G. Pullaiah College of Engineering and Technology

(Autonomous)

(Approved by AICTE | NAAC Accreditation with 'A' Grade | Accredited by NBA (ECE & EEE) | Affiliated to JNTUA)

Nandikotkur Road, Venkayapalli (V), Kurnool – 518452, Andhra Pradesh

MASTER OF TECHNOLOGY
COMPUTER SCIENCE AND ENGINEERING

ACADEMIC REGULATIONS GPCET – R25

M.Tech Regular Two Year Degree Programme
(for the batches admitted from the academic year 2025-26)

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Academic Regulations of M.Tech. (Full Time/Regular) Programme

(Effective for the students admitted into I year from the Academic Year 2025-26 and onwards)

G.Pullaiah College of Engineering and Technology, Kurnool offers **Two** Years (**Four** Semesters) full-time Master of Technology (M.Tech.) Degree programme, under Choice Based Credit System (CBCS) in different branches of Engineering and Technology with different specializations.

The G.Pullaiah College of Engineering and Technology, Kurnool shall confer M. Tech. degree on candidates who are admitted to the programme and fulfill all the requirements for the award of the degree.

1. **Award of the M.Tech. Degree**

   A student will be declared eligible for the award of the M.Tech. degree if he/she fulfills the following:

   1.1 Pursues a course of study for not less than two academic years and not more than four academic years.

   1.2 Registers for 75 credits and secures all 75 credits.

2. Students, who fail to fulfill all the academic requirements for the award of the degree within four academic years from the year of their admission, shall forfeit their seat in M.Tech. course and their admission stands cancelled.

3. **Programme of Study:**

   The following M.Tech specialization is currently offered under the Department of Computer Science and Engineering.

S.No.	Discipline	Name of the Specialization	Code
01	Computer Science and Engineering	Computer Science & Engineering	58

4. **Eligibility for Admissions:**

   4.1 Admission to the M. Tech Program shall be made subject to the eligibility, qualification and specialization prescribed by the A.P. State Government/University from time to time.

   4.2 Admissions shall be made either on the basis of either the merit rank or Percentile obtained by the qualified student in the relevant qualifying GATE Examination/ the merit rank obtained by the qualified student in an entrance test conducted by A.P. State Government (APPGECET) for M.Tech programmes an entrance test conducted by University/on the basis of any other exams approved by the University, subject to reservations as laid down by the Govt. from time to time.

5. **Programme related terms:**

   5.1 ***Credit:*** A unit by which the course work is measured. It determines the number of hours of instructions required per week. One credit is equivalent to one hour of teaching (Lecture/Tutorial) or two hours of practical work/field work per week.

Credit definition:

1 Hr. Lecture (L) per week	1 credit
1 Hr. Tutorial (T) per week	1 credit
1 Hr. Practical (P) per week	0.5 credit

5.2 ***Academic Year:*** Two consecutive (one odd + one even) semesters constitute one academic year.

5.3 ***Choice Based Credit System (CBCS):*** The CBCS provides choice for students to select from the prescribed courses.

6. Programme Pattern:

6.1 Total duration of the of M.Tech. programme is two academic years

6.2 Each academic year of study is divided into two semesters.

6.3 Each Semester shall be of 22 weeks duration (inclusive of Examinations), with a minimum of 90 instructional days per semester.

6.4 The student shall not take more than four academic years to fulfill all the academic requirements for the award of M.Tech. degree from the date of commencement of first year first semester, failing which the student shall forfeit the seat in M.Tech. programme.

6.5 The medium of instruction of the programme (including examinations and project reports) will be in English only.

6.6 All subjects/courses offered for the M.Tech. degree programme are broadly classified as follows:

S.No.	Broad Course Classification	Course Category	Description
1.	Core Courses	Foundational & Professional Core Courses (PC)	Includes subjects related to the parent discipline/department/branch of Engineering
2.	Elective Courses	Professional Elective Courses (PE)	Includes elective subjects related to the parent discipline/department/ branch of Engineering
		Open Elective Courses (OE)	Elective subjects which include inter-disciplinary subjects or subjects in an area outside the parent discipline which are of importance in the context of special skill development
3.	Mandatory Course	Quantum Technology and Application	To understand importance of latest technologies, research and process of creation of patents through research
		Research methodology & IPR	
4.		Skill Enhancement courses (SE)	Interdisciplinary / job-oriented/domain courses which are relevant to the industry
		Comprehensive Viva	To test the overall domain knowledge
		Short Term Industry Internship	To provide real time exposure
		Dissertation	To provide application of domain knowledge to solve real problems
5.	Audit Courses	Mandatory non credit courses	Covering subjects of developing desired attitude among the learners.

6.7 The college shall take measures to implement Virtual Labs (https://www.vlab.co.in) which provide remote access to labs in various disciplines of Engineering and will help student in learning basic and advanced concept through remote experimentation. Student shall be made to work on virtual lab experiments during the regular labs.

6.8 A faculty advisor/mentor shall be assigned to each specialization to advise students on the programme, its Course Structure and Curriculum, Choice of Courses, based on his competence, progress, pre-requisites and interest.

6.9 Preferably 25% course work for the theory courses in every semester shall be conducted in the blended mode of learning.

7. Attendance Requirements:

7.1 A student shall be eligible to appear for the University external examinations if he/she acquires i) a minimum of 50% attendance in each course and ii) 75% of attendance in aggregate of all the courses.

7.2 Condonation of shortage of attendance in aggregate up to 10% (65% and above and below 75%) in each semester may be granted by the College Academic Committee.

7.3 Condonation of shortage of attendance shall be granted only on genuine and valid reasons on representation by the candidate with supporting evidence

7.4 Students whose shortage of attendance is not condoned in any semester are not eligible to take their end examination of that class.

7.5 A stipulated fee shall be payable towards condonation of shortage of attendance.

7.6 A student will not be promoted to the next semester unless he satisfies the attendance requirements of the present semester. They may seek re-admission into that semester when offered next.

7.7 If any candidate fulfils the attendance requirement in the present semester, he shall not be eligible for readmission into the same class.

7.8 If the learning is carried out in blended mode (both offline & online), then the total attendance of the student shall be calculated considering the offline and online attendance of the student.

8. Evaluation – Distribution and Weightage of Marks:

The performance of a student in each semester shall be evaluated subject - wise (irrespective of credits assigned), for a maximum of 100 marks for theory and 100 marks for practical, based on Internal Evaluation and End Semester Examination.

8.1 There shall be five units in each of the theory subjects. For the theory subjects 60 marks will be for the End Examination and 40 marks will be for Internal Evaluation.

8.2 Two Internal Examinations shall be conducted for 30 marks each, one in the middle of the Semester and the other immediately after the completion of instruction period. The other 10 marks is awarded for continuous assessment in the form of assignments, quizzes, open book examination, presentation, etc. First mid examination shall be conducted for I & II units of the syllabus and second mid examination for III, IV & V units. Each mid exam shall be conducted for a total duration of 120 minutes with 3 questions (without choice) and each question carries 10 marks. Final Internal marks for a total of 40 marks shall be arrived at by considering the marks secured by the student in both the internal examinations with 80% weightage to the better internal exam and 20% to the other.

8.3 The following pattern shall be followed in the End Examination:

i. Five questions shall be set from each of the five units with either/or type for 12 marks each.

ii. All the questions have to be answered compulsorily.

iii. Each question may consist of one, two or more bits.

8.4 For practical subjects, 60 marks shall be for the End Semester Examinations and 40 marks will be for internal evaluation based on the day-to-day performance.

The internal evaluation based on the day-to-day work-10 marks, record- 10 marks and the remaining 20 marks to be awarded by conducting an internal laboratory test. The end examination shall be conducted by the examiners, with a breakup mark of Procedure-10, Experimentation-25, Results-10, Viva- voce-15.

8.5 There shall be Mandatory **Audit courses** in I & II semesters for zero credits. There is no external examination for audit courses. However, attendance shall be considered while calculating aggregate attendance and student shall be declared to have passed the mandatory course only when he/she secures 50% or more in the internal examinations. In case, the student fails, a re- examination shall be conducted for failed candidates for 40 marks for every six months/semester satisfying the conditions mentioned in item 1 & 2 of the regulations.

8.6 A candidate shall be deemed to have secured the minimum academic requirement in a subject if he secures a minimum of 40% of marks in the End Examination and a minimum aggregate of 50% of the total marks in the End Semester Examination and Internal Evaluation taken together.

8.7 In case the candidate does not secure the minimum academic requirement in any of the subjects he/she has to reappear for the Semester Examination either supplementary or regular in that subject or repeat the course when next offered or do any other specified subject as may be required.

8.8 The laboratory records and mid semester test papers shall be preserved for a minimum of 3 years in the respective institutions as per the University norms and shall be produced to the Committees of the University as and when the same are asked for.

9. Credit Transfer Policy

As per University Grants Commission (Credit Framework for Online Learning Courses through SWAYAM) Regulation, 2016, the University shall allow up to a maximum of 40% of the Professional and Open Electives in a semester through SWAYAM/SWAYAM Plus.

9.1 The University shall offer credit mobility for MOOCs and give the equivalent credit weightage to the students for the credits earned through online learning courses through SWAYAM platform.

9.2 The online learning courses available on the SWAYAM platform will be considered for credit transfer. SWAYAM course credits are as specified in the platform

9.3 Student registration for the MOOCs shall be only through the institution, it is mandatory for the student to share necessary information with the institution

9.4 The institution shall select the courses to be permitted for credit transfer through SWAYAM. However, while selecting courses in the online platform institution would essentially avoid the courses offered through the curriculum in the offline mode.

9.5 The institution shall notify at the beginning of semester the list of the online learning courses eligible for credit transfer in the forthcoming Semester.

9.6 Students may register for an 8-week (2 credits) or 12-week (3 credits) SWAYAM / SWAYAM plus course with the approval of the Head of the Department (HoD).

9.7 Examination fees, if applicable, shall be borne by the student. Pass marks and grading will be as per the GPCET academic regulations.

9.8 A student must get minimum 40% marks for assignments and quizzes on the SWAYAM/ SWAYAM plus platform to be eligible for the end-semester examination. The students who are unable to get minimum internal marks in SWAYAM/ SWAYAM plus platform, they have to re-register for the course in subsequent semester through SWAYAM/ SWAYAM plus platform.

9.9 The end-semester exam may be conducted by the National Testing Agency (NTA), the National Programme on Technology Enhanced Learning (NPTEL) or the University during the regular end-term exams. Evaluation shall comprise 60% weightage for the end-semester examination and 40% for assignments and quizzes conducted by the SWAYAM/ SWAYAM plus course coordinator. The student has to get 50% marks for internal and external with minimum of 40% marks in the external examination to declare them as pass.

9.10 The institution shall also ensure that the student has to complete the course and produce the course completion certificate as per the academic schedule given for the regular courses in that semester. However, the credits will be transferred to the students who got minimum 50% marks with 40% marks in the external examination

9.11 The institution shall designate a faculty member as a Mentor for each course to guide the students from registration till completion of the credit course.

9.12 The university shall ensure no overlap of SWAYAM MOOC exams with that of the university examination schedule. In case of delay in SWAYAM results, the university will re-issue the marks sheet for such students.

9.13 Student pursuing courses under MOOCs shall acquire the required credits only after successful completion of the course and submitting a certificate issued by the competent authority along with the minimum 50% of marks and grades.

9.14 The institution shall submit the following to the examination section of the university:

a) List of students who have passed MOOC courses in the current semester along with the certificates of completion.

b) Undertaking form filled by the students for credit transfer.

9.15 The university shall resolve any issues that may arise in the implementation of this policy from time to time and shall review its credit transfer policy in the light of periodic changes brought by UGC, SWAYAM, NPTEL and state government.

Note: Students shall also be permitted to register for MOOCs offered through online platforms other than SWAYAM NPTEL. In such cases, credit transfer shall be permitted only after seeking approval of the University at least three months prior to the commencement of the semester.

10. Re-registration for Improvement of Internal Evaluation Marks:

A candidate shall be given one chance to re-register for each subject provided the internal marks secured by a candidate are less than 50% and has failed in the end examination

10.1 The candidate should have completed the course work and obtained examinations results for **I, II and III** semesters.

10.2 The candidate should have passed all the subjects for which the Internal Evaluation marks secured are more than 50%.

10.3 Out of the subjects the candidate has failed in the examination due to Internal Evaluation marks secured being less than 50%, the candidate shall be given one chance for each Theory subject and for a maximum of **three** Theory subjects for Improvement of Internal evaluation marks.

10.4 The candidate has to re-register for the chosen subjects and fulfill the academic requirements.

10.5 For reregistration the candidates have to apply to the University through the college by paying the requisite fees and get approval from the University before the start of the semester in which re-registration is required

10.6 In the event of availing the Improvement of Internal evaluation marks, the internal evaluation

marks as well as the End Examinations marks secured in the previous attempt(s) for the reregistered subjects stand cancelled.

11. Evaluation of Project/Dissertation Work:

The Project work shall be initiated at the beginning of the III Semester and the duration of the Project is of two semesters. Evaluation of Project work is for 300 marks with 200 marks for internal evaluation and 100 marks for external evaluation. Progress of the project work is monitored through three reviews:

- Project review – I at the beginning of the III semester for zero marks
- Project review – II at the end of the third semester for 100 marks
- Project review – III before submission of the thesis i.e., end of the IV semesters for 100 marks

External evaluation of final Project work viva voce in IV semester shall be for 100 marks.

A Project Review Committee (PRC) shall be constituted with the Head of the Department as Chairperson, Project Supervisor and one faculty member of the department offering the M.Tech. programme.

11.1 A candidate is permitted to register for the Project Work in III Semester after satisfying the attendance requirement in all the subjects, both theory and laboratory (in I & II semesters).

11.2 A candidate is permitted to submit Project dissertation with the approval of PRC. The candidate has to pass all the theory, practical and other courses before submission of the Thesis.

11.3 Project work shall be carried out under the supervision of teacher in the parent department concerned.

11.4 A candidate shall be permitted to work on the project in an industry/research organization on the recommendation of the Head of the Department. In such cases, one of the teachers from the department concerned would be the internal guide and an expert from the industry/ research organization concerned shall act as co-supervisor/ external guide. It is mandatory for the candidate to make full disclosure of all data/results on which they wish to base their dissertation. They cannot claim confidentiality simply because it would come into conflict with the Industry's or R&D laboratory's own interests. A certificate from the external supervisor is to be included in the dissertation.

