CMR COLLEGE OF ENGINEERING &TECHNOLOGY

(UGC Autonomous)

Kandlakoya, Medchal Road, Hyderabad – 501 401

ACADEMIC REGULATIONS - R 22

Academic Regulations of M. Tech (Regular/Full Time) Programmes, 2022-23 (R22)CBCS)

(Effective for the students admitted into I Year from the Academic Year 2022-23)

1.0 Post-Graduate Degree Programmes in Engineering & Technology (PGP in E & T) CMR College of Engineering & Technology (CMRCET) offers **Two** Years (**Four** Semesters) full-time Master ofTechnology (M.Tech.) Degree Programmes, under Choice Based Credit System (CBCS) in different branches of Engineering and Technology with different specializations.

2.0 Eligibility for Admissions

2.1 Admission to the PGPs shall be made subject to eligibility, qualification and specializations prescribed by the University from time to time, for each specialization under each M.Tech programme.

2.2 Admission to the post graduate programme shall be made 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 Telangana State Government (PGECET) for M. Tech. programmes / an entrance test conducted by JNTUH/ on the basis of any other exams approved by the University, subject to reservations as laid down by the Govt. from time to time.

2.3 The medium of instructions for all PG Programmes will be **ENGLISH** only.

3.0 M. Tech. Programme (PGP in E & T) Structure

3.1 The M. Tech. Programs in E & T of CMRCET are of Semester pattern, with **Four** Semesters consisting of **Two** academic years, each academic year having **Two** Semesters (First/Odd and Second/Even Semesters). Each Semester shall be of 22 weeks duration (inclusive of Examinations), with a minimum of 90 instructional days per Semester.

3.2 The two-year M. Tech. program consists of **68** credits and the student has to register for all **68** creditsand earn all **68** credits for the award of M. Tech. degree. There is **NO** exemption of credits in any case.

3.3 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.

3.4 UGC/AICTE specified definitions/descriptions are adopted appropriately for various terms and abbreviations used in these PG academic regulations, as listed below:

3.4.1 Semester Scheme

Each Semester shall have 'Continuous Internal Evaluation (CIE)' and 'Semester End Examination (SEE)'. Choice Based Credit System (CBCS) and Credit Based Semester System (CBSS) are taken as 'references' for the present set of Regulations. The terms 'SUBJECT' and 'COURSE' imply thesame meaning here and refer to 'Theory Subject', or 'Lab Course', or 'Design/Drawing Subject', or 'Mini Project with Seminar', or 'Dissertation', as the case may be.

3.4.2 Credit Courses

All subjects/courses are to be registered by the student in a semester to earn credits which shall be assigned to each subject/course in an L: T: P: C (Lecture Periods: Tutorial Periods: Practical Periods: Credits) structure based on the following general pattern:

- One credit for one hour/week/semester for theory/lecture (L) courses
- One credit for two hours/ week/semester for laboratory/ practical (P) courses or tutorials (T)

Other student activities like study tour, guest lecture, conference/workshop participations, technical paper presentations and mandatory courses (Non-credit Audit Courses) will not carry any credits.

3.4.3 Subject Course Classification

All subjects/courses offered for the Post-Graduate Programme in E & T (M.Tech. Degree Programme) are broadly classified as follows. The University has followed in general the guidelines issued by AICTE/UGC.

S. No.	Broad Course Classification	Course Group/ Category	Course Description
1	Core Courses (CoC)	PCC- Professional Core Course	Includes subjects related to the parent discipline/department/ branch of Engineering
		Dissertation	M. Tech. Project or PG Project or Major Project
		Mini Project with Seminar	Seminar based on core contents related to ParentDiscipline/ Department/ Branch of Engineering
2	Elective Courses (EE)	PEC - Professional Electives Course	Includes elective subjects related to the parentdiscipline/department/branch of Engineering
		OEC - Open Electives Course	Elective subjects which include inter-disciplinary subjects or subjects in an area outside the parent discipline/department/ branch of Engineering
3	***Mandatory Courses***	--	***Non-Credit Audit Courses***

4.0 Course Registration

4.1 A 'Faculty Advisor or Counselor' shall be assigned to each specialization, who will advise on the PostGraduate Programme (PGP), its Course Structure and Curriculum, Choice/Option for Subjects/ Courses, based on his competence, progress, pre-requisites and interest.

4.2 The Academic Section of the College invites 'Registration Forms' from students within 15 days from the commencement of class work. The Registration Requests for any 'CURRENT SEMESTER' shall be completed BEFORE the commencement of SEEs (Semester End Examinations) of the 'PRECEDING SEMESTER'.

4.3 A Student can apply for Registration, ONLY AFTER obtaining the 'WRITTEN

APPROVAL' from his Faculty Advisor, which should be submitted to the College Academic Section through the Head of Department (a copy of it being retained with Head of Department, Faculty Advisor and the Student).

4.4 Subject/ Course Options through Registration are final and CANNOT be changed, nor can they be inter-changed; further, alternate choices also will not be considered. However, if the Subject/ Course that has already been listed for Registration by the College in a Semester could not be offered due to unforeseen or unexpected reasons, then the Student will be allowed to have alternate choice either for a new Subject, if it is offered, or for another existing Subject (subject to availability of seats). Such alternate arrangements will be made by the Head of Department, with due notification and time-framed schedule, within the FIRST WEEK from the commencement of Class-work for that Semester.

5.0 Attendance Requirements

The programmes are offered based on a unit system with each subject being considered a unit. Attendance is calculated separately for each subject.

5.1 Attendance in all classes (Lectures/Laboratories) is compulsory. The minimum required attendance ineach theory subject (***also mandatory Audit Courses***) including the attendance of mid-term examination /Laboratory etc. is 75%. Two periods of attendance for each theory subject shall be considered, if the student appears for the mid-term examination of that subject. ***The attendance of mandatory Audit Courses should be maintained separately by the College.*** A student shall not be permitted to appear for the Semester End Examinations (SEE), if his attendance is less than 75%.

5.2 A student's Seminar report and presentation on Mini Project shall be eligible for evaluation, only if he ensures a minimum of 75% of his attendance in Seminar presentation classes on Mini Project duringthat Semester.

5.3 Condoning of shortage of attendance (between 65% and 75%) up to a maximum of 10% (considering the days of attendance in sports, games, NCC, NSS activities and Medical grounds) in each subject (Theory/Lab/Mini Project with Seminar) of a semester shall be granted by the College Academic Committee on genuine reasons.

5.4 A prescribed fee per subject shall be payable for condoning shortage of attendance after getting the approval of College Academic Committee for the same. The College Academic Committee shall maintain relevant documents along with the request from the student.

5.5 Shortage of Attendance below 65% in any subject shall in **no case be condoned.**

5.6 A Student, whose shortage of attendance is not condoned in any Subject(s) (Theory/Lab/Mini Project with Seminar) in any Semester, is considered as 'Detained in that Subject(s), and is not eligible to write Semester End Examination(s) of such Subject(s), (in case of Mini Project with Seminar, his/her Mini Project with Seminar Report or Presentation are not eligible for evaluation) in that Semester; and he/she has to seek re-registration for those Subject(s) in subsequent Semesters, and attend the same as and when offered.

5.7 A student fulfills the attendance requirement in the present semester, shall not be

eligible for readmission into the same class.

5.8 a) A student shall put in a minimum required attendance in at least **three theory subjects (excluding *mandatory (non-credit audit)* course)** in first Year I semester for promotion to first Year II Semester.

b) A student shall put in a minimum required attendance in at least **three theory subjects (excluding *mandatory (non-credit audit)* course)** in first Year II semester for promotion to second Year I Semester.

6.0 Academic Requirements

The following academic requirements must be satisfied, in addition to the attendance requirements mentioned in item no. 5. The performance of the candidate in each semester shall be evaluated subject- wise, with a maximum of 100 marks per subject / course (theory / practical), based on Internal Evaluation and Semester End Examination.

6.1 A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/course, if he secures not less than:

- 40% of Marks (24 out of 60 marks) in the Semester End Examination;
- 40% of Marks in the internal examinations (16 out of 40 marks allotted for CIE); and
- A minimum of 50% of marks in the sum total of CIE (Continuous Internal Evaluation) and SEE(Semester End Examination) taken together; in terms of Letter Grades this implies securing **'B'** Grade or above in a subject.

