting techniques, State Machine.

UNIT V DEPLOYMENT AND MAINTENANCE **9**

Publishing using publish utility, Orchestration Server, Control bots, Orchestration Server to deploy bots, License management, Publishing and managing updates. RPA Vendors - Open Source RPA, Future of RPA.

Total : 45

REFERENCES

1. Learning Robotic Process Automation: Create Software robots and automate business processes with the leading RPA tool - UiPath by Alok Mani Tripathi, Packt Publishing, 2018.
2. Tom Taulli , "The Robotic Process Automation Handbook: A Guide to Implementing RPA Systems", Apress publications, 2020.
3. Frank Casale (Author), Rebecca Dilla (Author), Heidi Jaynes (Author), Lauren Livingston (Author), Introduction to Robotic Process Automation: a Primer, Institute of Robotic Process Automation, Amazon Asia-Pacific Holdings Private Limited, 2018.
4. Richard Murdoch, Robotic Process Automation: Guide To Building Software Robots, Automate Repetitive Tasks & Become An RPA Consultant, Amazon Asia-Pacific Holdings Private Limited, 2018.
5. A Gerardus Blokdyk, "Robotic Process Automation RPA A Complete Guide ", 2020.

SEMESTER-II

23MECS2E12 SOCIAL NETWORK 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

The goal of this course for the students is to

- Develop semantic web related simple applications.
- Infer Privacy and Security issues in Social Networking.
- Explain the data extraction and mining of social networks.
- Discuss the prediction of human behavior in social communities.
- Describe the Access Control, Privacy and Security management of social networks.

COURSE OUTCOMES

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

- Build semantic web related simple applications.
- Develop strategies for securing social media accounts and protecting personal information from cyber threats.
- Illustrate data extraction and mining of social networking medium.
- Discuss the prediction of human behavior in social communities.
- Describe the applications of social networks.

UNIT I FUNDAMENTALS OF SOCIAL NETWORKING 9

Introduction to Semantic Web, Limitations of current Web, Development of Semantic Web, Emergence of the Social Web, Social Network analysis, Development of Social Network Analysis, Key concepts and measures in network analysis, Historical overview of privacy and security, Major paradigms, for understanding privacy and security.

UNIT II SECURITY ISSUES IN SOCIAL NETWORKS 9

The evolution of privacy and security concerns with networked technologies, Contextual influences on privacy attitudes and behaviors, Anonymity in a networked world.

UNIT III EXTRACTION AND MINING IN SOCIAL NETWORKING DATA 9

Extracting evolution of Web Community from a Series of Web Archive, Detecting communities in social networks, Definition of community, Evaluating communities, Methods for community detection and mining, Applications of community mining algorithms, Tools for detecting communities social network infrastructures and communities, Big data and Privacy.

UNIT IV PREDICTING HUMAN BEHAVIOR AND PRIVACY ISSUES 9

Understanding and predicting human behavior for social communities, User data Management, Inference and Distribution, Enabling new human experiences, Reality mining, Context, Awareness,Privacy in online social networks,What is Neo4j, Nodes, Relationships, Properties.

UNIT V ACCESS CONTROL, PRIVACY AND IDENTITY MANAGEMENT 9

Understand the access control requirements for Social Network, Enforcing Access Control Strategies, Authentication and Authorization, Roles-based Access Control, Host, storage and network access control options, Firewalls, Authentication, and Authorization in Social Network, Identity & Access Management, Single Sign-on, Identity Federation, Identity providers and service consumers, The role of Identity provisioning.

Total : 45

REFERENCES

1. Peter Mika, Social Networks and the Semantic Web, First Edition, Springer 2007.
2. BorkoFurht, Handbook of Social Network Technologies and Application, First Edition, Springer, 2010.
3. David Easley, Jon Kleinberg, Networks, Crowds, and Markets: Reasoning about a Highly Connected World‖, First Edition, Cambridge University Press, 2010.
4. Easley D. Kleinberg J., Networks, Crowds, and Markets – Reasoning about a Highly Connected World‖, Cambridge University Press, 2010.
5. Jackson, Matthew O., Social and Economic Networks‖, Princeton University Press, 2008.
6. GuandongXu ,Yanchun Zhang and Lin Li, ―Web Mining and Social Networking – Techniques and applications‖, First Edition, Springer, 2011.
7. Dion Goh and Schubert Foo, Social information Retrieval Systems: Emerging Technologies and Applications for Searching the Web Effectively‖, IGI Global Snippet, 2008.