11.5 Continuous assessment of Project Work - I and Project Work – II in III & IV semesters respectively will be monitored by the PRC.

11.6 The candidate shall submit status report by giving seminars in three different phases (two in III semester and one in IV semester) during the project work period. These seminar reports must be approved by the PRC before submission of the Project Thesis.

11.7 After registration, a candidate must present in Project Review - I, in consultation with his Project Supervisor, the title, objective and plan of action of his Project work to the PRC for approval within four weeks from the commencement of III Semester. Only after obtaining the approval of the PRC can the student initiate the project work.

11.8 The Project Review - II in III semester carries internal marks of 100. Evaluation should be done by the PRC for 50 marks and the Supervisor will evaluate the work for the other 50 marks. The Supervisor and PRC will examine the Problem Definition, Objectives, Scope of Work, Literature Survey in the same domain and progress of the Project Work.

11.9 A candidate has to secure a minimum of 50% of marks to be declared successful in Project Review - II. Only after successful completion of Project Review – II, candidate shall be

permitted for Project Work Review – III in IV Semester. The unsuccessful students in Project Review - II shall reappear after three months.

11.10 The Project Review - III in IV semester carries 100 internal marks. Evaluation should be done by the PRC for 50 marks and the Supervisor will evaluate it for the other 50 marks. The PRC will examine the overall progress of the Project Work and decide whether or not eligible for final submission. A candidate has to secure a minimum of 50% of marks to be declared successful in Project Review - III. If student fails to obtain the required minimum marks, he/she has to reappear for Project Review - III after a month.

11.11 For the approval of PRC the candidate shall submit the draft copy of dissertation to the Head of the Department and make an oral presentation before the PRC.

11.12 After approval from the PRC, the student is permitted to submit a report. The dissertation report will be accepted only when the plagiarism is within 30% checked through Turnitin software (repository mode). The plagiarism report shall be submitted along with the dissertation report.

11.13 Research paper related to the Project Work shall be published in an SCI/ESCI/Scopus/UGC Care listed journal, or in conference proceedings with ISBN number organized by professional societies such as IEEE, IEI, etc.

11.14 After successful plagiarism check and publication of research paper, three copies of the dissertation certified by the supervisor and HOD shall be submitted to the College.

11.15 The dissertation shall be adjudicated by an external examiner selected by the University. For this, the Principal of the College shall submit a panel of three examiners as submitted by the supervisor concerned and department head for each student. However, the dissertation will be adjudicated by one examiner nominated by the University.

11.16 If the report of the examiner is not satisfactory, the candidate shall revise and resubmit the dissertation, in the time frame as decided by the PRC. If report of the examiner is unfavorable again, the thesis shall be summarily rejected. The candidate has to reregister for the project and complete the project within the stipulated time after taking the approval from the University

11.17 If the report of the examiner is satisfactory, the Head of the Department shall coordinate and make arrangements for the conduct of Project Viva voce exam.

11.18 The Project Viva voce examinations shall be conducted by a board consisting of the Supervisor, Head of the Department and the external examiner who has adjudicated the dissertation. For Dissertation Evaluation (Viva voce) in IV Sem. there are external marks of 100 and it is evaluated by external examiner. The candidate has to secure a minimum of 50% marks in Viva voce exam.

11.19 If he fails to fulfill the requirements as specified, he will reappear for the Project Viva voce examination only after three months. In the reappeared examination also, if he fails to fulfill the requirements, he will not be eligible for the award of the degree.

12. Industry Internships:

Industry internship either onsite or virtual with a minimum of 06-08 weeks‟ duration, done at the end of Ist year second semester. It shall be completed in collaboration with local industries, Govt. Organizations, construction agencies, Power projects, software MNCs or any industries in the areas of concerned specialization of the PG program. The student shall register for the internship as per course structure after commencement of academic year.

Evaluation of the summer internships shall be through the departmental committee. A student will be required to submit a summer internship report to the concerned department and appear for an oral presentation before the departmental committee comprising of Head of the Department,

Mentor/Supervisor of the internship and a senior faculty member of the department. A certificate of successful completion from industry shall be included in the report. Internship will be evaluated for 100 marks with 50 marks for the report evaluated by the mentor and 50 marks for oral presentation. A student should secure minimum 50% of marks for successful completion. In case, if a student fails, he/she shall reappear as and when semester supplementary examinations are conducted by the University.

13. Comprehensive Viva

A Comprehensive Viva shall be conducted after the II Semester examinations for 100 marks by a committee consisting of the Head of the Department, one senior faculty member of the same specialization, and an external subject expert appointed by the University. The student must secure a minimum of 50% marks to be declared as passed

14. Credits for Co-curricular Activities

The credits assigned for co-curricular activities shall be given by the principals of the colleges and the same shall be submitted to the University. A Student should earn 01 credits under the head of co-curricular activities, viz., attending Conference, Scientific Presentations and Other Scholarly Activities.

Following are the guidelines for awarding Credits for Co-curricular Activities

Name of the Activity	Maximum Credits / Activity
Participation in National Level Seminar/ Conference / Workshop /Training programs (related to the specialization of the student)	0.5
Participation in International Level Seminar / Conference / workshop/Training programs held outside India (related to the specialization of the student)	1
Academic Award/Research Award from State Level/National Agencies	0.5
Academic Award/Research Award from International Agencies	1
Research / Review Publication in National Journals (Indexed in Scopus / Web of Science)	0.5
Research / Review Publication in International Journals with Editorial board outside India (Indexed in Scopus / Web of Science)	1

Note:

i) Credit shall be awarded only for the first author. Certificate of attendance and participation in a Conference/Seminar is to be submitted for awarding credit. A minimum participation of five days is required to earn the necessary credits. Alternatively, the student may attend five different one day programs to meet this requirement.

ii) Certificate of attendance and participation in workshops and training programs (Internal or External) is to be submitted for awarding credit. The total duration should be at least one week.

iii) Participation in any activity shall be permitted only once for acquiring required credits under cocurricular activities

15. Grading:

As a measure of the student's performance, a 10-point Absolute Grading System using the following Letter Grades and corresponding percentage of marks shall be followed:

After each course is evaluated for 100 marks, the marks obtained in each course will be converted to a corresponding letter grade as given below, depending on the range in which the marks

obtained by the student fall.

Structure of Grading of Academic Performance

Letter Grade	Marks Range	Grade Point
S	91-100	10
A	81-90	9
B	70-80	8
C	60-69	7
D	55-59	6
E	50-54	5
F	<50	0
Absent	Ab (Absent)	0

i) A student obtaining Grade 'F' or Grade 'Ab' in a subject shall be considered failed and will be required to reappear for that subject when it is offered the next supplementary examination.

ii) For noncredit audit courses, "Satisfactory" or "Unsatisfactory" shall be indicated instead of the letter grade and this will not be counted for the computation of SGPA/CGPA/Percentage.

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

The Semester Grade Point Average (SGPA) is the ratio of sum of the product of the number of credits with the grade points scored by a student in all the courses taken by a student and the sum of the number of credits of all the courses undergone by a student, i.e.,

$$SGPA = \Sigma (C_i \times G_i)/\Sigma C_i$$

where, C_i is the number of credits of the i^{th} subject and G_i is the grade point scored by the student in the i^{th} course.

i) The Cumulative Grade Point Average (CGPA) will be computed in the same manner considering all the courses undergone by a student over all the semesters of a program, i.e.,

$$CGPA = \Sigma (C_i \times S_i)/ \Sigma C_i$$

where "S_i" is the SGPA of the i^{th} semester and C_i is the total number of credits up to that semester.

ii) Both SGPA and CGPA shall be rounded off to 2 decimal points and reported in the transcripts.

iii) While computing the SGPA the subjects in which the student is awarded Zero grade points will also be included.

Grade Point: It is a numerical weight allotted to each letter grade on a 10-point scale. Letter Grade: It is an index of the performance of students in a said course. Grades are denoted by letters S, A, B, C, D and F.

16. Award of Class:

After a student has satisfied the requirements prescribed for the completion of the program and is eligible for the award of M. Tech. Degree, he shall be placed in one of the following three classes:

Class Awarded	Percentage of Marks to be secured
First Class with Distinction	>=8
First Class	>= 7 and < 8
Pass Class	>=5 and < 7

17. Exit Policy:

The student shall be permitted to exit with a PG Diploma based on his/her request to the university through the respective institution at the end of first year subject to passing all the courses in first

year.

The University shall resolve any issues that may arise in the implementation of this policy from time to time and shall review the policy in the light of periodic changes brought by UGC, AICTE and State government.

18. Withholding of Results:

If the candidate has any case of in-discipline pending against him/her, the result of the candidate shall be withheld, and he/she will not be allowed/promoted into the next higher semester. The issue of degree is liable to be withheld in such cases.

19. Transitory Regulations

Discontinued, detained, or failed candidates are eligible for readmission as and when the semester is offered after fulfillment of academic regulations. Candidates who have been detained for want of attendance or not fulfilled academic requirements or who have failed after having undergone the course in earlier regulations or have discontinued and wish to continue the course are eligible for admission into the unfinished semester from the date of commencement of class work with the same or equivalent subjects as and when subjects are offered, subject to Section 2 and they will follow the academic regulations into which they are readmitted.

20. General:

20.1 The academic regulations should be read as a whole for purpose of any interpretation.

20.2 Disciplinary action for Malpractice/improper conduct in examinations is appended.

20.3 Where the words "he", "him", "his", occur in the regulations, they include "she", "her", "hers".

20.4 In the case of any doubt or ambiguity in the interpretation of the above rules, the decision of the Vice-Chancellor is final.

20.5 The University may change or amend the academic regulations or syllabi at any time and the changes or amendments shall be made applicable to all the students on rolls with effect from the dates notified by the University.

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RULES FOR

DISCIPLINARY ACTION FOR MALPRACTICES / IMPROPER CONDUCT IN EXAMINATIONS

	Nature of Malpractices/Improper conduct	**Punishment**
	If the candidate:	
1.(a)	Possesses or keeps accessible in examination hall, any paper, note book, programmable calculators, Cell phones, pager, palm computers or any other form of material concerned with or related to the subject of the examination (theory or practical) in which he is appearing but has not made use of (material shall include any marks on the body of the candidate which can be used as an aid in the subject of the examination)	Expulsion from the examination hall and cancellation of the performance in that subject only.

(b)	Gives assistance or guidance or receives it from any other candidate orally or by any other body language methods or communicates through cell phones with any candidate or persons in or outside the exam hall in respect of any matter.	Expulsion from the examination hall and cancellation of the performance in that subject only of all the candidates involved. In case of an outsider, he will be handed over to the police and a case is registered against him.
2.	Has copied in the examination hall from any paper, book, programmable calculators, palm computers or any other form of material relevant to the subject of the examination (theory or practical) in which the candidate is appearing.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted to appear for the remaining examinations of the subjects of that semester/year. The Hall Ticket of the candidate is to be cancelled and sent to the University.
3.	Impersonates any other candidate in connection with the examination.	The candidate who has impersonated shall be expelled from examination hall. The candidate is also debarred for four consecutive semesters from class work and all University examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat. The performance of the original candidate, who has been impersonated, shall be cancelled in all the subjects of the examination (including practical's and project work) already appeared and shall not be allowed to appear for examinations of the remaining subjects of that semester/year. The candidate is also debarred for four consecutive semesters from class work and all University examinations if his involvement is established. Otherwise, the candidate is debarred for two consecutive semesters from class work and all University examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat. If the imposter is an outsider, he will be handed over to the police and a case is registered against him.
4.	Smuggles in the Answer book or additional sheet or takes out or arranges to send out the question paper during the examination or answer book or additional sheet, during or after the examination.	Expulsion from the examination hall and cancellation of performance in that subject and all the other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred for two consecutive semesters from class work and all University examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat.
5.	Uses objectionable, abusive or offensive language in the answer paper or in letters to the examiners or writes to the examiner requesting him to award pass marks.	Cancellation of the performance in that subject only.
6.	Refuses to obey the orders of the Chief Superintendent /Assistant - Superintendent /any	In case of students of the college, they shall be expelled from examination halls and cancellation of

	officer on duty or misbehaves or creates disturbance of any kind in and around the examination hall or organizes a walk out or instigates others to walk out, or threatens the officer-in charge or any person on duty in or outside the examination hall of any injury to his person or to any of his relations whether by words, either spoken or written or by signs or by visible representation, assaults the officer-in-charge, or any person on duty in or outside the examination hall or any of his relations, or indulges in any other act of misconduct or mischief which result in damage to or destruction of property in the examination hall or any part of the College campus or engages in any other act which in the opinion of the officer on duty amounts to use of unfair means or misconduct or has the tendency to disrupt the orderly conduct of the examination.	their performance in that subject and all other subjects the candidate(s) has (have) already appeared and shall not be permitted to appear for the remaining examinations of the subjects of that semester/year. If the candidate physically assaults the invigilator/ officer-in-charge of the Examinations, then the candidate is also debarred and forfeits his/her seat. In case of outsiders, they will be handed over to the police and a police case is registered against them.
7.	Leaves the exam hall taking away answer script or intentionally tears of the script or any part thereof inside or outside the examination hall.	Expulsion from the examination hall and cancellation of performance in that subject and all the other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred for two consecutive semesters from class work and all University examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat.
8.	Possess any lethal weapon or firearm in the examination hall.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred and forfeits the seat.
9.	If student of the college, who is not a candidate for the particular examination or any person not connected with the college indulges in any malpractice or improper conduct mentioned in clause 6 to 8.	Student of the colleges expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred and forfeits the seat. Person(s) who do not belong to the College will be handed over to police and, a police case will be registered against them.
10.	Comes in a drunken condition to the examination hall.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that

		semester/year.
11.	Copying detected on the basis of internal evidence, such as, during valuation or during special scrutiny.	Cancellation of the performance in that subject only or in that subject and all other subjects the candidate has appeared including practical examinations and project work of that semester/year examinations, depending on the recommendation of the committee.
12.	If any malpractice is detected which is not covered in the above clauses 1 to 11 shall be reported to the University for further action to award suitable punishment.	