6.2 A student shall be deemed to have satisfied the academic requirements and earned the credits allottedto Mini Project with seminar, if student secures not less than 50% marks (i.e. 50 out of 100 allottedmarks). The student would be treated as failed, if student (i) does not submit a seminar report on Mini Project or does not make a presentation of the same before the evaluation committee as per schedule or (ii) secures less than 50% marks in Mini Project with seminar evaluation. The failed student shall reappear for the above evaluation when the notification for supplementary examination is issued.

6.3 A student shall register for all subjects for total of **68** credits as specified and listed in the course structure for the chosen specialization, put in the required attendance and fulfill the academic requirements for securing **68** credits obtaining a minimum of **'B'** Grade or above in each subject, and all **68** credits securing Semester Grade Point Average **(SGPA) ≥ 6.0** (in each semester) and final Cumulative Grade Point Average **(CGPA)** (i.e., CGPA at the end of PGP**) ≥ 6.0**, and shall ***pass all themandatory Audit Courses*** to complete the PGP successfully.

Note: (1) The SGPA will be computed and printed on the marks memo only if the candidate passes inall the subjects offered and gets minimum B grade in all the subjects.

(2) CGPA is calculated only when the candidate passes in all the subjects offered in all thesemesters

6.4 Marks and Letter Grades obtained in all those subjects covering the above specified **68** credits aloneshall be considered for the calculation of final CGPA, which will be indicated in the Grade Card /Marks Memo of second year second semester.

6.5 If a student registers for extra subject(s) (in the parent department or other departments/ branches of Engineering) other than those listed subjects totaling to **68** credits as specified in the course structure, the performance in extra subject(s) (although evaluated and graded using the same procedure as that of the required **68** credits) will not be considered while calculating the SGPA and CGPA. For such extra subject(s) registered, percentage of marks and Letter Grade alone will be indicated in the Grade Card/Marks Memo, as a performance measure, subject to completion of the attendance and academic requirements as stated in items 5 and 6.1 - 6.3.

6.6 When a student is detained due to shortage of attendance in any subject(s) in any semester, no Grade allotment will be made for such subject(s). However, he is eligible for re-registration of such subject(s) in the subsequent semester(s), as and when next offered, with the academic regulations of the batch into which he is re-registered, by paying the prescribed fees per subject. In all these re-registration cases, the student shall have to secure a fresh set of internal marks and Semester End Examination marks for performance evaluation in such subject(s), and SGPA/CGPA calculations.

6.7 A student eligible to appear for the Semester End Examination in any subject, but absent from it or failed (failing to secure 'B' Grade or above), may reappear for that subject at the supplementary examination as and when conducted. In such cases, his Internal Marks assessed earlier for that subject will be carried over, and added to the marks secured in the supplementary examination, for the purpose of evaluating his performance in that subject.

6.8 A Student who fails to earn 68 credits as per the specified course structure, and as indicated above, within four academic years from the date of commencement of his first year first semester, shall forfeit his seat in M. Tech. programme and his admission shall stand cancelled.

7.0 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.

7.1 The performance of a student in every subject/course (including practicals and Project) will be evaluated for 100 marks each, with 40 marks allotted for CIE (Continuous Internal Evaluation) and 60 marks for SEE (Semester End-Examination). The Continuous Internal Evaluation shall be made based on the average of the marks secured in the two Mid-Term Examinations conducted, first Mid-Term examinations in the middle of the Semester and second Mid-Term examinations during the last week of instruction.

7.2 In CIE, for theory subjects, during a semester, there shall be two mid-term examinations. Each Mid- Term examination consists of two parts i) **Part – A** for 10 marks, ii) **Part – B** for 20 marks with a total duration of 2 hours as follows:

1. Mid-Term Examination for 30 marks:
   a. Part - A: Objective/quiz paper for 10 marks.
   b. Part – B: Descriptive paper for 20 marks.

The objective/quiz paper is set with multiple choice, fill-in the blanks and match the following type of questions for a total of 10 marks. The descriptive paper shall contain 6 full questions out of which, the student has to answer 4 questions, each carrying 5 marks. The average of the two Mid Term Examinations shall be taken as the final marks for Mid Term Examination (for 30 marks).

The remaining 10 marks of Continuous Internal Assessment (out of 40) are distributed as:

2. Assignment for 5 marks. (Average of 2 Assignments each for 5 marks)
3. Subject Viva-Voce/PPT/Poster Presentation/ Case Study on a topic in the concerned subject for 5 marks.

While the first mid-term examination shall be conducted on 50% of the syllabus, the second mid-term examination shall be conducted on the remaining 50% of the syllabus.

Five (5) marks are allocated for assignments (as specified by the subject teacher concerned). The first assignment should be submitted before the conduct of the first mid-term examination, and the second assignment should be submitted before the conduct of the second mid-term examination. The average of the two assignments shall be taken as the final marks for assignment (for 5 marks).

Subject Viva-Voce/PPT/Poster Presentation/ Case Study on a topic in the concerned subject for 5 marks before II Mid-Term Examination.

- The Student, in each subject, shall have to earn 40% of marks (i.e. 16 marks out of 40 marks) inCIE, 40% of marks (i.e. 24 marks out of 60) in SEE and Overall 50% of marks (i.e. 50 marks out of 100 marks) both CIE and SEE marks taking together.

The student is eligible to write Semester End Examination of the concerned subject, if the student scores ≥ 40% (16 marks) of 40 Continuous Internal Examination (CIE) marks.

In case, the student appears for Semester End Examination (SEE) of the concerned subject but not scored minimum 40% of CIE marks (16 marks out of 40 internal marks), his performance in that subjectin SEE shall stand cancelled inspite of appearing the SEE.

The details of the end semester question paper pattern are as follows:

7.3 The Semester End Examinations (SEE), for theory subjects, will be conducted for 60 marks consistingof two parts viz. i) **Part- A** for 10 marks, ii) **Part - B** for 50 marks.

- Part-A is a compulsory question which consists of ten sub-questions from all units carrying equalmarks.
- Part-B consists of five questions (numbered from 2 to 6) carrying 10 marks each. Each of these questions is from each unit and may contain sub-questions. For each question there will be an "either" "or" choice, which means that there will be two questions from each unit and the studentshould answer either of the two questions.

- The duration of Semester End Examination is 3 hours.

7.4 For practical subjects there shall be a Continuous Internal Evaluation (CIE) during the semester for 40 marks and 60 marks for semester end examination. Out of the 40 marks for internal evaluation:

1. A write-up on day-to-day experiment in the laboratory (in terms of aim, components/procedure, expected outcome) which shall be evaluated for 10 marks
2. 10 marks for viva-voce (or) tutorial (or) case study (or) application (or) poster presentation of thecourse concerned.
3. Internal practical examination conducted by the laboratory teacher concerned shall be evaluatedfor 10 marks.
4. The remaining 10 marks are for Laboratory Project, which consists of the Design (or) Software /Hardware Model Presentation (or) App Development (or) Prototype Presentation submission which shall be evaluated after completion of laboratory course and before semester end practical examination.

The Semester End Examination shall be conducted with an external examiner and the laboratory teacher. The external examiner shall be appointed from the cluster / other colleges which will be decided by the examination branch of the University.

In the Semester End Examination, held for 3 hours, total 60 marks are divided and allocated as shownbelow:

1. 10 marks for write-up
2. 15 for experiment/program
3. 15 for evaluation of results
4. 10 marks for presentation on another experiment/program in the same laboratory course and
5. 10 marks for viva-voce on concerned laboratory course.

- The Student, in each subject, shall have to earn 40% of marks (i.e. 16 marks out of 40 marks) inCIE, 40% of marks (i.e. 24 marks out of 60) in SEE and Overall 50% of marks (i.e. 50 marks out of 100 marks) both CIE and SEE marks taking together.

The student is eligible to write Semester End Examination of the concerned subject, if the student scores ≥ 40% (16 marks) of 40 Continuous Internal Examination (CIE) marks.

In case, the student appears for Semester End Examination (SEE) of the concerned subject but not scored minimum 40% of CIE marks (16 marks out of 40 internal marks), his performance in that subjectin SEE shall stand cancelled inspite of appearing the SEE.

7.5 For conducting laboratory end examinations of all PG Programmes, one internal examiner and one external examiner are to be appointed by the Principal/Controller of Examinations. The external examiner should be selected from outside the College

concerned but within the cluster.