SEMESTER-III

23MECS3E01 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

The goal of this course for the students is to

- Understand the Web analytics platform, and their evolution.
- Learn various Data collection techniques.
- Analyze benefits of surveys and capturing of data
- Infer Common metrics of web as well as KPI related concepts.
- Illustrate about the various Web analytics versions.

COURSE OUTCOMES

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

- Summarize the fundamentals of web analytics, including key concepts, terminology, and metrics.
- Organize set up and configure web analytics tools, such as Google Analytics or Adobe Analytics.
- Interpret web analytics data and use it to make data-driven decisions.
- Outline the role of web analytics in digital marketing and e-commerce.
- Describe how to use web analytics to track and measure the success of online campaigns and initiatives.

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 : 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 and Sons, 2002.

SEMESTER-III

23MECS3E02 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

The goal of this course for the students is to

- Understand the computational approaches to Modeling, Feature Extraction.
- Analyze the need and application of Map Reduce.
- Infer the various search algorithms applicable to Big Data.
- Analyze and interpret streaming data.
- Identify large data sets and learn the variousclustering techniques applicable to Big Data.

COURSE OUTCOMES

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

- Analyze the fundamentals of big data and its characteristics.
- Summarize techniques for data preprocessing and feature selection for big data analysis.
- Illustrate the differences between supervised, unsupervised, and reinforcement learning approaches.
- Implement popular big data mining and analytics tools, such as Apache Spark and Hadoop.
- Infer the ways to use machine learning algorithms for big data classification, clustering, and association rule mining.

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 : 45

REFERENCES

1. Jure Leskovec, Anand Rajaraman, Jeffrey David Ullman, "Mining of MassiveDatasets", Cambridge University Press, 3rd Edition, 2020.
2. Jiawei Han, Micheline Kamber, Jian Pei, "Data Mining Concepts andTechniques", Morgan Kaufman 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, Heikki Mannila and Padhraic Smyth, "Principles of Data Mining", MIT PRESS,2001.
5. https://swayam.gov.in/nd2_arp19_ap60/preview.
6. https://nptel.ac.in/content/storage2/nptel_data3/html/mhrd/ict/text/106104189/lec1.pdf.
7. https://examupdates.in/big-data-analytics/.
8. https://www.tutorialspoint.com/big_data_analytics/index.htm.
9. https://www.tutorialspoint.com/data_mining/index.htm.

SEMESTER-III

23MECS3E03 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

The goal of this course for the students is to

- Inculcate skills to both design and critique visualizations.
- Introduce visual perception and core skills for visual analysis.
- Understand technological advancements of data visualization.
- Learn various data visualization techniques.
- Analyze the methodologies used to visualize large data sets.

COURSE OUTCOMES

Upon completion of this course the students will be able to

- Apply data visualization to a defined data set.
- Summarize the Visualization stages and visual variables.
- Apply the visualization techniques in physical sciences, computer science, applied mathematics and medical sciences.
- Build visualization techniques to built-in framework.
- Identify appropriate data visualization techniques given particular requirements imposed by the data.

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 : 45

REFERENCES

1. Matthew Ward, Georges Grinstein and Daniel Keim, “Interactive Data Visualization Foundations, Techniques, Applications”, 2020.
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, 2014.

SEMESTER-III

23MECS3E04 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 for the students :is to

- Recognize classes of optimization problems in machine learning and related disciplines.
- Understand the mathematical underpinnings of optimization methods via examples drawn from machine learning, computer vision, engineering, and data analysis.
- Learn foundational optimization ideas including gradient descent, stochastic gradient methods, higher-order methods, and more advanced optimization algorithms.
- Classify optimization problems by their tractability, difficulty, and compatibility with existing software.
- 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.
- Summarize optimization techniques and numerical methods of optimization.
- Outline fundamentals of optimization methods and apply different techniques to solve various optimization problems arising from machine learning.
- Illustrate Optimization Methods for co variance relations.
- Discuss about Parallel and Distributed Optimization Algorithms and applications.