1. Malpractices identified by squad or special invigilators
2. Punishments to the candidates as per the above guidelines.
3. Punishment for institutions: (if the squad reports that the college is also involved in encouraging malpractices)
4. A show cause notice shall be issued to the college.
5. Impose a suitable fine on the college.
6. Shifting the examination center from the college to another college for a specific period of not less than one year.

Note:

Whenever the performance of a student is cancelled in any subject/subjects due to Malpractice, he has to register for End Examinations in that subject/subjects consequently and has to fulfill all the norms required for the award of Degree.

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G. PULLAIAH COLLEGE OF ENGINEERING AND TECHNOLOGY, KURNOOL (AUTONOMOUS)

M.TECH IN COMPUTER SCIENCE AND ENGINEERING

COURSE STRUCTURE & SYLLABUS

SEMESTER – I

S.No.	Code	Course Name	Category	Hours per week			Credits	Scheme of evaluation Maximum Marks		
				L	T	P		Internal marks	External Marks	Total
1.	**C45801**	Advanced Data Structures & Algorithms	PC	3	0	0	3	40	60	100
2.	**C45802**	Distributed Operating Systems	PC	3	0	0	3	40	60	100
3.	**C45803a** **C45803b** **C45803c**	**Program Elective-I** 1. Advanced Computer Architecture 2. Enterprise Cloud Concepts 3. Applied Machine Learning	PE	3	0	0	3	40	60	100
4.	**C45804a** **C45804b** **C45804c**	**Program Elective-II** 1. Natural Language Processing 2. Smart Sensor Networks & IoT 3. Computing for Data Analytics	PE	3	0	0	3	40	60	100
5.	**C45805**	Advanced Data Structures & Algorithms Lab	PC	0	0	4	2	40	60	100
6.	**C45806**	Distributed Operating Systems Lab	PC	0	0	4	2	40	60	100
7.	**C45807**	Research Methodology and IPR	MC	2	0	0	2	40	60	100
8.	**C45808**	Full stack Development Using MERN	SE	0	1	2	2	40	60	100
9.	**C45809a** **C45809b** **C45809c**	Audit Course – I English for Research Paper Writing Disaster Management Essence of Indian Traditional Knowledge	AC	2	0	0	0	40*	-	40*
Total:				16	1	10	20	320	480	800

***There is no external examination for audit course. Student shall be declared to have passed the mandatory course only when he/she secures 50% or more in the internal examinations.**

G. PULLAIAH COLLEGE OF ENGINEERING AND TECHNOLOGY, KURNOOL (AUTONOMOUS)

M.TECH IN COMPUTER SCIENCE AND ENGINEERING

COURSE STRUCTURE & SYLLABUS

SEMESTER – II

S.No.	Code	Course Name	Category	Hours per week			Credits	Scheme of evaluation Maximum Marks		
				L	T	P		Internal marks	External Marks	Total
1.	**C45810**	Advances in Software Engineering	PC	3	0	0	3	40	60	100
2.	**C45811**	Advanced Databases	PC	3	0	0	3	40	60	100
3.	**C45812a** **C45812b** **C45812c**	**Program Elective – III** 1. Block Chain Technology 2. Advanced Computer Networks 3. Deep Learning and Applications	PE	3	0	0	3	40	60	100
4.	**C45813a** **C45813b** **C45813c**	**Program Elective – IV** 1. Generative AI 2. Digital Forensics 3. Robotic Process Automation	PE	3	0	0	3	40	60	100
5.	**C45814**	Advance in Software Engineering Lab	PC	0	0	4	2	40	60	100
6.	**C45815**	Advanced Databases Lab	PC	0	0	4	2	40	60	100
7.	**C45816**	Quantum Technologies And Applications	MC	2	0	0	2	40	60	100
8.	**C45817**	Comprehensive Viva Voce	PC	0	0	0	2	100	-	100
9.	**C45818**	Audit Course – II	AC	2	0	0	0	40*	-	-
Total				16	0	8	20	380	420	800

***There is no external examination for audit course. Student shall be declared to have passed the mandatory course only when he/she secures 50% or more in the internal examinations.**

G. PULLAIAH COLLEGE OF ENGINEERING AND TECHNOLOGY, KURNOOL (AUTONOMOUS)

M.TECH IN COMPUTER SCIENCE AND ENGINEERING

COURSE STRUCTURE & SYLLABUS

SEMSTER - III

S.No.	Code	Course Name	Category	Hours per week			Credits	Scheme of evaluation Maximum Marks		
				L	T	P		Internal marks	External Marks	Total
1.	**C45819a** **C45819b** **C45819c**	**Program Elective – V** 1. Software Defined Networks 2. Reinforcement Learning 3. Data Science	PE	3	0	0	3	40	60	100
2.	**C45820**	Open Elective-I	OE	3	0	0	3	40	60	100
3.	**C45821**	Dissertation Phase – I	PR	0	0	20	10	100	-	100
4.	**C45822**	Industry Internship		0	0	0	2	100	-	100
5.	**C45823**	Co- Curricular Activities		0	0	0	1	Grade		
Total				6	0	20	19	280	120	400

SEMESTER - IV

S.No.	Course codes	Course Name	Category	Hours per week			Credits	Scheme of Examination		
				L	T	P		Internal	External	Total
1.	**C43824**	Dissertation Phase – II	PR	0	0	32	16	100	100	200
Total							**16**	**100**	**100**	**200**

OPEN ELECTIVE OFFERED TO OTHER DEPARTMENTS

- **Advanced Data Structures & Algorithms**
- **Cloud Computing**

Course Code	ADVANCED DATA STRUCTURES AND ALGORITHMS	L	T	P	C
C45801		3	0	0	3
	Semester	I			

Course Objectives:

The course aims to:

- Introduce fundamental data structures including linked lists, stacks, queues, trees, graphs, dictionaries, and hashing techniques.
- Develop algorithmic skills for designing and analyzing searching, sorting, and traversal methods.
- Teach implementation of priority queues, binary search trees, and balanced trees (AVL, Red-Black, Splay, B-Trees).
- Enable students to select and apply appropriate data structures for solving computational problems efficiently.
- Foster understanding of the performance analysis and comparative evaluation of data structures and algorithms.
-

Course Outcomes (CO): Student will be able to

After completing this course, students will be able to:

CO1: Implement and manipulate linear data structures like singly/doubly linked lists, circular lists, stacks, and queues using dynamic memory allocation.

CO2: Apply and analyze searching and sorting algorithms including linear, binary search, bubble, selection, insertion, quick, and merge sort.

CO3: Design and implement dictionaries and hashing techniques to efficiently store and retrieve data.

CO4: Construct and operate on trees and priority queues, performing insertion, deletion, and traversal operations.

CO5: Compare and implement balanced search trees (AVL, Red-Black, Splay, B-Trees) for optimized data access and storage.

UNIT - I	Introduction	Lecture Hrs:

Introduction to Data Structures, Singly Linked Lists, Doubly Linked Lists, Circular Lists-Algorithms. Stacks and Queues: Algorithm Implementation using Linked Lists.

UNIT - II	Searching and Sorting:	Lecture Hrs:

Linear and Binary Search Methods, Sorting: -Basic sorting techniques, Radix Sort, Bucket Sort, Shell Sort Trees- Binary trees, Properties, Representation and Traversals, Expression Trees (Infix, prefix, postfix). Graphs-Basic Concepts, Storage structures and Traversals.

UNIT - III	Dictionaries and Hashing	Lecture Hrs:

Dictionaries: Definition, Dictionary Abstract Data Type, Implementation of Dictionaries. Hashing: Review of Hashing, Hash Function, Collision Resolution Techniques in Hashing, Separate Chaining, Open Addressing, Linear Probing, Quadratic Probing, Double Hashing, Rehashing, Extendible Hashing

UNIT - IV	Priority queues	Lecture Hrs:

Definition, ADT, Realizing a Priority Queue Using Heaps, Definition, Insertion, Deletion .Search Trees- Binary Search Trees, Definition, ADT, Implementation, Operations-Searching, Insertion, Deletion.

UNIT - V	Search Trees-	Lecture Hrs:

AVL Trees, Definition, Height of AVL Tree, Operations-, Insertion, Deletion and Searching, Introduction to Red-Black and Splay Trees, B-Trees, Height of B-Tree, Insertion, Deletion and Searching, Comparison of Search Trees.

Textbooks:

1. Data Structures: A Pseudo Code Approach, 2/e, Richard F.Gilberg, Behrouz A. Forouzon and Cengage 2. Data Structures, Algorithms and Applications in java, 2/e, SartajSahni, University Press
Reference Books:
1. Data Structures and Algorithm Analysis, 2/e, Mark Allen Weiss, Pearson. 2. Data Structures and Algorithms, 3/e, Adam Drozdek, Cengage 3. C and Data Structures: A Snap Shot Oriented Treatise Using Live Engineering Examples, N.B.Venkateswarulu, E.V.Prasad and S Chand & Co.

Course Code	DISTRIBUTED OPERATING SYSTEMS	L	T	P	C
C45802		3	0	0	3
	Semester	I			

Course Objectives:

- Introduce the architectures, principles, and design issues of distributed, database, and multiprocessor operating systems.
- Develop an understanding of communication, synchronization, deadlock handling, and agreement protocols in distributed environments.
- Explain distributed resource management, shared memory, scheduling, and fault tolerance techniques.
- Provide knowledge of security and protection models, and cryptographic methods for secure distributed computing.
- Explore the structure and design issues of multiprocessor and database operating systems with concurrency control mechanisms.

Course Outcomes (CO): Student will be able to

CO1: Explain the architectures, limitations, and synchronization mechanisms (logical clocks, mutual exclusion) in distributed systems.

CO2: Analyze distributed deadlock detection methods, agreement protocols, and distributed resource management techniques.

CO3: Apply concepts of distributed shared memory, scheduling, and fault-tolerance techniques for reliable system design.

CO4: Evaluate models of protection, access control, and cryptographic algorithms for ensuring data security in distributed systems.

CO5: Compare multiprocessor and database operating systems, and analyze concurrency control algorithms for distributed databases.

UNIT - I		Lecture Hrs:

Architectures of Distributed Systems, System Architecture types, issues in distributed operating systems, communication networks, communication primitives. Theoretical Foundations, inherent limitations of a distributed system, lamp ports logical clocks, vector clocks, casual ordering of messages, global state, cuts of a distributed computation, termination detection.

UNIT - II		Lecture Hrs:

Distributed Mutual Exclusion: The Classification of Mutual Exclusion Algorithms, Non-Token – Based Algorithms: Lamport's Algorithm, The Ricart-Agrawala Algorithm, Maekawa's Algorithm, Token-Based Algorithms: Suzuki-Kasami's Broadcast Algorithm, Singhal'sHeurisric Algorithm, Raymond's Heuristic Algorithm

UNIT - III		Lecture Hrs:

Distributed Deadlock Detection: Preliminaries, Deadlock Handling Strategies in Distributed Systems, Issues in Deadlock Detection and Resolution, Control Organizations for Distributed Deadlock Detection, Centralized- Deadlock – Detection Algorithms, Distributed Deadlock Detection Algorithms, Hierarchical Deadlock Detection Algorithms

UNIT - IV		Lecture Hrs:

Multiprocessor System Architectures: Introduction, Motivation for multiprocessor Systems, Basic Multiprocessor System Architectures Multi Processor Operating Systems: Introduction, Structures of Multiprocessor Operating Systems, Operating Design Issues, Threads, Process Synchronization, Processor Scheduling. Distributed File Systems: Architecture, Mechanisms for Building Distributed File Systems, Design Issues

UNIT - V		Lecture Hrs:

Distributed Scheduling: Issues in Load Distributing, Components of a Load Distributed Algorithm, Stability, Load Distributing Algorithms, Requirements for Load Distributing, Task Migration, Issues in task Migration Distributed Shared Memory: Architecture and Motivation, Algorithms for Implementing DSM, Memory Coherence, Coherence Protocols, Design Issues

Textbooks:

1.Advancedconceptsinoperatingsystems:Distributed,Databaseandmultiprocessoroperating systems",MukeshSinghal, Niranjan andG.Shivaratri,TMH, 2001

2. **Andrew S. Tanenbaum, Maarten Van Steen,** *Distributed Systems: Principles and Paradigms*, Pearson Education, 2nd Edition, 2006.

Reference Books:

1. **Andrew S. Tanenbaum, Maarten Van Steen**, *Distributed Systems: Principles and Paradigms*, Pearson Education, 2nd Edition, 2006.
2. **Silberschatz, Galvin, Gagne**, *Operating System Concepts*, Wiley, 9th Edition, 2018.
3. **M. Mitzenmacher, E. Upfal**, *Probability and Computing: Randomized Algorithms and Probabilistic Analysis*, Cambridge University Press, 2005.
4. **Alan Tucker**, *Applied Combinatorics*, John Wiley & Sons, 5th Edition, 2007.
5. **Nancy A. Lynch**, *Distributed Algorithms*, Morgan Kaufmann, 1996.
6. **George Coulouris, Jean Dollimore, Tim Kindberg, Gordon Blair**, *Distributed Systems: Concepts and Design*, Pearson, 5th Edition, 2011.

Course Code		L	T	P	C
C45803a	**ADVANCED COMPUTER ARCHITECTURE (Program Elective I)**	3	0	0	3
	Semester	I			

Course Objectives:

- To impart the concepts and principles of parallel and advanced computer architectures.
- To develop the design techniques of Scalable and multithreaded Architectures.
- To apply the concepts and techniques of parallel and advanced computer architectures to design modern computer systems

Course Outcomes (CO): Student will be able to

- Analyze various parallel computer models, program partitioning techniques, and system interconnect architectures to evaluate conditions for parallelism.
- Apply performance metrics and scalability analysis to assess parallel processing applications using advanced processor and memory technologies.
- Design and differentiate linear, non-linear, instruction, and arithmetic pipelines to enhance execution performance in modern processors.
- Examine multiprocessor and multicomputer architectures, cache coherence protocols, and synchronization mechanisms for scalable system design.
- Evaluate vector and SIMD processing principles through case studies like CM-5 to identify their effectiveness in solving computationally intensive applications.

UNIT - I	**Micro Processors**	Lecture Hrs:

Theory of Parallelism, Parallel computer models, The State of Computing, Multiprocessors and Multi computers, Multi vector and SIMD Computers, PRAM and VLSI models, Architectural development tracks, Program and network properties, Conditions of parallelism, Program partitioning and Scheduling, Program flow Mechanisms, System interconnect Architectures.