7.6 There shall be Mini Project with Seminar during I year II semester for internal evaluation of 100 marks. The Departmental Academic Committee (DAC) will review the progress of the mini project during the seminar presentations and evaluate the same for 50 marks. Mini Project Viva Voce will be evaluated by the DAC for another 50 marks before the semester end examinations. Student shall carryout the mini project in consultation with the mini project supervisor which may include critically reviewing the literature, project implementation and submit it to the department in the form of a report and shall make an oral presentation before the DAC consisting of Head of the Department, Mini Project supervisor and two other senior faculty members of the department. The student has to secure a minimum of 50% of marks in i) seminar presentation and ii) mini project viva voce, to be declared successful. If he fails to obtain the minimum marks, he has to reappear for the same as and when scheduled.

7.7 Every candidate shall be required to submit a dissertation on a topic approved by the Dissertation Review Committee.

7.8 A Dissertation Review Committee (DRC) shall be constituted with the Head of the Department as Chairperson, Dissertation Supervisor and one senior faculty member of the Department offering the M.Tech. programme.

7.9 Registration of Dissertation Work: A candidate is permitted to register for the Dissertation Work after satisfying the attendance requirement in all the subjects, both theory and laboratory.

7.10 After satisfying 7.9, a candidate must present in ***Dissertation Work Review - I***, in consultation with his Dissertation Supervisor, the title, objective and plan of action of his Dissertation work to the Dissertation Review Committee (DRC) for approval ***within four weeks*** from the commencement of **Second year First Semester**. Only after obtaining the approval of the DRC can the student initiate the Dissertation work.

7.11 If a candidate wishes to change his supervisor or topic of the Dissertation, he can do so with the approval of the DRC. However, the DRC shall examine whether or not the change of topic/supervisor leads to a major change of his initial plans of Dissertation proposal. If yes, his date of registration for the project work starts from the date of change of Supervisor or topic as the case may be.

7.12 A candidate shall submit his Dissertation progress report in two stages at least with a gap of **three** months between them.

7.13 The work on the Dissertation shall be initiated at the beginning of the II year and the duration of the Dissertation is two semesters. A candidate is permitted to submit Dissertation Thesis only after successful completion of all theory and practical courses with the approval of DRC ***not earlier than 40 weeks*** from the date of approval of the Dissertation work. For the approval of DRC, the candidate shall submit the draft copy of thesis to the Head of the Department and make an oral presentation before the DRC.

7.14 The Dissertation Work Review - II in II Year I Semester carries 100 internal marks. Evaluation should be done by the DRC for 50 marks and the Supervisor will evaluate the

work for the other 50 marks. The Supervisor and DRC will examine the Problem Definition, Objectives, Scope of Work, Literature Survey in the same domain and progress of the Dissertation Work. A candidate has to secure a minimum of 50% of marks to be declared successful in Dissertation Work Review - II. If he fails to obtain the minimum required marks, he has to reappear for Dissertation Work Review - II as and when conducted.

7.15 The Dissertation Work Review - III in II Year II Sem. carries 100 internal marks. Evaluation should be done by the DRC for 50 marks and the Supervisor will evaluate it for the other 50 marks. The DRC will examine the overall progress of the Dissertation Work and decide whether or not the Dissertation is eligible for final submission. A candidate has to secure a minimum of 50% of marks to be declared successful in Dissertation Work Review - III. If he fails to obtain the required minimum marks, he has to reappear for Dissertation Work Review - III as and when conducted. For Dissertation Evaluation (Viva Voce) in II Year II Semester there are external marks of 100 and it is evaluated by the external examiner. The candidate has to secure a minimum of 50% marks in Dissertation Evaluation (Viva- Voce) examination.

7.16 Dissertation Work Reviews - II and III shall be conducted in phase I (Regular) and Phase II (Supplementary). Phase II will be conducted only for unsuccessful students in Phase I. The unsuccessful students in Dissertation Work Review - II (Phase II) shall reappear for it at the time of Dissertation Work Review - III (Phase I). These students shall reappear for Dissertation Work Review
- III in the next academic year at the time of Dissertation Work Review - II only after completion of Dissertation Work Review - II, and then Dissertation Work Review - III follows. The unsuccessful students in Dissertation Work Review - III (Phase II) shall reappear for Dissertation Work Review - III in the next academic year only at the time of Dissertation Work Review - II (Phase I).

7.17 After approval from the DRC, a soft copy of the thesis should be submitted for ANTI-PLAGIARISM check and the plagiarism report should be submitted to the Examination branch and be included in the final thesis. The Thesis will be accepted for submission, if the similarity index is less than **30%**. If the similarity index has more than the required percentage, the student is advised to modify accordingly and re- submit the soft copy of the thesis after one month. The maximum number of re-submissions of thesis after plagiarism check is limited to ***TWO***. The candidate has to register for the Dissertation work and work for two semesters. After three attempts, the admission is liable to be cancelled. The college authorities are advised to make plagiarism check of every soft copy of theses before submissions.

7.18 Three copies of the Dissertation Thesis certified by the supervisor shall be submitted to the College, after submission of a research paper related to the Dissertation work in a UGC approved journal. A copy of the submitted research paper shall be attached to thesis.

7.19 The thesis shall be adjudicated by an external examiner selected by the Principal/Controller of Examinations. For this, the Head of the department shall submit a panel of **three** examiners from among the list of experts in the relevant specialization as

submitted by the supervisor concerned.

7.20 If the report of the external examiner is unsatisfactory, the candidate shall revise and resubmit the Thesis. If the report of the examiner is unsatisfactory again, the thesis shall be summarily rejected. Subsequent actions for such dissertations may be considered, only on the specific recommendationsof the external examiner and /or Dissertation Review Committee. No further correspondence in thismatter will be entertained, if there is no specific recommendation for resubmission.

7.21 If the report of the examiner is satisfactory, the Head of the Department shall coordinate and decide for the conduct of Dissertation Viva-Voce examination. The Dissertation Viva-Voce examination shall beconducted by a board consisting of the Supervisor, Head of the Department and the external examiner who adjudicated the Thesis. The candidate has to secure a minimum of 50% of marks in DissertationEvaluation (Viva-Voce) examination.

7.22 If he fails to fulfill the requirements as specified in 7.21, he will reappear for the Dissertation 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, unless he is asked to revise and resubmit his Dissertation Work by the board within a specified time period (within ***four*** years from thedate of commencement of his first year first semester).

7.23 The Dissertation Viva-Voce External examination marks must be submitted to the Examination branch on the day of the examination.

7.24 For mandatory non-credit Audit courses, a student has to secure 40 marks out of 100 marks (i.e. 40% of the marks allotted) in the continuous internal evaluation for passing the subject/course. These marks should also be uploaded along with the internal marks of other subjects.

7.25 No marks or letter grades shall be allotted for mandatory non-credit Audit Courses. Only Pass/Fail shall be indicated in Grade Card.

8.0 Re-Admission/Re-Registration

8.1 Re-Admission for Discontinued Student

A student, who has discontinued the M. Tech. degree programme due to any reason whatsoever, may be considered for 'readmission' into the same degree programme (with the same specialization) with the academic regulations of the batch into which he gets readmitted, with prior permission from the authorities concerned, subject to item 6.6.

8.2 If a student is detained in a subject (s) due to shortage of attendance in any semester, he may be permitted to **re-register** for the same subject(s) in the same category (core or elective group) or equivalent subject, if the same subject is not available, as suggested by the Board of Studies of that department, as and when offered in the subsequent semester(s), with the academic regulations of thebatch into which he seeks re-registration, with prior permission from the authorities concerned, subject to item 3.2

8.3 A candidate shall be given only one-time chance to re-register and attend the classes for a maximum of two subjects in a semester, if the internal marks secured by a candidate

are less than40% and failed in those subjects but fulfilled the attendance requirement. A candidate must re-registerfor failed subjects within four weeks of commencement of the class work, in the next academic year and secure the required minimum attendance. In the event of the student taking this chance, his Continuous Internal Evaluation (internal) marks and Semester End Examination marks obtained in the previous attempt stand cancelled.

9.0 Examinations and Assessment - The Grading System

9.1 Grades will be awarded to indicate the performance of each student in each Theory Subject, or Lab/Practicals, or Mini Project with Seminar, Dissertation, etc., based on the percentage of marks obtained in CIE + SEE (Continuous Internal Evaluation + Semester End Examination, both taken together) as specified in Item 7 above, and a corresponding Letter Grade shall be given.