UNIT I INTRODUCTION 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 OPTIMIZATION METHODS : STOCHASTIC AND ONLINE VARIANTS 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 ADVANCED OPTIMIZATION TECHNIQUES 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 ROBUST OPTIMIZATION TECHNIQUES **9**

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

UNIT V ADVANCED MODELS **9**

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

Total : 45

REFERENCES

1. Suvrit Sra, Sebastian Nowozin, and Stephen J. Wright, "Optimization for Machine Learning", MIT Press, First Edition,2013.
2. Stephen Boyd and Lieven Vandenberghe, "Convex Optimization", Cambridge UniversityPress, First Edition2009.
3. Nocedal. J and Wright. S.J," Numerical Optimization", Springer Publishers, First Edition, 2006.
4. SébastienBubeck, "Convex Optimization: Algorithms and Complexity", Now Publishers Inc, FirstEdition,2015.
5. Cong Fang, Huan Li, and Zhouchen Lin, "Accelerated Optimization for Machine Learning",Springer Publishers, First Edition, 2020.

SEMESTER-III

23MECS3E05 MULTICORE ARCHITECTURE AND PROGRAMMING 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 for the students is to

- Understand the need for multi-core processors, and their architecture.
- Infer the challenges in parallel and multithreaded programming.
- Learn about the various parallel programming paradigms,
- Develop multicore programs and design parallel solutions.
- Illustrate about the various parallel programming paradigms and solutions.

COURSE OUTCOMES

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

- Describe multicore architectures and identify their characteristics and challenges.
- Identify the issues in programming Parallel Processors.
- Solve programs using OpenMP and MPI.
- Design parallel programming solutions to common problems.
- Compare programming for serial processors and programming for parallel processors.

UNIT I MULTI-CORE PROCESSORS 9

Single core to Multi-core architectures – SIMD and MIMD systems – Interconnection networks – Symmetric and Distributed Shared Memory Architectures – Cache coherence – Performance Issues – Parallel program design.

UNIT II PARALLEL PROGRAM CHALLENGES 9

Performance – Scalability – Synchronization and data sharing – Data races – Synchronization primitives (mutexes, locks, semaphores, barriers) – deadlocks and livelocks – communication between threads (condition variables, signals, message queues and pipes).

UNIT III SHARED MEMORY PROGRAMMING WITH OPENMP 9

OpenMP Execution Model – Memory Model – OpenMP Directives – Work-sharing Constructs – Library functions – Handling Data and Functional Parallelism – Handling Loops – Performance Considerations.

UNIT IV DISTRIBUTED MEMORY PROGRAMMING WITH MPI **9**

MPI program execution – MPI constructs – libraries – MPI send and receive – Point-to-point and Collective communication – MPI derived datatypes – Performance evaluation.

UNIT V PARALLEL PROGRAM DEVELOPMENT **9**

Case studies – n-Body solvers – Tree Search – OpenMP and MPI implementations and comparison.

Total : 45

REFERENCES

1. Peter S. Pacheco, "An Introduction to Parallel Programming, Morgan-Kauffman/Elsevier, 2021.
2. Darryl Gove, "Multicore Application Programming for Windows, Linux, and Oracle Solaris, Pearson, 2011.
3. Michael J Quinn, "Parallel programming in C with MPI and OpenMP, Tata McGraw Hill,2018.
4. Victor Alessandrini, Shared Memory Application Programming, 1st Edition, Concepts and Strategies in Multicore Application Programming, Morgan Kaufmann, 2015.
5. Yan Solihin, Fundamentals of Parallel Multicore Architecture, CRC Press, 2015
6. https://www.academia.edu/43941059/MULTI_CORE_ARCHITECTURES_AND_PROGRAMMING
7. https://www.utas.edu.au/courses/cse/units/kit308-multicore-architecture-and-programming.

23MECS3E06 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

The goal of this course for the students is to

- Understand the mathematical foundations needed for performance evaluation of computer systems.
- Learn the metrics used for performance evaluation.
- Infer the analytical modeling of computer systems.
- Enable the students to develop new queuing analysis for both simple and complex systems.
- Appreciate the use of smart scheduling and introduce the students to analytical techniques for evaluating scheduling policies.

COURSE OUTCOMES

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

- Identify the need for performance evaluation and the metrics used for it.
- Distinguish between open and closed queuing networks.
- Analyze Little‘e law and other operational laws to multi server.
- Apply the operational laws to open and closed systems.
- Build discrete-time and continuous-time Markov chains to model real world systems.