UNIT - II	**Parallel Processing**	Lecture Hrs:

Principles of Scalable performance, Performance metrics and measures, Parallel Processing applications, Speed up performance laws, Scalability Analysis and Approaches, Hardware Technologies, Processes and Memory Hierarchy, Advanced Processor Technology, Superscalar and Vector Processors.

UNIT - III	**Pipeline Processors**	Lecture Hrs:

Shared-Memory Organizations, Sequential and weak consistency models, Pipelining and superscalar techniques, Linear Pipeline Processors, Non-Linear Pipeline Processors, Instruction Pipeline design, Arithmetic pipeline design, superscalar pipeline design.

UNIT - IV	**Architecture of Microprocessors**	Lecture Hrs:

Parallel and Scalable Architectures, Multiprocessors and Multi computers, Multiprocessor system interconnects, cache coherence and synchronization mechanism, Three Generations of Multi computers, Message-passing Mechanisms, Multi vector and SIMD computers.

UNIT - V	**Applications**	Lecture Hrs:

Vector Processing Principles, Multi vector Multiprocessors, Compound Vector processing, SIMD computer Organizations, The connection machine CM-5.

Textbooks:

1. Advanced Computer Architecture, Kai Hwang, 2nd Edition, Tata McGraw Hill Publishers.

Reference Books:

1. Computer Architecture, J.L. Hennessy and D.A. Patterson, 4th Edition, ELSEVIER.
2. Advanced Computer Architectures, S.G.Shiva, Special Indian edition, CRC, Taylor &Francis.
3. Introduction to High Performance Computing for Scientists and Engineers, G. Hager and G.Wellein, CRC Press, Taylor & Francis Group.
4. Advanced Computer Architecture, D. Sima, T. Fountain, P. Kacsuk, Pearson education.
5. Computer Architecture, B. Parhami, Oxford Univ. Press.

Course Code	ENTERPRISE CLOUD CONCEPTS	L	T	P	C
C45803b	(PROGRAM ELECTIVE - III)	3	0	0	3
	Semester	I			

Course Objectives:

Knowledge on significance of cloud computing and its fundamental concepts and models.

Course Outcomes (CO): Student will be able to

1. Understand importance of cloud architecture
2. Illustrating the fundamental concepts of cloud security
3. Analyze various cloud computing mechanisms
4. Understanding the architecture and working of cloud computing.

UNIT - I		Lecture Hrs:

Understanding Cloud Computing: Origins and influences, Basic Concepts and Terminology, Goals and Benefits, Risks and Challenges. Fundamental Concepts and Models: Roles and Boundaries, Cloud Characteristics, Cloud Delivery Models, Cloud Deployment Models.

UNIT - II		Lecture Hrs:

Cloud-Enabling Technology: Broadband Networks and Internet Architecture, Data Center Technology, Virtualization Technology CLOUD COMPUTING MECHANISMS: Cloud Infrastructure Mechanisms: Logical Network Perimeter, Virtual Server, Cloud Storage Device, Cloud Usage Monitor, Resource Replication

UNIT - III		Lecture Hrs:

Cloud Management Mechanisms: Remote Administration System, Resource Management System, SLA Management System, Billing Management System, Case Study Example

Cloud Computing Architecture
Fundamental Cloud Architectures: Workload Distribution Architecture, Resource Pooling Architecture, Dynamic Scalability Architecture, Elastic Resource Capacity Architecture, Service Load Balancing Architecture, Cloud Bursting Architecture, Elastic Disk Provisioning Architecture, Redundant Storage Architecture, Case Study Example

UNIT - IV		Lecture Hrs:

Cloud-Enabled Smart Enterprises Introduction, Revisiting the Enterprise Journey, Service-Oriented Enterprises, Cloud Enterprises, Smart Enterprises, The Enabling Mechanisms of Smart Enterprises Cloud-Inspired Enterprise Transformations Introduction, The Cloud Scheme for Enterprise Success, Elucidating the Evolving Cloud Idea, Implications of the Cloud on Enterprise Strategy, Establishing a Cloud-Incorporated Business Strategy

UNIT - V		Lecture Hrs:

Transitioning to Cloud-Centric Enterprises The Tuning Methodology, Contract Management in the Cloud Cloud-Instigated IT Transformations Introduction, Explaining Cloud Infrastructures, A Briefing on Next-Generation Services, Service Infrastructures, Cloud Infrastructures, Cloud Infrastructure Solutions, Clouds for Business Continuity, The Relevance of Private Clouds, The Emergence of Enterprise Clouds

Textbooks:

1. Erl Thomas, Puttini Ricardo, Mahmood Zaigham, Cloud Computing: Concepts, Technology & Architecture 1st Edition,
2. Pethuru Raj, Cloud Enterprise Architecture, CRC Press

Reference Books:

1. James Bond, The Enterprise Cloud, O'Reilly Media, Inc.

Course Code	APPLIED MACHINE LEARNING	L	T	P	C
C45803c	(Program Elective I)	3	0	0	3
	Semester	I			

Course Objectives:

- To know the fundamental concepts of Machine Learning.
- To understand linear, distance based, and decision tree based models
- To explore tools and practices for Machine learning in Real world situation.
- To know the Artificial Neural Network and Reinforcement Learning.

Course Outcomes (CO): Student will be able to

- Understand the fundamental concepts of machine learning
- Apply linear, distance based, and decision tree based models
- Analyze probabilistic, neural network models
- Design a suitable machine learning model for a given scenario

UNIT - I		Lecture Hrs:

Introduction to Machine Learning: Introduction. Different types of learning, Examples of Machine Learning Applications Supervised Learning: Learning a Class from Examples, Probably Approximately Correct Learning, Learning multiple classes, Model selection and generalization Regression: Linear regression, Multiple Linear regression, Logistic Regression.

UNIT - II		Lecture Hrs:

The ingredients of machine learning: Tasks, Models, Features Binary classification and related tasks: Classification, Assessing classification performance, Visualizing classification performance Beyond binary classification: Multi-class classification, Regression, Unsupervised and descriptive learning

UNIT - III		Lecture Hrs:

Decision Tree learning – Introduction, Decision tree representation, Appropriate problems for decision tree learning, The basic decision tree learning algorithm, Inductive bias in decision tree, Issues in decision tree learning. Linear models: The least-squares method, Multivariate linear regression, The perceptron, Support vector machines, Soft margin SVM, Going beyond linearity with kernel methods.

UNIT - IV		Lecture Hrs:

Distance Based Models: Introduction, Neighbours and exemplars, Nearest Neighbours classification, K-Means algorithms, Clustering around medoids Probabilistic Models: Using Naïve Bayes Model for classification, Expectation Maximization, Gaussian Mixture models

UNIT - V		Lecture Hrs:

Artificial Neural Networks: Introduction, Neural network representation, appropriate problems for neural network learning, Multilayer networks and the back propagation, Advanced topics in Artificial Neural Networks Reinforcement Learning: Introduction, Learning tasks, Q-learning

Textbooks:

1. Machine Learning: The art and Science of algorithms that make sense of data, Peter Flach, Cambridge University Press, 2012
2. Tom M. Mitchell, Machine Learning, India Edition 2013, McGraw Hill Education

Reference Books:

1. AurélienGéron, Hands-On Machine Learning with Scikit-Learn, Keras, and Tensor Flow: Concepts, Tools, and Techniques to Build Intelligent Systems 2nd Edition
2. Stephen Marsland, "Machine Learning – An Algorithmic Perspective", Second Edition, Chapman and Hall/CRC Machine Learning and Pattern Recognition Series, 2014
3. EthemAlpaydın, Introduction to machine learning, second edition, MIT press.
4. T. Hastie, R. Tibshirani and J. Friedman, "Elements of Statistical Learning", Springer Series, 2nd edition

Course Code	NATURAL LANGUAGE PROCESSING	L	T	P	C
C45804a	(Program Elective II)	3	0	0	3
	Semester	I			

Course Objectives:

- Introduce the fundamental concepts of human language, linguistic structures, and their computational representation for Natural Language Processing.
- Develop knowledge of grammars, parsing strategies, semantic interpretation, and language modelling techniques for designing NLP systems.
- Explore advanced NLP applications such as machine translation, multilingual information retrieval, and cross-lingual language processing.

Course Outcomes (CO): Student will be able to

- **Understand linguistic foundations** of English syntax and various levels of language analysis for Natural Language Processing.
- **Apply parsing techniques** such as top-down, bottom-up, ATNs, and feature-based systems for grammatical analysis of natural language.
- **Analyse different grammar formalisms and parsing approaches** to handle language phenomena like movement, ambiguity, and human preferences in parsing.
- **Construct semantic representations** using logical forms, thematic roles, and speech acts, and apply n-gram and statistical models for language modeling.
- **Evaluate and compare machine translation approaches** and demonstrate understanding of systems like Anusaraka for multilingual language processing.
- **Implement and analyze multilingual information retrieval systems**, applying appropriate pre-processing, evaluation metrics, and tools for cross-lingual retrieval.

UNIT - I		Lecture Hrs:

The Study of Language, Applications of NLP, Evaluating Language Understanding Systems, Different Levels of Language Analysis, Representations and Understanding, Organization of Natural language Understanding Systems, Linguistic Background: An outline of English Syntax

UNIT - II		Lecture Hrs:

Grammars and Parsing- Top-Down and Bottom-Up Parsers, Transition Network Grammars, Feature Systems and Augmented Grammars, Morphological Analysis and the Lexicon, Parsing with Features, Augmented Transition Networks, Bayes Rule, Shannon game, Entropy and Cross Entropy

UNIT - III		Lecture Hrs:

Grammars for Natural Language, Movement Phenomenon in Language, Handling questions in Context Free Grammars, Hold Mechanisms in ATNs, Gap Threading, Human Preferences in Parsing, Shift Reduce Parsers, Deterministic Parsers.

UNIT - IV		Lecture Hrs:

Semantic Interpretation: Semantic & Logical form, Word senses & ambiguity, The basic logical form language, Encoding ambiguity in the logical Form, Verbs & States in logical form, Thematic roles, Speech acts &embedded sentences, Defining semantics structure model theory.
Language Modelling: Introduction, n-Gram Models, Language model Evaluation, Parameter Estimation, Language Model Adaption, Types of Language Models, Language-Specific Modelling Problems, Multilingual and Cross lingual Language Modelling.

UNIT - V		Lecture Hrs:

Machine Translation Survey: Introduction, Problems of Machine Translation, Is Machine Translation Possible, Brief History, Possible Approaches, Current Status. Anusaraka or Language Accessor: Background, Cutting the Gordian Knot, The Problem, Structure of Anusaraka System, User Interface, Linguistic Area, Giving up Agreement in Anusarsaka Output, Language Bridges.

Textbooks:

1. James Allen, Natural Language Understanding, 2nd Edition, 2003, Pearson Education.
2. Multilingual Natural Language Processing Applications: From Theory To Practice-Daniel M.Bikel and ImedZitouni, Pearson Publications.

3. Natural Language Processing, Apaninian perspective, AksharBharathi, Vineetchaitanya, Prentice–Hall of India.
Reference Books:
1. Charniack, Eugene, Statistical Language Learning, MIT Press, 1993. 2. Jurafsky,Dan and Martin, James, Speech and Language Processing, 2nd Edition, Prentice Hall, 2008. 3. Manning, Christopher and Henrich, Schutze, Foundations of Statistical Natural Language Processing, MIT Press, 1999.

Course Code	SMART SENSOR NETWORKS & IOT	L	T	P	C
C45804b	(Program Elective II)	3	0	0	3
	Semester	I			

Course Objectives:

- To provide an in-depth understanding of IoT concepts, applications, and research areas in domains such as smart cities, smart health, smart energy, and smart transportation.
- To analyzeIoT system architectures, design constraints, physical devices, communication protocols, and middleware for advanced implementation.
- To explore industrial and commercial IoT applications, including automation, sensor networks, and emerging trends like edge computing, cloud of things, and digital twins.

Course Outcomes (CO): Student will be able to

- Explain the fundamental concepts, applications, and research areas of IoT across various domains.
- AnalyzeIoT reference architectures, functional and deployment views, and real-world design constraints including hardware, technical, and operational limitations.
- Demonstrate practical knowledge of IoT devices, programming, operating systems, communication protocols, network security, and database management.
- Apply IoT principles to industrial automation and enterprise integration using frameworks such as SOCRADES and IMC-AESOP.
- Evaluate case studies in commercial building automation and emerging IoT trends, including edge/fog computing, predictive maintenance, and digital twin technologies.

UNIT - I		Lecture Hrs:

Introduction and Applications: smart transportation, smart cities, smart living, smart energy, smart health, and smart learning. Examples of research areas include for instance: Self-Adaptive Systems, Cyber Physical Systems, Systems of Systems, Software Architectures and Connectors, Software Interoperability, Big Data and Big Data Mining, Privacy and Security IoT Reference Architecture Introduction, Functional View, Information View, Deployment and Operational View, Other Relevant architectural views.

UNIT - II		Lecture Hrs:

Real-World Design Constraints- Introduction, Technical Design constraints, hardware, Data representation and visualization, Interaction and remote control.

UNIT - III		Lecture Hrs:

IOT Physical Devices & Endpoints: What is an IOT Device, Exemplary Device Board, Linux on Raspberry, Interface and Programming & IOT Device. Hardware Platforms and Energy Consumption, Operating Systems, Time Synchronization, Positioning and Localization, Medium Access Control, Topology and Coverage Control, **Routing:** Transport Protocols, Network Security, Middleware, Databases

UNIT - IV		Lecture Hrs:

Industrial Automation-Service-oriented architecture-based device integration, SOCRADES: realizing the enterprise integrated Web of Things, IMC-AESOP: from the Web of Things to the Cloud of Things, Commercial Building Automation-Introduction,

UNIT - V		Lecture Hrs:

Case study: phase one-commercial building automation today.
Case study: phase two commercial building automation in the future. Recent trends in sensor network and IOT architecture, Automation in Industrial aspect of IOT.

Textbooks:

. Mandler, B., Barja, J., MitreCampista, M.E., Cagáová, D., Chaouchi, H., Zeadally, S., Badra, M., Giordano, S., Fazio, M., Somov, A., Vieriu, R.-L., Internet of Things. IoT Infrastructures, Springer International Publication

. Internet of Things: A Hands-On Approach Paperback – 2015, by ArsheepBahga (Author), Vijay Madisetti (Author)
. IoT Fundamentals: Networking Technologies, Protocols and Use Cases for the Internet of Things by Pearson Paperback – 16 Aug 2017 ,by Hanes David (Author), Salgueiro Gonzalo (Author), Grossetete Patrick (Author), Barton Rob (Author).