9.2 As a measure of the student's performance, a 10-point Absolute Grading System using the followingLetter Grades (UGC Guidelines) and corresponding percentage of marks shall be followed:

% of Marks Secured in a subject/Course (Class Intervals)	Letter Grade (UGC Guidelines)	Grade Points
90% and above (≥ 90%, ≤ 100%)	O (Outstanding)	10
Below 90% but not less than 80% (≥80%, <90%)	A^+ (Excellent)	9
Below 80% but not less than 70% (≥ 70%, <80%)	A (Very Good)	8
Below 70% but not less than 60% (≥ 60%, <70%)	B^+ (Good)	7
Below 60% but not less than 50% (≥ 50%, <60%)	B (above Average)	6
Below 50% (< 50%)	F (FAIL)	0
Absent	**Ab**	**0**

9.3 A student obtaining **'F'** Grade in any Subject is deemed to have 'failed' and is required to reappear as 'Supplementary Candidate' for the Semester End Examination (SEE), as and when conducted. In such cases, his Internal Marks (CIE Marks) in those subjects will remain as obtained earlier.

9.4 If a student has not appeared for the examinations, '**Ab**' Grade will be allocated to him for any subject and shall be considered 'failed' and will be required to reappear as 'Supplementary Candidate' for the Semester End Examination (SEE), as and when conducted.

9.5 A Letter Grade does not imply any specific marks percentage; it is only the range of percentage of marks.

9.6 In general, a student shall not be permitted to repeat any Subject/ Course (s) only for the sake of 'Grade Improvement' or 'SGPA/ CGPA Improvement'.

9.7 A student earns Grade Point (GP) in each Subject/ Course, on the basis of the Letter Grade obtained by him in that Subject/ Course. The corresponding 'Credit Points' (CP) are computed by multiplying the Grade Point with Credits for that particular Subject/ Course.

Credit Points (CP) = Grade Point (GP) x Credits …. For a Course

9.8 The student passes the Subject/ Course only when he **gets GP ≥ 6 (B Grade or above).**

9.9 The Semester Grade Point Average (SGPA) is calculated by dividing the Sum of Credit Points (CP) secured from ALL Subjects/ Courses registered in a Semester, by the Total Number of Credits registered during that Semester. SGPA is rounded off to TWO Decimal Places. SGPA is thus computed as

$$\text{SGPA} = \{ \sum_{i=1}^{N} C_i G_i \} / \{ \sum_{i=1}^{N} C_i \}$$ **…. For each Semester,**

where 'i' is the Subject indicator index (taking into account all Subjects in a Semester), 'N' is the no. of Subjects 'REGISTERED' for the Semester (as specifically required and listed under the Course Structure of the parent Department), C_i is the no. of Credits allotted to the ith Subject, and G_i represents the Grade Points (GP) corresponding to the Letter Grade awarded for that ith Subject.

9.10 The Cumulative Grade Point Average (CGPA) is a measure of the overall cumulative performance of a student over all Semesters considered for registration. The CGPA is the ratio of the Total Credit Points secured by a student in ALL registered Courses in ALL Semesters, and the Total Number of Credits registered in ALL the Semesters. CGPA is rounded off to TWO Decimal Places. CGPA is thus computed from the I Year Second Semester onwards, at the end of each Semester, as per the formula

$$\text{CGPA} = \{ \sum_{j=1}^{M} C_j G_j \} / \{ \sum_{j=1}^{M} C_j \}$$ **… for all S Semesters registered**

(ie., up to and inclusive of S Semesters, S ≥ 2),

where 'M' is the TOTAL no. of Subjects (as specifically required and listed under the Course Structure of the parent Department) the Student has 'REGISTERED' for from the 1st Semester onwards upto and inclusive of the Semester S (obviously M > N), 'j' is the Subject indicator index (taking into account all Subjects from 1 to S Semesters), C_j is the no. of Credits allotted to the jth Subject, and G_j represents the Grade Points (GP) corresponding to the Letter Grade awarded for that jth Subject. After registration and completion of I Year I Semester however, the SGPA of that Semester itself may be taken as the CGPA, as there are no cumulative effects.

Illustration of calculation of SGPA

Course/Subject	Credits	Letter Grade	Grade points	Credit Points
Course 1	4	A	8	4*8 = 32
Course 2	4	O	10	4*10 = 40
Course 3	4	B	6	4*6 = 24
Course 4	3	B	6	3*6 = 18
Course 5	3	A+	9	3*9 = 27
Course 6	3	B	6	3*6 = 18

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SGPA = 159/21 = 7.57

Illustration of calculation of CGPA

Semester	Credits	SGPA	Credits * SGPA
Semester I	24	7	24*7 = 168
Semester II	24	6	24*6 = 144
Semester III	24	6.5	24*6.5 = 156
Semester IV	24	6	24*6 = 144
	96		612

CGPA = 612/96 = 6.37

10.0 Award of Degree and Class

10.1 If a student who registers for all the specified Subjects/ Courses as listed in the Course Structure, satisfies all the Course Requirements, and passes the examinations prescribed in the entire PG Programme (PGP), and secures the required number of **68** Credits (with CGPA ≥ 6.0), shall be declaredto have 'QUALIFIED' for the award of the M.Tech. Degree in the chosen Branch of Engineering and Technology with the specialization that he was admitted into.

10.2 Award of Class

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

Class Awarded	CGPA
First Class with Distinction	≥ 7.75
First Class	6.75≤ CGPA < 7.75
Second Class	6.00≤ CGPA < 6.75

A student with final CGPA (at the end of the **PGP) < 6.00** shall not be eligible for the Award of Degree.

11.0 Withholding of Results

If the student has not paid the dues, if any, to the University or if any case of indiscipline is pending against him, the result and degree of the student will be withheld and he will not be allowed into the next semester.

12.0 General

12.1 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 or tutorial) or two hours ofpractical work/field work per week.

12.2 Credit Point: It is the product of grade point and number of credits for a course.

12.3 Wherever the words "he", "him", "his", occur in the regulations, they shall include "she", "her".

12.4 The academic regulation should be read as a whole for the purpose of any interpretation.

12.5 In case of any doubt or ambiguity in the interpretation of the above rules, the decision of the University is final.

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

MALPRACTICE RULES

Disciplinary Action for Malpractices/Improper Conduct in Examinations

	Nature of Malpractices/ Improper conduct	Punishment
1.(a)	Possesses or keeps accessible in examination hall, any paper, note book, programmable calculators, Cell phones, pager, palm computers, smart watches, electronic gadgets 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. Confiscation of Cell phones, pager, palm computers, smart watches, electronic gadgets etc. and the same would be handed over only after punishment finalized by Malpractice Committee.
(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, pager, palm computers, smart watches, electronic gadgets 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. Confiscation of Cell phones, pager, palm computers, smart watches, electronic gadgets etc. and the same would be handed over only after punishment finalized by Malpractice Committee.
2.	Has copied in the examination hall from any paper, book, programmable calculators, palm computers, cell phones, smart watches, electronic gadgets 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 excluding Project work/ Mandatory Courses /Technical Seminar 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. Confiscation of Cell phones, pager, palm computers, smart watches, electronic gadgets etc. and the same would be handed over only after punishment finalized by Malpractice Committee.
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 and forfeits the seat. The performance of the original candidate Who has been impersonated, shall be cancelled in all the subjects of the examination (including practicals 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 two consecutive semesters from class work and all end semester 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 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 end semester 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
6.	Refuses to obey the orders of the Chief Superintendent/Assistant– Superintendent / any officer on duty or misbehaves or creates disturbance of any kind in and around the or organizes a walk out or instigates others **to** examination hall-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.	In case of students of the college, they shall be expelled from examination halls and cancellation of 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. The candidates are also debarred and forfeit their seats. 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 Semester End 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.	If the student belongs to the college, expulsion from the examination performance in that subject and all other subjects shall and cancellation of 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 state of inebriated/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 other 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 and all other subjects the candidate has appeared including practical examinations excluding Project work/ Mandatory Courses /Technical Seminar of that semester/year.
12.	If any malpractice is detected which is not covered in the above clauses 1 to 11 shall be	

	reported to the College Academic Committee for further action to award suitable punishment.	

Malpractices identified by squad or special invigilators

Punishments to the candidates as per the above guidelines.