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 : 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, 1992.
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 for Experimental Design, Measurement, Simulation and Modeling‖, Wiley-Interscience, 1991.
7. https://opencourses.emu.edu.tr/course/view.php?id=16.
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SEMESTER-III

23MECS3E07 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

The goal of this course for the students is to

- Understand the basic principles and concepts of robotics.
- Develop programming skills for controlling robots using software and hardware interfaces.
- Learn how to use mathematical models and algorithms to design and control robot behaviors.
- Infer the applications and limitations of different types of robots
- Learn about the challenges and ethical considerations in the field of robotics.

COURSE OUTCOMES

Upon completion of this course the students will be able to

- Describe the fundamentals of robotics.
- Illustrate the concept of kinematics and dynamics in robotics.
- Discuss robot control techniques.
- Infer basis of intelligence in robotics and task planning.
- Discuss the industrial applications of robotics.

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 : 45

REFERENCES

1. John J. Craig, 'Introduction to Robotics (Mechanics and Control)', Addison-Wesley, 2ndEdition, 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.

23MECS3E08 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

The goal of this course for the students is to

- Understand basics of linguistics, probability and statistics.
- Study statistical approaches to NLP and understand sequence labeling.
- Outline different parsing techniques associated with NLP.
- Explore semantics of words and semantic role labeling of sentences.
- Perform 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.
- Outline the challenges of natural language understanding and processing.
- Apply a sequence labeling problem for a given domain.
- Build semantic processing tasks and simple document indexing and searching system using the concepts of NLP.
- Develop a simple chatbot using dialogue system concepts.

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 : 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

23MECS3E09 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

The goal of this course for the students is to

- Understand the basics of GPU architectures.
- Learn CPU GPU Program Partitioning.
- Write programs for massively parallel processors.
- Analyze the issues in mapping algorithms for GPUs.
- Introduce different GPU programming models.

COURSE OUTCOMES

Upon completion of this course the students will be able to

- Analyze the basics of parallel computing and the use of GPUs for accelerating computations.
- Discuss the CUDA programming language and how to use it to program GPUs.
- Illustrate the architecture of GPUs and how it differs from CPUs.
- Demonstrate how to optimize code for GPU architectures and how to benchmark performance.
- Express the application of GPUs in different domains such as scientific computing, machine learning, and computer graphics.

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 : 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.

SEMESTER-III

23MECS3E10 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

The goal of this course for the students is to

- Learn the basic concepts and terminology of DevOps.
- Gain knowledge on Devops platform.
- Build micro service for an application.
- Familiar with DevOps automation tools.
- Infer basics of MLOps.

COURSE OUTCOMES

Upon completion of this course the students will be able to

- Compare Agile process models and Devops process model.
- Outline the processes of migrating applications to the cloud, managing change, and ensuring smooth operation and support of cloud-based services.
- Apply effective communication and coordination mechanisms between Microservices to ensure the quality and reliability of Microservices..
- Outline benefits and challenges of automating infrastructure provisioning, configuration, and management.
- Apply machine learning, software engineering, and DevOps practices to ensure efficient and reliable deployment of machine learning models in production

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 : 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

SEMESTER-III

23MECS3E11 AUTONOMOUS 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

The goal of this course for the students is to

- Impart knowledge on the functional architecture of autonomous vehicles.
- Infer knowledge on Localization and mapping fundamentals.
- Illustrate knowledge on process end effectors and robotic controls .
- Learn Robot cell design, Robot Transformation and Sensors.
- Understand Micro/Nano Robotic Systems.

COURSE OUTCOMES

Upon completion of this course the students will be able to

- Analyze the fundamental concepts and principles of autonomous systems, including their applications and benefits.
- Discuss the software and hardware components required to build autonomous systems, including sensors, actuators, and communication systems.
- Design solutions for autonomous systems control.
- Analyze Robot Transformations, Sensors and Cell Design.
- Illustrate the working principles of Micro/Nano Robotic system.

UNIT I INTRODUCTION AND FUNCTIONAL ARCHITECTURE 9

Functional architecture - Major functions in an autonomous vehicle system, Motion Modeling - Coordinate frames and transforms, point mass model, Vehicle modeling (kinematic and dynamic bicycle model - two-track models), Sensor Modeling - encoders, inertial sensors, GPS.