Course Code	COMPUTING FOR DATA ANALYTICS	L	T	P	C
C45804c	(Program Elective II)	3	0	0	3
	Semester	I			

Course Objectives:

- Provide knowledge of the **data analytics lifecycle**, including business understanding, data science roles, and project deliverables.
- Develop a strong foundation in **statistical methods, probability, and hypothesis testing** for data-driven decision-making.
- Equip students with skills to apply **predictive analytics, regression, time series forecasting, and experimental design techniques** to real-world datasets.

Course Outcomes (CO): Student will be able to

- **Understand the data analytics lifecycle** and identify the roles and responsibilities of data scientists in business analytics projects.
- **Apply statistical techniques** such as measures of central tendency, variation, skewness, and kurtosis for data summarization and interpretation.
- **Analyze probability distributions** (binomial, Poisson, normal, exponential, gamma, etc.) and apply them in modeling uncertain events.
- **Perform hypothesis testing and predictive analytics** using t-tests, chi-square tests, regression, correlation, and multiple correlation methods.
- **Design forecasting models** (moving average, exponential smoothing, seasonal trends) and conduct **design of experiments** (ANOVA, Latin square, factorial design) for analytical problem solving.

UNIT - I	DATA ANALYTICS LIFE CYCLE	Lecture Hrs:

Introduction to Big data Business Analytics - State of the practice in analytics role of data scientists - Key roles for successful analytic project - Main phases of life cycle - Developing core deliverables for stakeholders.

UNIT - II	STATISTICS	Lecture Hrs:

Sampling Techniques - Data classification, Tabulation, Frequency and Graphic representation - Measures of central value - Arithmetic mean, Geometric mean, Harmonic mean, Mode, Median, Quartiles, Deciles, Percentile - Measures of variation – Range, IQR, Quartile deviation, Mean deviation, standard deviation, coefficient variance, skewness, Moments & Kurtosis.

UNIT - III	PROBABILITY AND HYPOTHESIS TESTING	Lecture Hrs:

Random variable, distributions, joint probability function, marginal density function. Random vectors - Some special probability distribution - Binomial, Poison, Geometric, uniform, exponential, normal, gamma and Erlang - Normal distribution.

UNIT - IV	PREDICTIVE ANALYTICS	Lecture Hrs:

Sampling distribution – Estimation - point, confidence - Test of significance, 1& 2 tailed test, uses of t-distribution, F-distribution, $\chi 2$ distribution - Predictive modeling and Analysis - Regression Analysis, Correlation analysis, Rank correlation coefficient, Multiple correlation.

UNIT - V	TIME SERIES FORECASTING AND DESIGN OF EXPERIMENTS	Lecture Hrs:

Forecasting Models for Time series : MA, SES, TS with trend, season - Design of Experiments, one way classification, two way classification, ANOVA, Latin square, Factorial Design.

Textbooks:

1. Chris Eaton, Dirk Deroos, Tom Deutsch et al., ―Understanding Big Data, Mc Graw Hill, 2012.
2. Alberto Cordoba, ―Understanding the Predictive Analytics Lifecycle, Wiley, 2014.
3. Eric Siegel, Thomas H. Davenport, ―Predictive Analytics: The Power to Predict Who Will Click, Buy, Lie, or Die, Wiley, 2013.

Reference Books:

1. James R Evans,―Business Analytics – Methods, Models and Decisions, Pearson 2013.
2. R. N. Prasad, Seema Acharya, ―Fundamentals of Business Analytics, Wiley, 2015.
3. S M Ross, ―Introduction to Probability and Statistics for Engineers and Scientists‖, Academic Foundation, 2011.
4. David Hand, HeikiMannila, Padhria Smyth, ―Principles of Data Mining, PHI 2013.
5. Spyros Makridakis, Steven C Wheelwright, Rob J Hyndman, ―Forecasting methods and applications Wiley 2013(Reprint).
6. David Hand, HeikkiMannila, Padhraic Smyth, ―Principles of Data mining, PHI 2013.

Course Code	ADVANCED DATA STRUCTURES AND ALGORITHMS LAB	L	T	P	C
C45805		0	0	4	2
	Semester	I			

Course Objectives:

- To introduce students to the implementation of linear and non-linear data structures using linked representation.
- To provide practical knowledge on stack and queue operations and their applications in problem solving.
- To enable students to implement tree structures and perform operations like traversal, insertion, deletion, and balancing.
- To develop skills in implementing searching and sorting techniques to improve problem-solving efficiency.
- To expose students to advanced data structures such as AVL Trees, B-Trees, and Hashing for efficient storage and retrieval.
- To enhance the ability to design, test, and analyze algorithms for graph traversal and dictionary

Course Outcomes (CO):

- **Implement linear data structures** such as single, double, and circular linked lists to perform insertion, deletion, searching, and traversal operations.
- **Apply stack and queue concepts** using linked lists to solve real-world computational problems such as expression evaluation and infix-to-postfix conversion.
- **Develop and test tree-based and Graph-based data structures** including Binary Search Trees, AVL Trees, and B-Trees using recursive and iterative approaches, Graph traversals.
- **Implement and compare searching and sorting techniques** to analyze their performance and efficiency.
- **Apply hashing techniques** for efficient dictionary implementation and collision resolution.
- **Analyze and evaluate the performance of different data structures** to select appropriate techniques for given computational problems.

Experiment 1:
Write a program to perform various operations on single linked list

Experiment 2:
Write a program for the following
a) Reverse a linked list
b) Sort the data in a linked list
c) Remove duplicates
d) Merge two linked lists

Experiment 3: Write a program to perform various operations on doubly linked list.

Experiment 4: Write a program to perform various operations on circular linked list.

Experiment 5: Write a program for performing various operations on stack using linked list.

Experiment 6: Write a program for performing various operations on queue using linked list.

Experiment 7: Write a program for the following using stack
a) Infix to postfix conversion.
b) Expression evaluation.

Experiment 8: Write a program to implement various operations on Binary Search Tree Using Recursive and Non-Recursive methods.

Experiment 9: Write a program to implement the following for a graph. a) BFS b) DFS

Experiment 10: Write a program to implement various Sorting Techniques

Experiment 11: Write a program to implement various Searching Techniques

Experiment 12: Write a program to implement various operations on AVL trees.

Experiment 13: Write a program to perform the following operations:
a) Insertion into a B-tree
b) Searching in a B-tree

Experiment 15: Write a program to implement all the functions of Dictionary (ADT) using Hashing.

References:

a) **Ellis Horowitz, SartajSahni, and SanguthevarRajasekaran** – *Fundamentals of Computer Algorithms*, Universities Press, 2008.
b) **Mark Allen Weiss** – *Data Structures and Algorithm Analysis in C++ / Java*, Pearson Education, 4th Edition, 2013.
c) **Seymour Lipschutz** – *Data Structures with C*, Schaum's Outline Series, McGraw Hill, 2011.
d) **Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, and Clifford Stein** – *Introduction to Algorithms*, MIT Press, 3rd Edition, 2009.

Course Code	DISTRIBUTED OPERATING SYSTEMS LAB	L	T	P	C
C45806		0	0	4	2
	Semester	I			

Course Objectives:

- To provide hands-on experience in implementing synchronization, deadlock detection, and resource management algorithms in distributed and multiprocessor systems.
- To develop the ability to design and simulate mechanisms for fault tolerance, load balancing, task migration, and secure communication using cryptographic techniques.
- To enable students to apply concurrency control methods in distributed databases and critically analyze the performance of various distributed algorithms.

Course Outcomes (CO):

- Implement and analyze synchronization mechanisms in distributed environments.
- Develop and evaluate distributed deadlock detection techniques.
- Design and implement distributed shared memory models and scheduling algorithms.
- Apply security and cryptographic techniques to distributed systems.
- Implement concurrency control algorithms in database operating systems.
- Gain hands-on experience in developing efficient multiprocessor operating system components.

List of Experiments

Unit I: Architectures & Synchronization

1. **Implementation of Lamport's Logical Clocks** – Simulate logical clock updates in a distributed system.
2. **Vector Clocks and Causal Ordering** – Implement vector clocks and analyze message ordering.
3. **Distributed Mutual Exclusion Algorithms** – Implement Ricart-Agrawala and Maekawa's mutual exclusion algorithms.

Unit II: Deadlock Detection & Resource Management

4. **Simulation of Distributed Deadlock Detection Algorithms** – Implement centralized and distributed deadlock detection techniques.
5. **Hierarchical Deadlock Detection** – Implement a hierarchical approach to detecting deadlocks in a distributed system.

Unit III: Shared Memory, Scheduling & Fault Tolerance

6. **Implementation of Load Balancing Algorithms** – Compare load balancing techniques (static and dynamic).
7. **Task Migration Mechanism** – Implement and analyze task migration in a distributed system.

Unit IV: Security & Cryptography

8. **Access Matrix Model Implementation** – Simulate access control using an access matrix.
9. **Implementation of Data Encryption Standard (DES) Algorithm** – Encrypt and decrypt messages using DES.

10. **Public Key Cryptography using RSA** – Implement RSA encryption and authentication mechanisms.

Unit V: Multiprocessor & Database OS

11. **Process Synchronization in Multiprocessor Systems** – Implement and analyze thread synchronization.
12. **Concurrency Control using Lock-Based Algorithms** – Implement two-phase locking protocol.
13. **Timestamp-Based Concurrency Control** – Develop a timestamp-based concurrency control mechanism.
14. **Optimistic Concurrency Control Algorithm** – Implement an optimistic concurrency control protocol.

References

1. **MukeshSinghal and Niranjan G. Shivaratri** – *Advanced Concepts in Operating Systems: Distributed, Database, and Multiprocessor Operating Systems*, McGraw Hill, 2001.
2. **Andrew S. Tanenbaum and Maarten Van Steen** – *Distributed Systems: Principles and Paradigms*, Pearson Education, 2nd Edition, 2007.
3. **George Coulouris, Jean Dollimore, Tim Kindberg, and Gordon Blair** – *Distributed Systems: Concepts and Design*, Pearson Education, 5th Edition, 2012.
4. **Pradeep K. Sinha** – *Distributed Operating Systems: Concepts and Design*, PHI Learning, 2008.

Course Code	FULL STACK DEVELOPMENT USING MERN (Skill Enhancement Course)	L	T	P	C
C45808		0	1	2	2
	Semester	I			

Course Objectives:

- Provide strong foundations in web development technologies (HTML, CSS, JavaScript, ES6).
- Introduce server-side programming with Node.js and Express.js for building scalable applications.
- Enable students to work with relational (MySQL) and non-relational (MongoDB) databases.
- Impart skills to design and develop interactive user interfaces using ReactJS.
- Enhance problem-solving abilities through full-stack web application development experiments.

Course Outcomes (CO):

CO1: Apply fundamental web technologies (HTML, CSS, JavaScript, ES6) to design responsive web pages.
CO2: Develop server-side applications using Node.js and Express.js with REST API integration.
CO3: Perform database operations using MySQL and MongoDB and integrate them with backend services.
CO4: Design and implement dynamic, component-based user interfaces using ReactJS.
CO5: Develop and deploy full-stack applications by combining frontend, backend, and database skills.
CO6: Demonstrate problem-solving, debugging, and version control skills in web development projects.

List of Experiments:

Module 1: Web Development Fundamentals

Fundamentals of Web Design, Webpage and Website, Web application HTML Typography, Images, Tables, Lists, Hyperlinks etc. CSS Syntax and usage, CSS Selectors, CSS on body, CSS on Text, CSS on Links, CSS on Tables, CSS on Lists, CSS on Forms, CSS on Images, CSS on DIV, W3.CSS Framework

List of Experiments :

- **HTML & CSS Basics** – Create a personal portfolio webpage using HTML (headings, lists, tables, hyperlinks, forms) and style it with CSS selectors.
- **Responsive Layout** – Develop a responsive webpage using DIV, CSS box model, and W3.CSS framework.
- **Styled Components** – Design a webpage for a college event with images, tables, and styled navigation menu using CSS.

Module 2: JavaScript and ECMA Script 6

JavaScript Fundamentals - Grammar and types, Control flow and error handling - Loops, Function - Objects, Arrays, Promises - ES6 Let and const, Template literals - Arrow Function, Default parameter, Async Await

List of Experiments :

- **JavaScript Fundamentals** – Build a simple calculator app using functions, loops, and control flow.
- **Array & Object Manipulation** – Write a program using ES6 features (let/const, arrow functions, template literals) to manage student records.
- **Async Programming** – Create a webpage that fetches and displays random user data from a public API using Promises and Async/Await.

Module 3: Node.js

overview, Node.js - basics and setup - Node.js console, Node.js command utilities - Node.js modules, concepts - Node.js events, database access - Node.js with Express.js, Express.js Request/Response - Express.js Get, Express.js Post - Express.js Routing, Express.js Cookies - Express.js File Upload, Middleware - Express.js Scaffolding, Template

List of Experiments :

- **Node.js Basics** – Write a Node.js script to create a local server and display "Hello World" in the browser.
- **Express.js Routing** – Build a REST API with Express.js that handles GET and POST requests for a student information system.
- **File Handling** – Develop a Node.js application to upload, read, and display a text/JSON file using Express middleware.

Module 4: MySQL and MongoDB

MySQL Concepts - Create, Read, Update, Delete Operation - SQL and NoSQL concepts - Create and manage MongoDB - Migration of data into MongoDB - MongoDB with NodeJS - Services offered by MongoDB

List of Experiments :

- **MySQL CRUD** – Create a MySQL database for employee records and perform Create, Read, Update, Delete (CRUD) operations.
- **MongoDB CRUD with Node.js** – Build a Node.js application that connects to MongoDB and manages student data.
- **Migration Project** – Write a script to migrate data from MySQL to MongoDB and display it through a Node.js API.

Module 5: React JS

ReactJS introduction and overview - ReactJS installation and environment setup - Introducing JSX, Rendering Elements - Components and Props - State and Lifecycle - Handling Events - Conditional Rendering - Lists and Keys, Forms - Lifting State Up

List of Experiments :

- **React Components** – Build a React app to display a list of courses using functional components and props.
- **State & Events** – Create a counter and a form component in React using useState and event handling.
- **Conditional Rendering & Lists** – Develop a React to-do list application with add/delete functionality and conditional rendering of completed tasks.