Malpractice identified at Spot center during valuation

1) The following procedure is to be followed in the case of malpractice cases detected during valuation, scrutiny etc. at spot center. Malpractice is detected at the spot valuation. The case is to be referred to the malpractice committee. Malpractice committee will meet and discuss/question the candidate and based on the evidences, the committee will recommend suitable action on the candidate.
2) A notice is to be served to the candidate(s) involved through the Principal regarding the malpractice and seek explanations.
3) The involvement of staff who are in charge of conducting examinations, invigilators valuing examination papers and preparing / keeping records of documents relating to the examinations in such acts (inclusive of providing in correct or misleading information) that infringe upon the course of natural justice to one and all concerned at the examinations shall be viewed seriously and recommended for award of appropriate punishment after thorough enquiry.
4) Based on the explanation and recommendation of the committee action may be initiated.

Malpractice committee:

(a) Chief Superintendent	Chairman
(b) Controller of Examinations	Member
(c) Dean Academics	Member
(d) Chief Examiner of the Course/ Subject Expert	Member
(e) Concerned Head of the Department	Member
(f) Observer	Member

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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING
M. Tech (CSE) Course Structure R-22

(Applicable for the Batch admitted from the Academic Year 2022-23 onwards)

I Year I semester							
S.No	**Group**	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**
1	PC – I	B458301	Mathematical Foundations of Computer Science	3	0	0	3
2	PC – II	B458302	Advanced Data Structures	3	0	0	3
3	PE-I	B458401	Database Programming with PL/SQL	3	0	0	3
		B458402	Deep Learning				
		B458403	Natural Language Processing				
4	PE – II	B458404	Applied Cryptography	3	0	0	3
		B458405	Software Quality Engineering				
		B458406	Mining Massive Datasets				
5	Lab – I	B458501	Advanced Data Structures Lab	0	0	4	2
6	Lab – II		Professional Elective - I Lab	0	0	4	2
7		B458303	Research Methodology & IPR	2	0	0	2
8	Audit – I		Audit Course- I	2	0	0	0
TOTAL CREDITS				**16**	**0**	**8**	**18**

PE-Professional Elective, OE-Open Elective.
Professional Elective- III and Professional Elective- III Lab must be of same course.

I Year II Semester							
S.No	**Group**	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**
1	PC – III	B458304	Advanced Algorithms	3	0	0	3
2	PC – IV	B458305	Advanced Computer Architecture	3	0	0	3
3	PE – III	B458407	Enterprise Cloud Concepts	3	0	0	3
		B458408	Advanced Computer Networks				
		B458409	Edge Analytics				
4	PE-IV	B458410	Bioinformatics	3	0	0	3
		B458411	Nature Inspired Computing				
		B458412	Robotic Process Automation				
5	Lab – III	B40532	Advanced Algorithms Lab	0	0	4	2
6	Lab – IV		Professional Elective - III Lab	0	0	4	2
7		B458306	Mini Project with Seminar	0	0	4	2
8.	Audit – II		Audit Course- II	2	0	0	2
TOTAL CREDITS				**14**	**0**	**12**	**18**

PE-Professional Elective, OE-Open Elective.
Professional Elective- III and Professional Elective- III Lab must be of same course.

II Year III Semester							
S.No	**Group**	**Course code**	**Course Title**	**L**	**T**	**P**	**C**
1	PE -V	B40519	Digital Forensics	3	0	0	3
		B40520	High Performance Computing				
		B40521	Quantum Computing				
2	OE		Open Elective	3	0	0	3
3	Dissertation	B458802	Dissertation Work Review – I	0	0	12	6
TOTAL CREDITS				**6**	**0**	**12**	**12**

PE-Professional Elective, OE-Open Elective

II Year IV Semester							
S.No	**Group**	**Course code**	**Course Title**	**L**	**T**	**P**	**C**
1	Dissertation	B458803	Dissertation Work Review – II	0	0	12	6
2	Dissertation	B458804	Dissertation Viva-Voce	0	0	28	14
TOTAL CREDITS				**0**	**0**	**40**	**20**

List of Professional Elective Labs

Course Code	Group	Course Name
B458503	PE-I	Database Programming with PL/SQL Lab
B458504		Deep Learning Lab
B458505		Natural Language Processing Lab
B458506	PE-III	Enterprise Cloud Concepts Lab
B458507		Advanced Computer Networks Lab
B458508		Edge Analytics Lab

List of Audit Courses

S.No	Code	Audit Course Title
1	B400701	English for Research Paper Writing
2	B400702	Disaster Management
3	B400703	Sanskrit for Technical Knowledge
4	B400704	Value Education
5	B400705	Constitution of India
6	B400706	Pedagogy Studies
7	B400707	Stress Management by yoga
8	B400708	Personality Development Through Life Enlightenment Skills

List of Open Electives offered by the Department

S.No	Code	Open Electives
1	B458601	Optimization Techniques

****END****

(B458301) MATHEMATICAL FOUNDATIONS OF COMPUTER SCIENCE

M. Tech CSE/CS I Year I Sem.

L	T	P	C
3	0	0	3

Pre-requisites: An understanding of Math in general is sufficient.
Course Objectives: To learn
1.Introduces the elementary discrete mathematics for computer science and engineering.
2.Topics include formal logic notation, methods of proof, induction, sets, relations, graph theory, permutations and combinations, counting principles; recurrence relations and generating functions.

Course Outcomes:
After learning the contents of this paper the student must be able to
1.Ability to understand and construct precise mathematical proofs.
2.Ability to use logic and set theory to formulate precise statements.
3.Ability to analyze and solve counting problems on finite and discrete structures.
4.Ability to describe and manipulate sequences.
5.Ability to apply graph theory in solving computing problems.

UNIT-I:
The Foundations Logic and Proofs: Propositional Logic, Applications of Propositional Logic, Propositional Equivalence, Predicates and Quantifiers, Nested Quantifiers, Rules of Inference, Introduction to Proofs, Proof Methods and Strategy.

UNIT-II:
Basic Structures, Sets, Functions, Sequences, Sums, Matrices and Relations: Sets, Functions, Sequences & Summations, Cardinality of Sets and Matrices Relations, Relations and Their Properties, n-ary Relations and Their Applications, Representing Relations, Closures of Relations, Equivalence Relations, Partial Orderings.

UNIT-III:
Algorithms, Induction and Recursion: Algorithms, The Growth of Functions, Complexity of Algorithms. Induction and Recursion: Mathematical Induction, Strong Induction and Well-Ordering, Recursive Definitions and Structural Induction, Recursive Algorithms, Program Correctness.

UNIT-IV:
Discrete Probability and Advanced Counting Techniques:
An Introduction to Discrete Probability. Probability Theory, Bayes' Theorem, Expected Value and Variance. Advanced Counting Techniques:
Recurrence Relations, Solving Linear Recurrence Relations, Divide-and-Conquer Algorithms and Recurrence Relations, Generating Functions, Inclusion-Exclusion, Applications of Inclusion-Exclusion.

UNIT-V:
Graphs: Graphs and Graph Models, Graph Terminology and Special Types of Graphs, Representing Graphs and Graph Isomorphism, Connectivity, Euler and Hamilton Paths, Shortest-Path Problems, Planar Graphs, Graph Coloring.

Trees: Introduction to Trees, Applications of Trees, Tree Traversal, Spanning Trees, Minimum Spanning Trees.

TEXT BOOKS:

1.Discrete Mathematical Structures with Applications to Computer Science: J.P. Tremblay, R. Manohar, McGraw-Hill, 1st ed.

2.Discrete Mathematics for Computer Scientists & Mathematicians: Joe l. Mott, Abraham Kandel, Teodore P. Baker, Prentis Hall of India, 2nd ed.

REFERENCES:

1.Discrete and Combinatorial Mathematics - an applied introduction: Ralph.P. Grimald, Pearson education, 5th edition.
2.Discrete Mathematical Structures: Thomas Kosy, Tata McGraw Hill publishing co.

****END****

(B458302) ADVANCED DATA STRUCTURES (PC-II)

	L	T	P	C
M.Tech CSE/CS I Year I Sem.	**3**	**0**	**0**	**3**

Prerequisites: A course on "Data Structures"

Course Objectives
1.Introduces the heap data structures such as leftist trees, binomial heaps, Fibonacci and min- max heaps
2.Introduces a variety of data structures such as disjoint sets, hash tables, search structures and digital search structures

Course Outcomes
1.Ability to select the data structures that efficiently model the information in a problem
2.Ability to understand how the choice of data structures impact the performance of programs
3.Design programs using a variety of data structures, including hash tables, search structures and digital search structures

UNIT - I
Heap Structures
Introduction, Min-Max Heaps, Leftist trees, Binomial Heaps, Fibonacci heaps.