UNIT II PERCEPTION FOR AUTONOMOUS SYSTEMS 9

SLAM - Localization and mapping fundamentals, LIDAR and visual SLAM, Navigation – Global path planning, Local path planning, Vehicle control - Control structures, PID control, Linear quadratic regulator, Sample controllers.

UNIT III ROBOTICS INTRODUCTION, END EFFECTORS AND CONTROL 9

Robot anatomy-Definition, law of robotics, Simple problems Specifications of Robot-Speed of Robot-Robot joints and links Robot classifications-Architecture of robotic systems, Mechanical grippers-Slider crank mechanism, Screw type, Rotary actuators, cam type-Magnetic grippers Vacuum grippers-Air operated grippers-Gripper force analysis-Gripper design-Simple problems Robot controls-Point to point control, Continuous path control, Intelligent robot Control system for robot joint-Control actions-Feedback devices-Encoder, Resolver, LVDT Motion Interpolations Adaptive control.

UNIT IV ROBOT TRANSFORMATIONS, SENSORS AND ROBOT CELL DESIGN 9

Robot kinematics-Types- 2D, 3D Transformation-Scaling, Rotation, Translation- Homogeneous coordinates, multiple transformation-Simple problems. Sensors in robot – Touch sensors-Tactile, Robot work cell design and control-Sequence control, Operator interface, Safety monitoring devices in Robot-Mobile robot working principle, actuation using MATLAB, NXT Software.

UNIT V MICRO/NANO ROBOTICS SYSTEM 9

Micro/Nano robotics system overview-Scaling effect-Top down and bottom up approach Actuators of Micro/Nano robotics system-Nano robot communication techniques-Fabrication of micro/nano grippers-Wall climbing micro robot working principles-Biomimetic robot-Swarm robot-Nano robot in targeted drug delivery system.

Total : 45

REFERENCES

1. S.R. Deb, Robotics Technology and flexible automation, Tata McGraw-Hill Education.,2009.
2. Mikell P Groover & Nicholas G Odrey, Mitchel Weiss, Roger N Nagel, Ashish Dutta, Industrial Robotics, Technology programming and Applications, McGraw Hill, 2012.
3. Karsten Berns, Ewald Puttkamer, Springer, Autonomous Land Vehicles: Steps towards Service Robots, 2009.
4. Sebastian Thrun, Wolfram Burgard, Dieter Fox., Probabilistic robotics. MIT Press, 2019.
5. Steven M. LaValle., Planning algorithms, Cambridge University Press, 2006.
6. Daniel Watzenig and Martin Horn (Eds.), Automated Driving: Safer and More Efficient Future Driving, Springer, 2017.
7. Markus Maurer, Autonomous driving: technical, legal and social aspects. Springer, 2016 8. Jha, Theory, Design and Applications of Unmanned Aerial Vehicles, CRC Press, 2016.
8. https://electrical.eng.unimelb.edu.au/study/autonomous-systems-specialisation.
9. https://masterschool.eitdigital.eu/autonomous-systems.

23MECS3E12 IMAGE PROCESSING AND 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

The goal of this course for the students is to

- Understand the image processing concepts and analysis.
- Infer the image processing techniques.
- Familiarize the image processing environment and their applications,
- Appreciate the use of image processing in various applications.
- Learn image registration and visualization techniques.

COURSE OUTCOMES

Upon completion of this course the students will be able to

- Summarize the fundamentals of digital image processing and the characteristics of images.
- Analyze image enhancement techniques such as contrast stretching, histogram equalization, and spatial filtering.
- Analyze and process images in the frequency domain using Fourier Transform and other techniques.
- Summarize various image segmentation techniques such as thresholding, region-based segmentation, and clustering.
- Develop proficiency in using image processing software and tools like MATLAB, OpenCV, and ImageJ.

UNIT I IMAGE PROCESSING FUNDAMENTALS 9

Introduction – Elements of visual perception, Steps in Image Processing Systems – Digital Imaging System - Image Acquisition – Sampling and Quantization – Pixel Relationships – File Formats – colour images and models - Image Operations – Arithmetic, logical,statistical and spatial operations.

UNIT II IMAGE ENHANCEMENT AND RESTORATION 9

Image Transforms -Discrete and Fast Fourier Transform and Discrete Cosine Transform, Spatial Domain - Gray level Transformations Histogram Processing Spatial Filtering – Smoothing and Sharpening. Frequency Domain: Filtering in Frequency Domain – Smoothing and Sharpening filters – Homomorphic Filtering., Noise models, Constrained and Unconstrained restoration models.