Textbooks

1. **Alex Banks, Eve Porcello** – *Learning React: Modern Patterns for Developing React Apps*, O'Reilly.
2. **StoyanStefanov** – *React Up & Running: Building Web Applications*, O'Reilly.
3. **Mario Casciaro, Luciano Mammino** – *Node.js Design Patterns*, Packt.
4. **Seyed M.M. Iravani** – *Learning Web Design: A Beginner's Guide to HTML, CSS, JavaScript, and Web Graphics*, O'Reilly.

Reference Books

1. **Robin Wieruch** – *The Road to React*, Leanpub.
2. **Carl Rippon** – *React 18 Design Patterns and Best Practices*, Packt.
3. **KirupaChinnathambi** – *Learning React: A Hands-On Guide to Building Web Applications*, Addison-Wesley.
4. **Ethan Brown** – *Web Development with Node and Express: Leveraging the JavaScript Stack*, O'Reilly.
5. **Kristina Chodorow** – *MongoDB: The Definitive Guide*, O'Reilly.
6. **Ben Forta** – *SQL in 10 Minutes, Sams Teach Yourself*, Sams Publishing.

Course Code	CLOUD COMPUTING	L	T	P	C
C43825		3	0	0	3
Semester					

Course Objectives:

- Analyze the trade-offs between deploying applications in the cloud and over the local infrastructure. Compare the advantages and disadvantages of various cloud computing platforms.
- Investigate how a global storage solution can be optimized so that it can be delivered successfully from the cloud
- Evaluate information storage management design in a cloud environment and how it relates to the business objectives of an organization
- Analyze how best to provide reliable access to information both locally and remotely using storage technologies
- Critically appraise the opportunities and challenges of information management in complex business environments.

Course Outcomes (CO): Student will be able to

- Deploy applications over commercial cloud computing infrastructures such as Amazon Web Services, Windows Azure, and Google App Engine.
- Program data intensive parallel applications in the cloud.
- Analyze the performance, scalability, and availability of the underlying cloud technologies and software.
- Identify security and privacy issues in cloud computing.
- Solve a real-world problem using cloud computing through group collaboration.

UNIT - I		Lecture Hrs:

Definition, characteristics, components, Cloud service provider, the role of networks in Cloud computing, Cloud deployment models- private, public & hybrid, Cloud service models, multitenancy, Cloud economics and benefits, Cloud computing platforms - IaaS: Amazon EC2, PaaS: Google App Engine, Microsoft Azure, SaaS.

UNIT - II		Lecture Hrs:

Virtualization concepts, Server virtualization, Storage virtualization, Storage services, Network virtualization, Service virtualization, Virtualization management, Virtualization technologies and architectures, virtual machine, Measurement and profiling of virtualized applications. Hypervisors: KVM, Xen, VMware hypervisors and their features

UNIT - III		Lecture Hrs:

Relational databases, Cloud file systems: GFS and HDFS, Bigtable, HBase and Dynamo. MapReduce and extensions: Parallel computing, the map -Reduce model, Parallel efficiency of Map Reduce.

UNIT - IV		Lecture Hrs:

Cloud security fundamentals, Vulnerability assessment tool for cloud, Privacy and Security in cloud. Cloud computing security architecture: General Issues, Trusted Cloud computing, Secure Execution Environments and Communications, Micro - architectures; Identity Management and Access control, Autonomic security.

UNIT - V		Lecture Hrs:

Issues in cloud computing Implementing real time application over cloud platform, Issues in Inter - cloud environments, QOS Issues in Cloud, Dependability, data migration, streaming in Cloud. Quality of Service (QoS) monitoring in a Cloud computing environment. Cloud Middleware.

Textbooks:

1. Enterprise Cloud Computing by Gautam Shroff, Cambridge publication
2. Gautam Shroff, “Enterprise Cloud Computing Technology Architecture Applications”, Cambridge University Press; 1 edition, [ISBN: 978-0521137355], 2010.

Reference Books:

1. Cloud Security by Ronald Krutz and Russell Dean Vines, Wiley -India
2. Dr. Kumar Saurabh, “Cloud Computing”, Wiley Publication
3. Dimitris N. Chorafas, “Cloud Computing Strategies” CRC Press; 1 edition [ISBN: 1439834539],2010 4. Toby Velte, Anthony Velte, Robert Elsenpeter, “Cloud Computing, A Practical Approach” McGraw Hill Osborne Media; 1 edition [ISBN: 0071626948], 200
5. RajkumarBuyya, James Broberg, Andrzej M. Goscinski, “Cloud Computing: Principles and Paradigms”, Wiley Publication, 2011
6. Tim Mather, SubraKumaraswamy, Shahed Latif, “Cloud Security and Privacy: An Enterprise Perspective on Risks and Compliance”, O’ReillyMediaInc, 2009

SEMESTER II

Course Code	Advances in Software Engineering	L	T	P	C
C45810		3	0	0	3
	Semester	II			

Course Objectives:

- Understand and apply advanced software process models and project management techniques (estimation, scheduling, risk, CMMI).
- Perform requirements engineering and create UML-based system models (scenario, flow, class, behavioral).

Course Outcomes (CO): Student will be able to

1: Demonstrate understanding of advanced software process models and project management practices.
2: Apply requirement engineering and advanced modeling techniques to software system design.
3: Develop robust designs using object-oriented, component-based, and aspect-oriented approaches.
4: Evaluate software quality through systematic testing, reviews, and maintenance strategies.
5: Analyze emerging research challenges and apply metrics, configuration management, and agile practices in modern software engineering.

UNIT - I	Software Process and Project Management	Lecture Hrs:

Software Engineering – A Layered Technology, Process Models: Waterfall, Incremental, Evolutionary, Spiral, Agile Development, Unified Process Framework.
Software Project Management Concepts: Estimation, Scheduling, Risk Analysis, Process Improvement and Capability Maturity (CMMI, ISO Standards).

UNIT - II	Requirements Engineering and Modeling	Lecture Hrs:

Requirement Engineering Tasks: Inception, Elicitation, Elaboration, Negotiation, Specification, Validation.
System Modeling with UML, Scenario-based, Flow-oriented, Behavioral and Class-based modelling, Design Concepts and Principles, Architectural Design – Styles and Patterns

UNIT - III	Advanced Design and Development Concepts	Lecture Hrs:

Component-level Design, Object-Oriented Design using UML, Design Patterns and Frameworks, Aspect-Oriented Software Engineering, Reuse-oriented Software Engineering.

UNIT - IV	Software Quality, Testing and Maintenance	Lecture Hrs:

Quality Concepts and Quality Assurance, Software Reviews, Formal Technical Reviews, Software Testing Strategies: Unit, Integration, System, Regression Testing, Black-box and White-box Testing, Software Maintenance and Reengineering.

UNIT - V	Advanced Topics and Emerging Trends	Lecture Hrs:

Software Configuration Management (SCM) and Version Control, Software Reliability and Safety Engineering, Agile Software Development and DevOps, Software Metrics and Measurement.
Emerging Areas: AI in Software Engineering, Cloud-based SE, Secure Software Development.

Textbooks:

1. Software Engineering A Practitioner's Approach, Roger S. Pressman, 9th Edition McGrawHill International Edition.
2. Fundamentals of Software Engineering, Rajib Mall, Fifth Edition, PHI.

Reference Books:

1. Software Engineering, Ian Sommerville, Tenth Edition, Pearson education.
2. Software Engineering : A Primer, Waman S Jawadekar, Tata McGraw-Hill, 2008
3. Software Engineering, A Precise Approach, Pankaj Jalote, Wiley India,2010.
4. Software Engineering, Principles and Practices, Deepak Jain, Oxford University Press.

Course Code	ADVANCED DATABASES	L	T	P	C
C45811		3	0	0	3
	Semester	II			

Course Objectives:

Knowledge on concepts of Distributed Databases, Object-Based Databases, advanced database models

Course Outcomes (CO): Student will be able to

1. Understand Database system Architectures and parallel databases
2. Analyze transactions, Concurrency Control in Distributed Databases
3. Understand the importance of Data Warehousing and Mining
4. Illustrate concepts of object based databases

UNIT - I — Lecture Hrs:

Database System Architectures Centralized and Client –Server Architectures, Server System Architectures, Parallel Systems, Distributed Systems, Network Types Parallel Databases: Introduction, I/O Parallelism, Interquery Parallelism, Intra Query Parallelism, Intraoperation Parallelism, Interoperation Parallelism, Query Optimization, Design of Parallel Systems, Parallelism on Multicore Processors

UNIT - II — Lecture Hrs:

Distributed Databases Homogeneous and Heterogeneous Databases, Distributed Data Storage, Distributed Transactions, Commit Protocols, Concurrency Control in Distributed Databases, Availability, Distributed Query Processing, Heterogeneous Distributed Databases, Cloud-Based Databases, Directory Systems

UNIT - III — Lecture Hrs:

Data Warehousing and Mining Decision-Support Systems, Data Warehousing, Data Mining, Classification, Association Rules, Other Types of Associations, Clustering, Other Forms of Data Mining

UNIT - IV — Lecture Hrs:

Object-Based Databases Introduction, Complex Data Types, Structured Types and Inheritance in SQL, Table Inheritance, Array and Multiset Types in SQL, Object-Identity and Reference Types in SQL, Implementing O-R Features, Persistent Programming Languages, Object-Relational Mapping, Object-Oriented versus Object-Relational.

UNIT - V — Lecture Hrs:

Motivation, Structure of XML Data, XML Document Schema, Querying and Transformation, Application Program Interfaces to XML, Storage of XML Data, XML Applications

Applications Advanced database models and applications: Active Database Concepts and Triggers, Temporal database concepts, Spatial database concepts, Multimedia database concepts, Deductive databases

Textbooks:

1. Abraham Silberschatz, Henry F. Korth, S. Sudarshan Database System Concepts, Sixth Edition
2. RamezElmasri, Shamkant B. Navathe, Database systems- Models, Languages, Design and Application Programming

Reference Books:

Course Code	BLOCKCHAIN TECHNOLOGY	L	T	P	C
C45812a	(PROGRAM ELECTIVE -III)	3	0	0	3
	Semester	II			

Course Objectives:

1. To learn the fundamentals of Blockchain and various types of block chain and consensus mechanisms.
2. To understand the public block chain system, Private block chain system and consortium blockchain.
3. Able to know the security issues of blockchain technology.

Course Outcomes (CO): Student will be able to

1. Understanding concepts behind crypto currency
2. Applications of smart contracts in decentralized application development
3. Understand frameworks related to public, private and hybrid blockchain
4. Create blockchain for different application case studies

UNIT - I	Lecture Hrs:

Fundamentals of Blockchain: Introduction, Origin of Blockchain, Blockchain Solution, Components of Blockchain, Block in a Blockchain,The Technology and the Future. Blockchain Types and Consensus Mechanism: Introduction, Decentralization and Distribution, Types of Blockchain, Consensus Protocol. Cryptocurrency – Bitcoin, Altcoin and Token: Introduction, Bitcoin and the Cryptocurrency, Cryptocurrency Basics, Types of Cryptocurrencies, Cryptocurrency Usage.

UNIT - II	Lecture Hrs:

Public Blockchain System: Introduction, Public Blockchain, Popular Public Blockchains, The Bitcoin Blockchain, Ethereum Blockchain. Smart Contracts: Introduction, Smart Contract, Characteristics of a Smart Contract, Types of Smart Contracts, Types of Oracles, Smart Contracts in Ethereum, Smart Contracts in Industry.

UNIT - III	Lecture Hrs:

Private Blockchain System: Introduction, Key Characteristics of Private Blockchain, Why We Need Private Blockchain, Private Blockchain Examples, Private Blockchain and Open Source, E- commerce Site Example, Various Commands (Instructions) in E-commerce Blockchain, Smart Contract in Private Environment, State Machine, Different Algorithms of Permissioned Blockchain, Byzantine Fault, Multichain.

Consortium Blockchain: Introduction, Key Characteristics of Consortium Blockchain, Why We Need Consortium Blockchain, Hyperledger Platform, Overview of Ripple, Overview of Corda. Initial Coin Offering: Introduction, Blockchain Fundraising Methods, Launching an ICO, Investing in an ICO, Pros and Cons of Initial Coin Offering, Successful Initial Coin Offerings, Evolution of ICO, ICO Platforms.

UNIT - IV	Lecture Hrs:

Security in Blockchain: Introduction, Security Aspects in Bitcoin, Security and Privacy Challenges of Blockchain in General, Performance and Scalability, Identity Management and Authentication, Regulatory Compliance and Assurance, Safeguarding Blockchain Smart Contract (DApp), Security Aspects in Hyperledger Fabric.

Applications of Blockchain: Introduction, Blockchain in Banking and Finance, Blockchain in Education, Blockchain in Energy, Blockchain in Healthcare, Blockchain in Real-estate, Blockchain In Supply Chain, The Blockchain and IoT. Limitations and Challenges of Blockchain.

UNIT - V	Lecture Hrs:

Blockchain Case Studies: Case Study 1 – Retail, Case Study 2 – Banking and Financial Services, Case Study 3 – Healthcare, Case Study 4 – Energy and Utilities.

Blockchain Platform using Python: Introduction, Learn How to Use Python Online Editor, Basic Programming Using Python, Python Packages for Blockchain.

Blockchain platform using Hyperledger Fabric: Introduction, Components of Hyperledger Fabric Network, Chain codes from Developer.ibm.com, Blockchain Application Using Fabric Java SDK.

Textbooks:

1. “Blockchain Technology”, Chandramouli Subramanian, Asha A.George, Abhilasj K A and MeenaKarthikeyan , Universities Press.

Reference Books:

1. Michael Juntao Yuan, Building Blockchain Apps, Pearson, India.
2. Blockchain Blueprint for Economy, Melanie Swan, SPD O'reilly.
3. Blockchain for Business, Jai Singh Arun, Jerry Cuomo, Nitin Gaur, Pearson.

Course Code	Advanced Computer Networks	L	T	P	C
C45812b	(PROGRAM ELECTIVE -III)	3	0	0	3
	Semester	II			

Course Objectives:

This course aims to provide advanced background on relevant computer networking topics to have a comprehensive and deep knowledge in computer networks.