UNIT - II
Hashing and Collisions
Introduction, Hash Tables, Hash Functions, different Hash Functions: Division Method, Multiplication Method, Mid-Square Method, Folding Method, Collisions

UNIT - III
Search Structures: OBST, AVL trees, Red-Black trees, Splay trees,
Multiway Search Trees: B-trees, 2-3 trees

UNIT - IV
Digital Search Structures
Digital Search trees, Binary tries and Patricia, Multiway Tries, Suffix trees, Standard Tries, Compressed Tries

UNIT - V
Pattern matching
Introduction, Brute force, the Boyer –Moore algorithm, Knuth-Morris-Pratt algorithm, Naïve String, Harspool, Rabin Karp

TEXT BOOKS:
1.Fundamentals of data structures in C++ Sahni, Horowitz, Mehatha, Universities Press.
2.Introduction to Algorithms, TH Cormen, PHI

REFERENCES:

1.Design methods and analysis of Algorithms, SK Basu, PHI.
2.Data Structures & Algorithm Analysis in C++, Mark Allen Weiss, Pearson Education.
3.Fundamentals of Computer Algorithms, 2nd Edition, Ellis Horowitz, Sartaj Sahni, Sanguthevar Rajasekaran, Universities Press.

(B458401) DATABASE PROGRAMMING WITH PL/SQL (Professional Elective - I)

M.Tech CSE/CS I Year I Sem.

L	T	P	C
3	0	0	3

Course Objectives:
1.Knowledge on significance of SQL fundamentals.
2.Evaluate functions and triggers of PL/SQL
3.Knowledge on control structures, packages in PL/SQL and its applications

Course Outcomes:
1.Understand importance of PL/SQL basics
2.Implement functions and procedures using PL/SQL
3.Understand the importance of triggers in database

UNIT - I
PL/SQL Basics: Block Structure, Behavior of Variables in Blocks, Basic Scalar and Composite Data Types, Control Structures, Exceptions, Bulk Operations, Functions, Procedures, and Packages, Transaction Scope.

UNIT - II
Language Fundamentals & Control Structures: Lexical Units, Variables and Data Types, Conditional Statements, Iterative Statements, Cursor Structures, Bulk Statements, Introduction to Collections, Object Types: Varray and Table Collections, Associative Arrays, Oracle Collection API.

UNIT - III
Functions and Procedures: Function and Procedure Architecture, Transaction Scope, Calling Subroutines, Positional Notation, Named Notation, Mixed Notation, Exclusionary Notation, SQL Call Notation, Functions, Function Model Choices, Creation Options, Pass-by-Value Functions, Pass-by- Reference Functions, Procedures, Pass-by-Value Procedures, Pass-by-Reference Procedures, Supporting Scripts.

UNIT - IV
Packages: Package Architecture, Package Specification, Prototype Features, Serially Reusable Precompiler Directive, Variables, Types, Components: Functions and Procedures, Package Body, Prototype Features, Variables, Types, Components: Functions and Procedures, Definer vs. Invoker Rights Mechanics, Managing Packages in the Database Catalog, Finding, Validating, and Describing Packages, Checking Dependencies, Comparing Validation Methods: Timestamp vs. Signature.

UNIT - V
Triggers: Introduction to Triggers, Database Trigger Architecture, Data Definition Language Triggers, Event Attribute Functions, Building DDL Triggers, Data Manipulation Language Triggers, Statement-Level Triggers, Row-Level Triggers, Compound Triggers, INSTEAD OF Triggers, System and Database Event Triggers, Trigger Restrictions, Maximum Trigger Size, SQL Statements, LONG and LONG RAW Data Types.

TEXT BOOKS:

1. Oracle Database 12c PL/SQL Programming Michael McLaughlin, McGrawHill Education

REFERENCES:

1.Benjamin Rosenzweig, Elena Silvestrova Rakhimov, Oracle PL/SQL by example Fifth Edition
2.Dr. P. S. Deshpande, SQL & PL / SQL for Oracle 11g Black Book

END

(B458402) DEEP LEARNING (Professional Elective - I)

M.Tech CSE/CS I Year I Sem.

L	T	P	C
3	0	0	3

Course Objectives: students will be able
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:
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
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
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
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
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-Wordsmodel (CBOW), Glove, Evaluations and Applications in word similarity

UNIT - V
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

TEXT BOOKS:
1.Deep Learning by Ian Goodfellow, Yoshua Bengio 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.

REFERENCES:

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.

END

(B458403) NATURAL LANGUAGE PROCESSING (Professional Elective - I)

M.Tech CSE/CS I Year I Sem.

L	T	P	C
3	0	0	3

Prerequisites:
1.Data structures, finite automata and probability theory.
Course Objectives:
1. Introduction to some of the problems and solutions of NLP and their relation to linguistics and statistics.
Course Outcomes:
1.Show sensitivity to linguistic phenomena and an ability to model them with formal grammars.
2.Understand and carry out proper experimental methodology for training and evaluating empirical NLP systems
3.Able to manipulate probabilities, construct statistical models over strings and trees, and estimate parameters using supervised and unsupervised training methods.
4.Able to design, implement, and analyze NLP algorithms Able to design different language modeling Techniques.
5.Able to design different language modeling Techniques.

UNIT - I
Finding the Structure of Words: Words and Their Components, Issues and Challenges, Morphological Models. Finding the Structure of Documents: Introduction, Methods, Complexity of the Approaches, Performances of the Approaches

UNIT - II
Syntax Analysis: Parsing Natural Language, Treebanks: A Data-Driven Approach to Syntax, Representation of Syntactic Structure, Parsing Algorithms, Models for Ambiguity Resolution in Parsing, Multilingual Issues.

UNIT - III
Semantic Parsing: Introduction, Semantic Interpretation, System Paradigms, Word Sense Systems, Software.

UNIT - IV
Predicate-Argument Structure, Meaning Representation Systems, Software.

UNIT - V
Discourse Processing: Cohesion, Reference Resolution, Discourse Cohesion and Structure Language Modeling: Introduction, N-Gram Models, Language Model Evaluation, Parameter Estimation, Language Model Adaptation, Types of Language Models, Language-Specific Modeling Problems, Multilingual and Cross Lingual Language Modeling.

TEXT BOOKS:
1.Multilingual natural Language Processing Applications: From Theory to Practice – Daniel M. Bikel and Imed Zitouni, Pearson Publication

2.Natural Language Processing and Information Retrieval: Tanvier Siddiqui, U.S. Tiwary

REFERENCE:

1. Speech and Natural Language Processing - Daniel Jurafsky & James H Martin, Pearson Publications

(B458404) APPLIED CRYPTOGRAPHY (Professional Elective - II)

M.Tech CSE/CS I Year I Sem.

L	T	P	C
3	0	0	3

Course Objectives:
Knowledge on significance of cryptographic protocols and symmetric and public key algorithms

Course Outcomes:
1.Understand the various cryptographic protocols
2.Analyze key length and algorithm types and modes
3.Illustrate different public key algorithms in cryptosystems
4.Understand special algorithms for protocols and usage in the real world.

UNIT - I
Foundations: Terminology, Steganography, Substitution Ciphers and Transposition Ciphers, Simple XOR, One-Time Pads, Computer Algorithms, Large Numbers,
Cryptographic Protocols: Protocol Building Blocks: Introduction to Protocols, Communications Using Symmetric Cryptography, One-Way Functions, One-Way Hash Functions, Communications Using Public-Key Cryptography, Digital Signatures, Digital Signatures with Encryption, Random and Pseudo-Random-Sequence Generation

UNIT - II
Cryptographic Techniques: Key length: Symmetric Key length, Public key length, comparing symmetric and public key length.
Algorithm types and modes: Electronic Codebook Mode, Block Replay, Cipher Block Chaining Mode, Stream Cipher, Self-Synchronizing Stream Ciphers, Cipher-Feedback Mode, Synchronous Stream Ciphers, Output-Feedback Mod, Counter Mode, Other Block-Cipher Modes.