UNIT III IMAGE SEGMENTATION AND MORPHOLOGY **9**

Detection of Discontinuities – Edge Operators – Edge Linking and Boundary Detection – Thresholding – Region Based Segmentation – Motion Segmentation, Image Morphology: Binary and Gray level morphology operations - Erosion, Dilation, Opening and Closing Operations Distance Transforms- Basic morphological Algorithms. Features – Textures - Boundary representations and Descriptions- Component Labeling – Regional descriptors and Feature Selection Techniques.

UNIT IV IMAGE ANALYSIS AND CLASSIFICATION **9**

Image segmentation- pixel based, edge based, region based segmentation. Active contour models and Level sets for medical image segmentation, Image representation and analysis, Feature extraction and representation, Statistical, Shape, Texture, feature and statistical image classification.

UNIT V IMAGE REGISTRATION AND VISUALIZATION **9**

Rigid body visualization, Principal axis registration, Interactive principal axis registration, Feature based registration, Elastic deformation based registration, Image visualization – 2D display methods, 3D display methods, virtual reality based interactive visualization.

Total : 45

REFERENCES

1. Alasdair McAndrew, ―Introduction to Digital Image Processing with Matlab‖, Cengage Learning, 2011.
2. Anil J Jain, ―Fundamentals of Digital Image Processing‖, PHI, 2006.
3. Kavyan Najarian and Robert Splerstor,‖ Biomedical signals and Image processing‖,CRC – Taylor and Francis, New York, 2006.
4. Rafael C.Gonzalez and Richard E.Woods, ―Digital Image Processing‖, Third Edition, Pearson Education, 2008, New Delhi.
5. S.Sridhar, ―Digital Image Processing‖, Oxford University Press, 2011.

23MECS3E13 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

The goal of this course for the students is to

- Get exposed to the need for Bioinformatics technologies.
- Familiar with the modeling techniques.
- Learn microarray analysis.
- Illustrate Pattern Matching and Visualization.
- Infer about Microarray Analysis.

COURSE OUTCOMES

Upon completion of this course the students will be able to

- Infer different Data formats.
- Build machine learning algorithms for bioinformatics data.
- Develop models for biological data.
- Apply pattern matching techniques to bioinformatics data – protein data genomic data.
- Illustrate micro array technology for genomic expression study.

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 : 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.

23MECS3E14 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

The goal of this course for the students is to

- Develop Type Script Application.
- Build Single Page Application (SPA).
- Able to communicate with a server over the HTTP protocol.
- Learn 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

- Analyze basic programming skills using Javascript.
- Build a front-end web application using Angular.
- Develop modules to organise the Application on server.
- Build RESTful APIs with Node, Express and MongoDB with confidence.
- Illustrate complex, relational data in MongoDB using Mongoose.

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. Event Target 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 : 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

23MECS3E15 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

The goal of this course for the students is to

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

COURSE OUTCOMES

Upon completion of this course the students will be able to

- Analyze the concepts of SQA in software development life cycle.
- Demonstrate their capability to adopt quality standards.
- Illustrate the quality of software products.
- Apply the concepts in preparing the quality plan & documents.
- Develop effective software testing plans and strategies, including test case design, test execution, and test reporting.

UNIT I INTRODUCTION TO SOFTWARE QUALITY & ARCHITECTURE 9

Need for Software quality – Software quality assurance (SQA) – Software quality factors- McCall's quality 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 for software 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 qualitycost model – 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 process standards – Organization of Quality Assurance – Role of management in SQA – SQA unitsand other actors in SQA systems.

Total : 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

23MECS3E16 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

The goal of this course for the students is to

- Develop and Train Deep Neural Networks.
- Apply 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.
- Infer internal structure of LSTM and GRU and the differences between them.
- Ilustrate Auto Encoders for Image Processing.

COURSE OUTCOMES

Upon completion of this course the students will be able to

- Summarize the fundamental principles and concepts of deep learning, including artificial neural networks, convolutional neural networks, and recurrent neural networks.
- Analyze the techniques used in deep learning, such as back propagation, stochastic gradient descent, and regularization.
- Develop deep learning models for various tasks, such as image classification, object detection, and natural language processing.
- Describe fine-tune deep learning models using metrics such as accuracy, precision, and recall.
- Identify the ethical and social implications of deep learning, such as bias, privacy, and accountability.