Course Outcomes (CO): Student will be able to

1. Understanding of holistic approach to computer networking
2. Ability to understand the computer network protocols and their applications
3. Ability to design simulation concepts related to packet forwarding in networks.

UNIT - I		Lecture Hrs:

Data-link protocols: Ethernet, Token Ring and Wireless (802.11). Wireless Networks and Mobile IP: Infrastructure of Wireless Networks, Wireless LAN Technologies, IEEE 802.11 Wireless Standard, Cellular Networks, Mobile IP, Wireless Mesh Networks (WMNs), Multiple access schemes Routing and Internetworking: Network–Layer Routing, Least-Cost-Path algorithms, Non-Least-Cost-Path algorithms, Intra-domain Routing Protocols, Inter-domain Routing Protocols, Congestion Control at Network Layer.

UNIT - II		Lecture Hrs:

Transport and Application Layer Protocols: Client-Server and Peer-To-Peer Application Communication, Protocols on the transport layer, reliable communication. Routing packets through a LAN and WAN. Transport Layer, Transmission Control Protocol (TCP), User Datagram Protocol (UDP), Mobile Transport Protocols, TCP Congestion Control. Principles of Network Applications,

UNIT - III		Lecture Hrs:

The Web and HTTP, File Transfer: FTP, Electronic Mail in the Internet, Domain Name System (DNS), P2P File Sharing, Socket Programming with TCP and UDP, building a Simple Web Server Creating simulated networks and passing packets through them using different routing techniques. Installing and using network monitoring tools.

UNIT - IV		Lecture Hrs:

Wireless and Mobile Networks: Introduction, Wireless links and Network Characteristics - CDMA, Wifi: 802.11 Wireless LANS, Cellular internet access, Mobility management: Principles

UNIT - V		Lecture Hrs:

Multimedia networking: Multimedia networking applications, streaming stored video, Voice-over-IP, Protocols for real-time conversational applications.

Textbooks:

1. Computer Networking: A Top-Down Approach, James F. Kuros and Keith W. Ross, Pearson, 6th Edition, 2012.
2. Computer Networks and Internets, Duglas E. Comer, 6th Edition, Pearson.

Reference Books:

1. A Practical Guide to Advanced Networking, Jeffrey S. Beasley and PiyasatNilkaew, Pearson, 3rd Edition, 2012
2. Computer Networks, Andrew S. Tanenbaum, David J. Wetherall, Prentice Hall.

Course Code	Deep Learning and Applications	L	T	P	C
C45812c	(PROGRAM ELECTIVE -III)	3	0	0	3
	Semester	II			

Course Objectives:

1. To understand complexity of Deep Learning algorithms and their limitations
2. To be capable of performing experiments in Deep Learning using real-world data.

Course Outcomes (CO): Student will be able to

1. Implement deep learning algorithms, understand neural networks and traverse the layers of data 2. Learn topics such as convolutional neural networks, recurrent neural networks, training deep networks and high-level interfaces
3. Understand applications of Deep Learning to Computer Vision
4. Understand and analyze Applications of Deep Learning to NLP

UNIT - I		Lecture Hrs:

Introduction: Feed forward Neural networks, Gradient descent and the back propagation algorithm, Unit saturation, the vanishing gradient problem, and ways to mitigate it. RelU Heuristics for avoiding bad local minima, Heuristics for faster training, Nestors accelerated gradient descent, Regularization, Dropout

UNIT - II		Lecture Hrs:

Convolutional Neural Networks: Architectures, convolution/pooling layers, Recurrent Neural Networks: LSTM, GRU, Encoder Decoder architectures. Deep Unsupervised Learning: Auto encoders, Variational Auto-encoders, Adversarial Generative Networks, Auto-encoder and DBM Attention and memory models, Dynamic Memory Models

UNIT - III		Lecture Hrs:

Applications of Deep Learning to Computer Vision: Image segmentation, object detection, automatic image captioning, Image generation with Generative adversarial networks, video to text with LSTM models, Attention Models for computer vision tasks

UNIT - IV		Lecture Hrs:

Applications of Deep Learning to NLP: Introduction to NLP and Vector Space Model of Semantics, Word Vector Representations: Continuous Skip-Gram Model, Continuous Bag-of-Words model (CBOW), Glove, Evaluations and Applications in word similarity.

UNIT - V		Lecture Hrs:

Analogy reasoning: Named Entity Recognition, Opinion Mining using Recurrent Neural Networks: Parsing and Sentiment Analysis using Recursive Neural Networks: Sentence Classification using Convolutional Neural Networks, Dialogue Generation with LSTMs

Textbooks:

1. Deep Learning by Ian Goodfellow, YoshuaBengio and Aaron Courville, MIT Press.
2. The Elements of Statistical Learning by T. Hastie, R. Tibshirani, and J. Friedman, Springer.
3. Probabilistic Graphical Models. Koller, and N. Friedman, MIT Press.

Reference Books:

1. Bishop, C, M., Pattern Recognition and Machine Learning, Springer, 2006.
2. Yegnanarayana, B., Artificial Neural Networks PHI Learning Pvt. Ltd, 2009.
3. Golub, G.,H., and Van Loan, C.,F., Matrix Computations, JHU Press,2013.
4. Satish Kumar, Neural Networks: A Classroom Approach, Tata McGraw-Hill Education, 2004.

Online References:
1. http://www.deeplearning.net 2. https://www.deeplearningbook.org/ 3. https://developers.google.com/machine-learning/crash-course/ml-intro 4. www.cs.toronto.edu/~fritz/absps/imagenet.pdf 5. http://neuralnetworksanddeeplearning.com/

Course Code	GENERATIVE AI	L	T	P	C
C45813a	(PROGRAM ELECTIVE - IV)	3	0	0	3
	Semester	II			

Course Objectives:

1. To introduce the foundations, evolution, and core concepts of AI, ML, DL, NLP, and Generative AI.
2. To develop understanding of advanced neural architectures and generative models such as GANs, VAEs, and Transformers.
3. To explore Large Language Models, prompt engineering, and their real-world applications.
4. To familiarize learners with frameworks, multimodal applications, and ethical considerations in Generative AI.

Course Outcomes (CO): Student will be able to

1. Demonstrate knowledge of AI foundations, generative models, and advanced neural architectures.
2. Apply generative AI techniques to create solutions for text, image, video, and multimodal tasks.
3. Design, fine-tune, and optimize Large Language Models for specific applications.
4. Evaluate ethical, social, and legal implications of Generative AI deployments and propose mitigation strategies.

UNIT - I	Foundations of AI and Generative Models	Lecture Hrs:

Introduction and historical evolution to Artificial Intelligence (AI), Machine Learning (ML), Natural Language Processing (NLP)and Deep Learning (DL), Structure of Artificial Neural Networks (ANNs), Mathematical and computational foundations of generative modeling, Overview of generative models and their applications across various domains; Importance of Generative AI in modern applications, Transfer learning and in advancing Generative AI.

UNIT - II	Advanced Neural Architectures for Generative AI	Lecture Hrs:

VariationalAutoencoders (VAEs): principles and applications, Generative Adversarial Networks (GANs): architecture and working principles; Transformer architecture and attention mechanisms (in detail); Long Short-Term Memory Networks (LSTMs) and the limitations of traditional RNNs/LSTMs, Advanced Transformer architectures and techniques, Pre-training and transfer learning strategies for generative models.

UNIT - III	Large Language Models and Prompt Engineering	Lecture Hrs:

Overview of Large Language Models (LLMs), GPT architecture, variants, and working principles, Prétraining and fine-tuning GPT models for applications (e.g., chatbots, text generation), Case study: GPT-based customer support chatbot, BERT architecture, pre-training objectives, and fine-tuning, Prompt Engineering: Designing effective prompts, controlling model behavior, and improving output quality, Fine-tuning language models for creative writing and chatbot development.

UNIT - IV	Multi-Agent Systems and Generative AI Applications	Lecture Hrs:

Introduction to Multi-Agent Systems (MAS),Types of agents: reactive, deliberative, hybrid, and learning agents, Multi-agent collaboration and orchestration for generative tasks, Use cases: autonomous research assistants, cooperative creative generation, distributed problem-solving, Frameworks and tools: AutoGen, CrewAI, Hugging GPT for LLM-powered multi-agent systems, Generative AI applications: Art, Creativity, Image/Video generation, Music composition, Healthcare, Finance, Real-world case studies and deployment challenges

UNIT - V		Lecture Hrs:

Frameworks, Multimodal Applications, and Ethics LangChain framework: components and LLM application development, Retrieval-Augmented Generation (RAG), Embeddings, Indexing networks, and Vector databases, Generative AI across modalities: Text, Code, Image, and Video generation, Image and Video generation using GANs and VAEs, Multimodal Generative AI: integration and training strategies, Ethical considerations: bias, fairness, trust,

and responsible AI deployment, Social and legal implications of Generative AI, Risk mitigation strategies and real-world ethical case studies
Textbooks:
1. AltafRehmani, Generative AI for Everyone: Understanding the Essentials and Applications of This Breakthrough Technology. 2. Charu C. Aggarwal, Neural Networks and Deep Learning: A Textbook. Joseph Babcock, Raghav Bali, Generative AI with Python and TensorFlow 2, 2024.
Reference Books:
1. Josh Kalin, Generative Adversarial Networks Cookbook. 2. Jesse Sprinter, Generative AI in Software Development: Beyond the Limitations of Traditional Coding, 2024.
ONLINE REFERENCES
1. Fabian Gloeckle et al., Better & Faster Large Language Models via Multi-token Prediction, arXiv:2404.19737v1, 2024.Vaswani et al., Attention Is All You Need, NeurIPS 2017.

Course Code	DIGITAL FORENSICS	L	T	P	C
C45813b	(PROGRAM ELECTIVE - IV)	3	0	0	3
	Semester	II			

Course Objectives:

1. provides an in-depth study of the rapidly changing and fascinating field of computer forensics.
2. Combines both the technical expertise and the knowledge required to investigate, detect and prevent digital crimes.
3. Knowledge on digital forensics legislations, digital crime, forensics processes and procedures, data acquisition and validation, e-discovery tools
4. E-evidence collection and preservation, investigating operating systems and file systems, network forensics, art of steganography and mobile device forensics

Course Outcomes (CO): Student will be able to

1. Understand relevant legislation and codes of ethics.
2. Computer forensics and digital detective and various processes, policies and procedures.
3. E-discovery, guidelines and standards, E-evidence, tools and environment.
4. Email and web forensics and network forensics.

UNIT - I		Lecture Hrs:

Digital Forensics Science: Forensics science, computer forensics, and digital forensics. Computer Crime: Criminalistics as it relates to the investigative process, analysis of cyber criminalistics area, holistic approach to cyber-forensics

UNIT - II		Lecture Hrs:

Cyber Crime Scene Analysis: Discuss the various court orders etc., methods to search and seizure electronic evidence, retrieved and un-retrieved communications, Discuss the importance of understanding what court documents would be required for a criminal investigation.

UNIT - III		Lecture Hrs:

Evidence Management & Presentation: Create and manage shared folders using operating system, importance of the forensic mindset, define the workload of law enforcement, Explain what the normal case would look like, Define who should be notified of a crime, parts of gathering evidence, Define and apply probable cause.

UNIT - IV		Lecture Hrs:

Computer Forensics: Prepare a case, Begin an investigation, Understand computer forensics workstations and software, Conduct an investigation, Complete a case, Critique a case, Network Forensics: open-source security tools for network forensic analysis, requirements for preservation of network data.

UNIT - V		Lecture Hrs:

Mobile Forensics: mobile forensics techniques, mobile forensics tools. Legal Aspects of Digital Forensics: IT Act 2000, amendment of IT Act 2008. Recent trends in mobile forensic technique and methods to search and seizure electronic evidence

Textbooks:

1. John Sammons, The Basics of Digital Forensics, Elsevier
2. John Vacca, Computer Forensics: Computer Crime Scene Investigation, Laxmi Publications

Reference Books:

1. William Oettinger, Learn Computer Forensics: A beginner's guide to searching, analyzing, and securing digital evidence, Packt Publishing; 1st edition (30 April 2020), ISBN : 1838648178.
2. Thomas J. Holt, Adam M. Bossler, Kathryn C. Seigfried-Spellar, Cybercrime and Digital Forensics: An Introduction, Routledge.

Course Code	ROBOTIC PROCESS AUTOMATION	L	T	P	C
C45813c	(PROGRAMELECTIVE - IV)	3	0	0	3
	Semester	II			

Course Objectives:

Aim of the course is to make learners familiar with the concepts of Robotic Process Automation.

Course Outcomes (CO): Student will be able to

1. Describe RPA, where it can be applied and how it's implemented.
2. Identify and understand Web Control Room and Client Introduction
3. Understand how to handle various devices and the workload
4. Understand Bot creators, Web recorders and task editors

UNIT - I		Lecture Hrs:

Introduction to Robotic Process Automation & Bot Creation Introduction to RPA and Use cases – Automation Anywhere Enterprise Platform – Advanced features and capabilities – Ways to create Bots

UNIT - II		Lecture Hrs:

Web Control Room and Client Introduction - Features Panel - Dashboard (Home, Bots, Devices, Audit, Workload, Insights) - Features Panel – Activity (View Tasks in Progress and Scheduled Tasks) - Bots (View Bots Uploaded and Credentials)

UNIT - III		Lecture Hrs:

Devices (View Development and Runtime Clients and Device Pools) - Workload (Queues and SLA Calculator) - Audit Log (View Activities Logged which are associated with Web CR) - Administration (Configure Settings, Users, Roles, License and Migration) - Demo of Exposed API's – Conclusion – Client introduction and Conclusion.

UNIT - IV		Lecture Hrs:

Bot Creator Introduction – Recorders – Smart Recorders – Web Recorders – Screen Recorders - Task Editor – Variables - Command Library – Loop Command – Excel Command – Database Command - String Operation Command - XML Command

UNIT - V		Lecture Hrs:

Terminal Emulator Command - PDF Integration Command - FTP Command - PGP Command - Object Cloning Command - Error Handling Command - Manage Windows Control Command - Workflow Designer - Report Designer

Textbooks:

1. Learning Robotic Process Automation: Create Software robots and automate business processes with the leading RPA tool - UiPath: Create Software robots. with the leading RPA tool – UiPath Kindle Edition.