UNIT - III
Public-Key Algorithms: Background, Knapsack Algorithms, RSA, Pohlig-Hellman, Rabin, ElGamal, McEliece, Elliptic Curve Cryptosystems, LUC, Finite Automaton Public-Key Cryptosystems
Public-Key Digital Signature Algorithms: Digital Signature Algorithm (DSA), DSA Variants, Gost Digital Signature Algorithm, Discrete Logarithm Signature Schemes, Ong-Schnorr-Shamir, ESIGN

UNIT - IV
Special Algorithms for Protocols: Multiple-Key Public-Key Cryptography, Secret-Sharing Algorithms, Subliminal Channel, Undeniable Digital Signatures, Designated Confirmer Signatures, Computing with Encrypted Data, Fair Coin Flips, One-Way Accumulators, All-or-Nothing Disclosure of Secrets, Fair and Failsafe Cryptosystems, Zero-Knowledge Proofs of Knowledge, Blind Signatures, Oblivious Transfer, Secure Multiparty Computation, Probabilistic Encryption, Quantum Cryptography

UNIT - V

Real World Approaches: IBM Secret key management protocol, ISDN, Kerberos, KryptoKnight, Privacy enhanced mail (PEM), Message security protocol (MSP), PGP, Public-Key Cryptography Standards (PKCS), Universal Electronic Payment System (UEPS).

TEXTBOOKS:

1.Bruce Schneier, Applied Cryptography, Second Edition: Protocols, Algorithms, and Source Code in C (cloth)

****END****

(B458405) SOFTWARE QUALITY ENGINEERING (Professional Elective - II)

M.Tech CSE/CS I Year I Sem.	**L**	**T**	**P**	**C**
	3	**0**	**0**	**3**

Course Objectives: Knowledge on significance of Quality, quality assurance, quality engineering.

Course Outcomes:
1.Understand software quality and its perspectives
2.Analyze defect prevention and defect reduction in software quality assurance
3.Illustrate software quality engineering activities and its process

UNIT - I
Software Quality: Quality: perspectives and expectations, Quality frameworks and ISO-9126, correctness and defects: Definitions, properties and Measurements, A historical perspective of quality, software quality.

UNIT - II
Quality Assurance: Classification: QA as dealing with defects, Defect prevention- Education and training, Formal method, Other defect prevention techniques, Defect Reduction - Inspection: Direct fault detection and removal, Testing: Failure observation and fault removal, other techniques and risk identification, Defect Containment- software fault tolerance, safety assurance and failure containment

UNIT - III
Quality Engineering: Activities and process, Quality planning: Goal setting and Strategy formation, Quality assessment and Improvement, Quality engineering in software process.

UNIT - IV
Test Activities, Management and Automation: Test planning and preparation, Test execution, Result checking and measurement, Analysis and follow- up, Activities People and Management, Test Automation.

UNIT - V
Coverage and usage testing based on checklist and partitions: Checklist based testing and its limitations, Testing for partition Coverage, Usage based Statistical testing with Musa's operational profiles, Constructing operational profiles
Case Study: OP for the cartridge Support Software

TEXT BOOKS:
1.Jeff Tia`n, Software Quality Engineering, Testing, Quality Assurance, and Quantifiable improvement
2.Richard N. Taylor, Software Architecture: Foundations, Theory, and Practice

(B458406) MINING MASSIVE DATASETS (Professional Elective - II)

M.Tech CSE/CS I Year I Sem.

L	T	P	C
3	0	0	3

Prerequisites:
1.Students should be familiar with Data mining, algorithms, basic probability theory and Discrete math.

Course Objectives:
1.This course will cover practical algorithms for solving key problems in mining of massive datasets.
2.This course focuses on parallel algorithmic techniques that are used for large datasets.
3.This course will cover stream processing algorithms for data streams that arrive constantly, page ranking algorithms for web search, and online advertisement systems that are studied in detail.

Course Outcomes:
1.Handle massive data using MapReduce.
2.Develop and implement algorithms for massive data sets and methodologies in the context of data mining.
3.Understand the algorithms for extracting models and information from large datasets
4.Develop recommendation systems.
5.Gain experience in matching various algorithms for particular classes of problems.

UNIT - I:
Data Mining-Introduction-Definition of Data Mining-Statistical Limits on Data Mining, MapReduce and the New Software Stack-Distributed File Systems, MapReduce, Algorithms Using MapReduce.

UNIT - II:
Similarity Search: Finding Similar Items-Applications of Near-Neighbor Search, Shingling of Documents, Similarity-Preserving Summaries of Sets, Distance Measures.
Streaming Data: Mining Data Streams-The Stream Data Model , Sampling Data in a Stream, Filtering Streams.

UNIT - III:
Link Analysis-PageRank, Efficient Computation of PageRank, Link Spam
Frequent Itemsets-Handling Larger Datasets in Main Memory, Limited-Pass Algorithms, Counting Frequent Items in a Stream.
Clustering-The CURE Algorithm, Clustering in Non-Euclidean Spaces, Clustering for Streams and Parallelism.

UNIT - IV:
Advertising on the Web-Issues in On-Line Advertising, On-Line Algorithms, The Matching Problem, The Adwords Problem, Adwords Implementation.
Recommendation Systems-A Model for Recommendation Systems, Content-Based Recommendations, Collaborative Filtering, Dimensionality Reduction, The NetFlix Challenge.

UNIT - V:
Mining Social-Network Graphs-Social Networks as Graphs, Clustering of Social-Network Graphs, Partitioning of Graphs, Simrank, Counting Triangles.

TEXT BOOK:
1. Jure Leskovec, Anand Rajaraman, Jeff Ullman, Mining of Massive Datasets, 3rd Edition.

REFERENCES:
1.Jiawei Han & Micheline Kamber , Data Mining – Concepts and Techniques 3rd Edition Elsevier.
2.Margaret H Dunham, Data Mining Introductory and Advanced topics, PEA.
3.Ian H. Witten and Eibe Frank, Data Mining: Practical Machine Learning Tools and Techniques, Morgan Kaufmann.

END

(B458501) ADVANCED DATA STRUCTURES LAB (Lab - I)

M.Tech CSE/CS I Year I Sem.

L	T	P	C
0	0	4	2

Prerequisites:
1.A course on Computer Programming & Data Structures
Course Objectives:
1.Introduces the basic concepts of Abstract Data Types.
2.Reviews basic data structures such as stacks and queues.
3.Introduces a variety of data structures such as hash tables, search trees, tries, heaps, graphs, and B-trees.
4.Introduces sorting and pattern matching algorithms.

Course Outcomes:
1.Ability to select the data structures that efficiently model the information in a problem.
2.Ability to assess efficiency trade-offs among different data structure implementations or combinations.
3.Implement and know the application of algorithms for sorting and pattern matching.
4.Design programs using a variety of data structures, including hash tables, binary and general tree structures, search trees, tries, heaps, graphs, and B-trees.

List of Programs
1.Write a program to perform the following operations:
a)Insert an element into a binary search tree.
b)Delete an element from a binary search tree.
c)Search for a key element in a binary search tree.

2.Write a program for implementing the following sorting methods:
a)Merge sort b) Heap sort c) Quick sort

3.Write a program to perform the following operations:
a)Insert an element into a B- tree.
b)Delete an element from a B- tree.
c)Search for a key element in a B- tree.

4.Write a program to perform the following operations:
a) Insert an element into a Min-Max heap
b) Delete an element from a Min-Max heap
c) Search for a key element in a Min-Max heap

5.Write a program to perform the following operations:
a) Insert an element into a Lefiist tree
b) Delete an element from a Leftist tree
c) Search for a key element in a Leftist tree

6. Write a program to perform the following operations:
a) Insert an element into a binomial heap

b) Delete an element from a binomial heap.
c) Search for a key element in a binomial heap

7.Write a program to perform the following operations:
a) Insert an element into a AVL tree.
b) Delete an element from a AVL search tree.
c) Search for a key element in a AVL search tree.

8.Write a program to perform the following operations:
a) Insert an element into a Red-Black tree.
b) Delete an element from a Red-Black tree.
c) Search for a key element in a Red-Black tree.

9.Write a program to implement all the functions of a dictionary using hashing.

10.Write a program for implementing Knuth-Morris-Pratt pattern matching algorithm.

11.Write a program for implementing Brute Force pattern matching algorithm.

12.Write a program for implementing Boyer pattern matching algorithm.

TEXT BOOKS:

1.Fundamentals of Data structures in C, E. Horowitz, S. Sahni and Susan Anderson Freed, 2nd Edition, Universities Press
2.Data Structures Using C – A.S. Tanenbaum, Y. Langsam, and M.J. Augenstein, PHI/Pearson education.
3.Introduction to Data Structures in C, Ashok Kamthane, 1st Edition, Pearson.

REFERENCES:

1.The C Programming Language, B.W. Kernighan, Dennis M. Ritchie, PHI/Pearson Education
2.C Programming with problem solving, J.A. Jones & K. Harrow, Dreamtech Press
3.Data structures: A Pseudocode Approach with C, R.F. Gilberg And B.A. Forouzan, 2nd Edition, Cengage Learning

(B458503) DATABASE PROGRAMMING WITH PL/SQL LAB (Lab - II)

M.Tech CSE/CS I Year I Sem.