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. Hyper parameters.

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 : 45

REFERENCES

1. Deep Learning A Practitioner's Approach Josh Patterson and Adam Gibson O'ReillyMedia,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.

SEMESTER-III

23MECS3E17 SPEECH PROCESSING AND SYNTHESIS 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 for the students is to

- Understand the mathematical foundations needed for speech processing.
- Learn the basic concepts and algorithms of speech processing and synthesis.
- Familiarize the students with the various speech signal representation, coding and recognition techniques.
- Appreciate the use of speech processing in current technologies and to expose the students to real world applications of speech processing.

COURSE OUTCOMES

Upon completion of this course the students will be able to

- Identify the various temporal, spectral and cepstral features required for identifying speech units – phoneme, syllable and word.
- Determine and apply Mel-frequency cepstral coefficients for processing all types of signals.
- Illustrate the applications of speech processing and synthesis, such as speech recognition, speech enhancement, and voice-based human-computer interaction.
- Apply speech processing and synthesis tools and software, such as Praat, Festival, and HTS.
- Summarize the ethical and social implications of speech processing and synthesis, such as privacy, security, and bias.

UNIT I FUNDAMENTALS OF SPEECH PROCESSING 9

Introduction – Spoken Language Structure – Phonetics and Phonology – Syllables and Words – Syntax and Semantics – Probability, Statistics and Information Theory – Probability Theory – Estimation Theory – Significance Testing – Information Theory.

UNIT II SPEECH SIGNAL REPRESENTATIONS AND CODING 9

Overview of Digital Signal Processing – Speech Signal Representations – Short time FourierAnalysis – Acoustic Model of Speech Production – Linear Predictive Coding – Cepstral Processing – Formant Frequencies – The Role of Pitch – Speech Coding – LPC Coder.

UNIT III SPEECH RECOGNITION 9

Hidden Markov Models – Definition – Continuous and Discontinuous HMMs – PracticalIssues – Limitations. Acoustic Modeling – Variability in the Speech Signal – Extracting Features – Phonetic Modeling – Adaptive Techniques – Confidence Measures – Other Techniques.

UNIT IV TEXT ANALYSIS **9**

Lexicon – Document Structure Detection – Text Normalization – Linguistic Analysis –Homograph Disambiguation – Morphological Analysis – Letter-to-sound Conversion –Prosody – Generation schematic – Speaking Style – Symbolic Prosody – Duration Assignment – Pitch Generation.

UNIT V SPEECH SYNTHESIS **9**

Attributes – Formant Speech Synthesis – Concatenative Speech Synthesis – Prosodic Modification of Speech – Source-filter Models for Prosody Modification – Evaluation of TTS Systems.

Total : 45

REFERENCES

1. Joseph Mariani, ―Language and Speech Processing‖, Wiley, 2009.
2. Lawrence Rabiner and Biing-Hwang Juang, ―Fundamentals of Speech Recognition‖, Prentice Hall Signal Processing Series, 1993.
3. Sadaoki Furui, ―Digital Speech Processing: Synthesis, and Recognition, Second Edition, (Signal Processing and Communications)‖, Marcel Dekker, 2000.
4. Thomas F.Quatieri, ―Discrete-Time Speech Signal Processing‖, Pearson Education, 2002.
5. Xuedong Huang, Alex Acero, Hsiao-Wuen Hon, ―Spoken Language Processing – A guide to Theory, Algorithm and System Development‖, Prentice Hall PTR, 2001.

PROJECT WORK

M.E. COMPUTER SCIENCE AND ENGINEERING **2023-2024**

SEMESTER-III

23MECS391 PROJECT WORK PHASE I **12H-6C**

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

COURSE OBJECTIVES

The goal of this course for the students is to

- Identify of a real life problem in thrust areas.
- Propose different solutions for the problems based on literature survey.
- Develop a mathematical model for solving the above problem.
- Finalize of system requirements and specification.
- Know future trends in providing alternate solutions.
- Consolidate 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 identifiedresearch work
- Design systems using hardware components/software tools considering health, safety and societalneed 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 anddemonstration 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

23MECS491 PROJECT WORK AND VIVA VOCE PHASE II **24H-12C**

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

COURSE OBJECTIVES

The goal of this course for the students 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 seminarson the progress made in the project.
- 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