Reference Books:

1. Robotic Process Automation A Complete Guide - 2020 Edition Kindle Edition.

Course Code	Advances in Software Engineering Lab	L	T	P	C
C45814		0	0	4	2
Semester		II			

Course Objectives:

To provide hands-on experience with classical and modern process models (Waterfall, Incremental, Scrum) and compare their effectiveness.
To practice project management techniques including estimation (FPA/UCP), scheduling (Gantt/PERT), and risk management.
To perform requirements elicitation, prepare SRS, and create UML models for system analysis and design.
To apply object-oriented design principles, design patterns, and component-based/reuse-oriented development.
To implement black-box/white-box testing, software maintenance, refactoring, and reengineering.
To master modern tools and practices: Git, CI/CD pipelines, software metrics, and AI-based code analysis tools.

Course Outcomes (CO): Student will be able to

CO1: Apply various software process models and project management techniques (estimation, scheduling, risk management) to plan and manage software development effectively.

CO2: Perform requirements elicitation, documentation, and system modeling using UML to capture, analyze, and validate software requirements.

CO3: Design software systems using object-oriented principles, design patterns, and component-based approaches for modularity, reusability, and maintainability.

CO4: Implement software testing strategies, maintenance techniques, and reengineering practices to ensure software quality, reliability, and evolution.

CO5: Utilize modern software engineering tools and practices such as version control, DevOps pipelines, software metrics, and AI-based analysis to enhance development efficiency and quality assurance.

List of Experiments:

Experiment 1: Comparative Study of Process Models
Implement a simple project using **Waterfall** and **Incremental models**; compare effort, defects, and time taken.

Experiment 2: Agile Development Simulation
Develop a small software system using **Scrum methodology** with sprints, product backlog, sprint backlog, and daily scrums.

Experiment 3: Project Estimation and Scheduling
Perform **Function Point Analysis (FPA)** or **Use Case Points (UCP)** to estimate size and effort, then prepare a Gantt chart and PERT chart.

Experiment 4: Risk Analysis in Software Projects
Conduct risk identification, qualitative/quantitative assessment, and develop a **risk mitigation plan** for a given case study.

Experiment 5: Requirement Elicitation and SRS Document

Conduct requirement gathering for a mini-project and prepare a **Software Requirement Specification (SRS)** document.

Experiment 6: UML Modeling (Scenario-based & Structural)
Create **Use Case diagrams, Activity diagrams, and Sequence diagrams** for a given problem domain.

Experiment 7: UML Modeling (Class &Behavioral)
Create **Class diagrams, State machine diagrams, and Component diagrams** to represent system architecture.

Experiment 8: Object-Oriented Design Using UML
Design a software module using **OO principles** (encapsulation, inheritance, polymorphism) and illustrate with UML diagrams.

Experiment 9: Design Patterns Implementation
Implement **at least three design patterns** (e.g., Singleton, Factory, Observer) in Java/Python.

Experiment 10: Reuse-Oriented Software Engineering
Use existing **open-source libraries/frameworks** to develop a component-based application (e.g., web app using Django/Flask).

Experiment 11: Black-box and White-box Testing
Perform **equivalence partitioning and boundary value analysis** (black-box) and **basis path testing** (white-box) for a given program.

Experiment 12: Software Maintenance and Reengineering
Take an **existing open-source project** (small module), analyze it, and perform **refactoring/reengineering** for improvement.

Experiment 13: Version Control and DevOps Pipeline
Use **Git & GitHub/GitLab** for version control and demonstrate **CI/CD pipeline** setup with Jenkins/GitHub Actions.

Experiment 14: Software Metrics and AI in SE
Compute **software metrics** (complexity, coupling, cohesion) for a given project and explore an **AI tool** (e.g., GitHub Copilot, SonarQube) for software quality analysis.

Textbooks:

1. Software Engineering A Practitioner's Approach, Roger S. Pressman, 9th Edition McGrawHill International Edition.
2. Fundamentals of Software Engineering, Rajib Mall, Fifth Edition, PHI.

Reference Books:

1. Software Engineering, Ian Sommerville, Tenth Edition, Pearson education.
2. Software Engineering : A Primer, Waman S Jawadekar, Tata McGraw-Hill, 2008
3. Software Engineering, A Precise Approach, Pankaj Jalote, Wiley India,2010.
4. Software Engineering, Principles and Practices, Deepak Jain, Oxford University Press.

Course Code	ADVANCED DATABASES LAB	L	T	P	C
C45815		0	0	4	2
	Semester	II			

Course Objectives:

Knowledge on concepts of Distributed Databases, Object-Based Databases, advanced database models

Course Outcomes (CO): Student will be able to

1. Understand Database system Architectures and parallel databases
2. Analyze transactions, Concurrency Control in Distributed Databases
3. Understand the importance of Data Warehousing and Mining
4. Illustrate concepts of object based databases

List of Experiments

1. Write a program to implement RDBMS - Cursors, Triggers
2. Write a Program to implement Range Partitioning sort.
3. Write a program to implement parallel hash join
4. Write a program to implement parallel nested join loop
5. Write a program to implement parallelize duplicate elimination by partitioning the tuples
6. Perform data fragmentation of distributed data(Horizontal, Vertical, Hybrid fragmentation)
7. Implement deadlock detection in distributed databases
8. Implement Semi Join algorithm.
9. DataCube Implementation - Aggregation
10. Perform data Integration - Extraction, Transformation, Loading
11. Implement any one classifier
12. Implement vector space models for Text corpus
13. Demonstrate type inheritance, table inheritance in object based databases
14. Write queries in XQueries on DTD
15. Write queries in SQL/XML to convert University data - XML Schema

Textbooks:

1. Abraham Silberschatz, Henry F. Korth, S. Sudarshan Database System Concepts, Sixth Edition
2. RamezElmasri, Shamkant B. Navathe, Database systems- Models, Languages, Design and Application Programming.

SEMSTER - III

Course Code	SOFTWARE DEFINED NETWORKS	L	T	P	C
C45819a	(PROGRAM ELECTIVE – V)	3	0	0	3
	Semester	III			

Course Objectives:

● Understand the evolution of Software Defined Networks (SDN) and its interoperability.
● Examine the characteristics of SDN and its devices and controllers. Understand the OpenFlow specifications and its limitations.
● Comparison of SDN, Overlays and APIs.
● Design of network virtualization tunnels and offloading flows in data centers.
● Design and development of switch and controller in SDN application

Course Outcomes (CO): Student will be able to

● Analyze the implications of SDN for research and innovation data centers.
● Brief the OpenFlow basics and optical transport protocols.
● Develop the tunneling and path technologies for real world data center.
● Implementation of the access control for the campus and traffic engineering for service providers. Simulation and testing of SDN in open-source cloud software.
● Implementation of switch and controller in SDN applications

UNIT - I		Lecture Hrs:

Introduction: Evolution of Switches and Control Planes, SDN Implications for Research and Innovation, Data Center Innovation, Data Center Needs. The Evolution of Networking Technology, Forerunners of SDN, Legacy Mechanisms Evolve Toward SDN, Software Defined Networking Is Born,Sustaining SDN Interoperability, Open Source Contributions, Network Virtualization

UNIT - II		Lecture Hrs:

Fundamental Characteristics of SDN, SDN Operation, SDN Devices, SDN Controller, SDN Applications, Alternate SDN Method. The OpenFlow Specification, OpenFlow Overview, OpenFlow 1.0 and OpenFlow Basics, OpenFlow 1.0 to 1.5, Improving OpenFlow Interoperability, Optical Transport Protocol Extensions, OpenFlow Limitations.

UNIT - III		Lecture Hrs:

Alternative Definitions of SDN: Potential Drawbacks of Open SDN, SDN via APIs, SDN via Hypervisor-Based Overlays, SDN via Opening Up the Device, Network Functions Virtualization and Alternatives Overlap and Ranking.

UNIT - IV		Lecture Hrs:

SDN in the Data Center: Data Center Demands, Tunnelling Technologies for the Data Center, Path Technologies in the Data Center, Ethernet Fabrics in the Data Center, SDN Use Cases in the Data Center, Comparison of Open SDN, Overlays, and APIs, Real-World Data Center Implementations

UNIT - V		Lecture Hrs:

SDN Applications: Application Types, A Brief History of SDN Controllers, Using Floodlight for Training Purposes, A Simple Reactive Java Application, Controller Considerations, Network Device Considerations,12.9. Creating Network Virtualization Tunnels, Offloading Flows in the Data Center, Access Control for the Campus, Traffic Engineering for Service Providers

Textbooks:

. Software Defined Networks: A Comprehensive Approach by Paul Goransson and Chuck Black, Morgan Kaufmann Publications, 2014 .

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Reference Books:

7. SDN - Software Defined Networks by Thomas D. Nadeau & Ken Gray, O'Reilly, 2013
8. Software Defined Networking with OpenFlowBySiamakAzodolmolky, Packt Publishing, 2013

Course Code	REINFORCEMENT LEARNING	L	T	P	C
C45819b	(PROGRAM ELECTIVE – V)	3	0	0	3
	Semester	III			

Course Objectives:

Knowledge on fundamentals of reinforcement learning and the methods used to create agents that can solve a variety of complex tasks.

Course Outcomes (CO): Student will be able to

1. Understand basics of RL
2. Understand RL Framework and Markov Decision Process
3. Analyzingning through the use of Dynamic Programming and Monte Carlo
4. Understand TD(0) algorithm, TD(λ) algorithm

UNIT - I		Lecture Hrs:

Basics of probability and linear algebra, Definition of a stochastic multi-armed bandit, Definition of regret, Achieving sublinear regret, UCB algorithm, KL-UCB, Thompson Sampling.

UNIT - II		Lecture Hrs:

Markov Decision Problem, policy, and value function, Reward models (infinite discounted, total, finite horizon, and average), Episodic & continuing tasks, Bellman's optimality operator, and Value iteration & policy iteration

UNIT - III		Lecture Hrs:

The Reinforcement Learning problem, prediction and control problems, Model-based algorithm, Monte Carlo methods for prediction, and Online implementation of Monte Carlo policy evaluation

UNIT - IV		Lecture Hrs:

Bootstrapping; TD(0) algorithm; Convergence of Monte Carlo and batch TD(0) algorithms; Model-free control: Q-learning, Sarsa, Expected Sarsa.

UNIT - V		Lecture Hrs:

n-step returns; TD(λ) algorithm; Need for generalization in practice; Linear function approximation and geometric view; Linear TD(λ). Tile coding; Control with function approximation; Policy search; Policy gradient methods; Experience replay; Fitted Q Iteration; Case studies.

Textbooks:

1. "Reinforcement learning: An introduction," First Edition, Sutton, Richard S., and Andrew G. Barto, MIT press 2020
2. "Statistical reinforcement learning: modern machine learning approaches," First Edition, Sugiyama, Masashi. CRC Press 2015

Reference Books:

1. "Bandit algorithms," First Edition, Lattimore, T. and C. Szepesvári. Cambridge University Press. 2020
2. "Reinforcement Learning Algorithms: Analysis and Applications," Boris Belousov, Hany Abdulsamad, Pascal Klink, Simone Parisi, and Jan Peters First Edition, Springer 2021
3. Alexander Zai and Brandon Brown "Deep Reinforcement Learning in Action," First Edition, Manning Publications 2020

Course Code	DATA SCIENCE	L	T	P	C
C45819c	(PROGRAM ELECTIVE – V)	3	0	0	3
	Semester	III			

Course Objectives:

- To understand about Data Science
- To understand big data, to learn the analytics of Big Data how data is stored and processed in Hadoop
- To learn about Machine Learning Algorithms
- To learn model evaluation and how data is analyzed using R features .

Course Outcomes (CO): Student will be able to

- CO1: Explain Data Science concepts, lifecycle, roles, and differences between BI, Big Data, and Data Warehouse.
- CO2: Compare Hadoop ecosystem, HDFS, NoSQL with traditional RDBMS for big data handling.
- CO3: Perform exploratory data analysis using descriptive statistics, correlation, and ANOVA.
- CO4: Implement and evaluate key ML algorithms (Regression, Naïve Bayes, K-Means, KNN, Decision Tree, Random Forest) with cross-validation.
- CO5: Analyze and visualize data using R (vectors, matrices, charts, histograms, boxplots, scatterplots).

UNIT - I		Lecture Hrs:

Introduction to Data, Data Science, Data Process: Introduction to Data Science and data science process – Evolution of Data Science – Data Science Roles – Stages in a Data Science Project – Applications of Data Science in various fields ,data science profile , Types of Digital data: Classification of Digital Data, Introduction to Big Data: What is big data, Evolution of Big Data, Traditional Business Intelligence vs Big Data, Coexistence of Big Data and Data Warehouse.

UNIT - II		Lecture Hrs:

Data Collection and Data Preprocessing: Processing data with hadoop, interfacing with hadoop ecosystem. Hadoop: Features of Hadoop, Key advantages of hadoop, versions of hadoop, overview of hadoop ecosystem, Hadoop distributions. Why hadoop? RDBMS vs Hadoop, Distribution computing challenges, History of hadoop, Hadoop overview,HDFS NoSQL: Where it is used? What is it? Types of NoSQL Databases, Why NoSQL? Advantages of NoSQL, What we miss with NoSQL? Use of NoSQL in industry,SQL vs NoSQL.

UNIT - III		Lecture Hrs:

Exploratory Data Analytics: Descriptive Statistics – Mean, Standard Deviation, dispersion, Skewness and Kurtosis , statistical-interference-Correlation Statistics – ANOVA.

UNIT - IV		Lecture Hrs:

Algorithms/Model Development: Basic machine learning algorithms, Simple and Multiple Regression – naivebayes, k-.means ,KNN ,decision tree, random forest, LDA ,Prediction and Decision Making, Evaluation Metrics – Cross Validation – Overfitting.

UNIT - V		Lecture Hrs:

Data Visualization: using R, What is R? Why use R for analytics? How to run R? First R example, functions a short programming example, some important R data structures, vectors, matrices, lists, R programming structures, Charts, pie –charst, Barchart, boxplots, scatterplots ,linechart, Histograms, scatterplots ,Box plot.

Textbooks:

1. BIG DATA and ANALYTICS, Seema Acharya, SubhashiniChellappan, Wiley Publications.
2. Cathy O'Neil and Rachel Schutt , "Doing Data Science", O'Reilly, 2015.