L	T	P	C
0	0	4	2

Course Objectives:
1.Knowledge on significance of SQL fundamentals.
2.Evaluate functions and triggers of PL/SQL
3.Knowledge on control structures, packages in PL/SQL and its applications

Course Outcomes:
1.Understand importance of PL/SQL basics
2.Implement functions and procedures using PL/SQL
3.Understand the importance of triggers in database

List of Experiments:
1.Write a Pl/SQL program using FOR loop to insert ten rows into a database table.

2.Given the table EMPLOYEE (EmpNo, Name, Salary, Designation, DeptID), write a cursor to select the five highest paid employees from the table.

3.Illustrate how you can embed PL/SQL in a high-level host language such as C/Java And demonstrates how a banking debit transaction might be done.

4.Given an integer i, write a PL/SQL procedure to insert the tuple (i, 'xxx') into a given relation.

5.Write a PL/SQL program to demonstrate Exceptions.

6.Write a PL/SQL program to demonstrate Cursors.

7.Write a PL/SQL program to demonstrate Functions.

8.Write a PL/SQL program to demonstrate Packages.

9.Write PL/SQL queries to create Procedures.

10.Write PL/SQL queries to create Triggers.

****END****

(B458504) DEEP LEARNING LAB (Lab - II)

M.Tech CSE/CS I Year I Sem.

L	T	P	C
0	0	4	2

Course Objectives:

1.To Build The Foundation Of Deep Learning.

2.To Understand How To Build The Neural Network.

3.To enable students to develop successful machine learning concepts.

Course Outcomes:

1.Upon the Successful Completion of the Course, the Students would be able to:
2.Learn the Fundamental Principles Of Deep Learning.
3.Identify the Deep Learning Algorithms For Various Types of Learning Tasks in various domains.
4.Implement Deep Learning Algorithms And Solve Real-world problems.

LIST OF EXPERIMENTS:

1.Setting up the Spyder IDE Environment and Executing a Python Program

2.Installing Keras, Tensorflow and Pytorch libraries and making use of them

3.Applying the Convolution Neural Network on computer vision problems

4.Image classification on MNIST dataset (CNN model with Fully connected layer)

5.Applying the Deep Learning Models in the field of Natural Language Processing

6.Train a sentiment analysis model on IMDB dataset, use RNN layers with LSTM/GRU notes

7.Applying the Autoencoder algorithms for encoding the real-world data

8.Applying Generative Adversial Networks for image generation and unsupervised tasks.

TEXT BOOKS:

1.Deep Learning by Ian Goodfellow, Yoshua Bengio 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.

REFERENCES:

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.

Extensive Reading:

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

(B458505) NATURAL LANGUAGE PROCESSING LAB (Lab - II)

M. Tech CSE/CS I Year I Sem.	**L**	**T**	**P**	**C**
	0	**0**	**4**	**2**

Prerequisites: Data structures, finite automata and probability theory

Course Objectives:
1.To Develop and explore the problems and solutions of NLP.

Course Outcomes:
1.Show sensitivity to linguistic phenomena and an ability to model them with formal grammars.
2.Able to manipulate probabilities, construct statistical models over strings and trees, and estimate parameters using supervised and unsupervised training methods.
3.Able to design, implement, and analyze NLP algorithms

List of Experiments
Implement the following using Python

1.Tokenization

2.Stemming

3.Stop word removal (a, the, are)

4.Word Analysis

5.Word Generation

6.Pos tagging

7.Morphology

8.chunking

9.N-Grams

10.N-Grams Smoothing

TEXT BOOKS:
1.Multilingual natural Language Processing Applications: From Theory to Practice – Daniel M. Bikel and Imed Zitouni, Pearson Publication.
2.Natural Language Processing and Information Retrieval: Tanvier Siddiqui, U.S. Tiwary.

REFERENCES:
1. Speech and Natural Language Processing - Daniel Jurafsky & James H Martin, Pearson Publications.

(B458303) RESEARCH METHODOLOGY & IPR

M.Tech CSE/CS I Year I Sem.

L	T	P	C
2	0	0	2

Prerequisite: None

Course Objectives:
1.To understand the research problem
2.To know the literature studies, plagiarism and ethics
3.To get the knowledge about technical writing
4.To analyze the nature of intellectual property rights and new developments
5.To know the patent rights

Course Outcomes: At the end of this course, students will be able to
1.Understand research problem formulation.
2.Analyze research related information
3.Follow research ethics
4.Understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.
5.Understanding that when IPR would take such important place in growth of individuals & nation, it is needless to emphasis the need of information about Intellectual Property Right to be promoted among students in general & engineering in particular.
6.Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.

UNIT - I:
Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations.

UNIT - II:
Effective literature studies approaches, analysis, Plagiarism, Research ethics

UNIT - III:
Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee

UNIT - IV:
Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

UNIT - V:

Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications. New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

TEXT BOOKS:

1.Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science & engineering students"
2.C.R. Kothari, Research Methodology, methods & techniques, 2nd edition, New age International publishers

REFERENCES:

1.Ranjit Kumar, 2nd Edition, "Research Methodology: A Step by Step Guide for beginners"
2.Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd ,2007.
3.Mayall, "Industrial Design", McGraw Hill, 1992.
4.Niebel, "Product Design", McGraw Hill, 1974.
5.Asimov, "Introduction to Design", Prentice Hall, 1962.
6.Robert P. Merges, Peter S. Menell, Mark A. Lemley, "Intellectual Property in New Technological Age", 2016.
7.T. Ramappa, "Intellectual Property Rights Under WTO", S. Chand, 2008

(B458304) ADVANCED ALGORITHMS (PC - III)

	L	T	P	C
M.Tech CSE/CS I Year II Sem.	**0**	**0**	**4**	**2**

Pre-Requisites: UG level course in Algorithm Design and Analysis

Course Objectives:
1.Introduce students to the advanced methods of designing and analyzing algorithms.
2.The student should be able to choose appropriate algorithms and use it for a specific problem.
3.To familiarize students with basic paradigms and data structures used to solve advanced algorithmic problems.
4.Students should be able to understand different classes of problems concerning their computation difficulties.
5.To introduce the students to recent developments in the area of algorithmic design.

Course Outcomes: After completion of course, students would be able to:
1.Analyze the complexity/performance of different algorithms.
2.Determine the appropriate data structure for solving a particular set of problems.
3.Categorize the different problems in various classes according to their complexity.

UNIT – I
Sorting: Review of various sorting algorithms, topological sorting
Graph: Definitions and Elementary Algorithms: Shortest path by BFS, shortest path in edge-weighted case (Dijkstra's), depth-first search and computation of strongly connected components, emphasis on correctness proof of the algorithm and time/space analysis, example of amortized analysis.

UNIT – II
Matroids: Introduction to greedy paradigm, algorithm to compute a maximum weight maximal independent set. Application to MST.
Graph Matching: Algorithm to compute maximum matching. Characterization of maximum matching by augmenting paths, Edmond's Blossom algorithm to compute augmenting path.

UNIT - III
Flow-Networks: Maxflow-mincut theorem, Ford-Fulkerson Method to compute maximum flow, Edmond-Karp maximum-flow algorithm.
Matrix Computations: Strassen's algorithm and introduction to divide and conquer paradigm, inverse of a triangular matrix, relation between the time complexities of basic matrix operations, LUP-decomposition.

UNIT - IV
Shortest Path in Graphs: Floyd-Warshall algorithm and introduction to dynamic programming paradigm. More examples of dynamic programming.
Modulo Representation of integers/polynomials: Chinese Remainder Theorem, Conversion between base-representation and modulo-representation. Extension to polynomials. Application: Interpolation problem.

Discrete Fourier Transform (DFT): In complex field, DFT in modulo ring. Fast Fourier Transform algorithm. Schonhage-Strassen Integer Multiplication algorithm.

UNIT - V

Linear Programming: Geometry of the feasibility region and Simplex algorithm
NP-completeness: Examples, proof of NP-hardness and NP-completeness.
Recent Trends in problem solving paradigms using recent searching and sorting techniques by applying recently proposed data structures.

REFERENCES:

1.Cormen, Leiserson, Rivest, Stein, "Introduction to Algorithms".
2.Aho, Hopcroft, Ullman "The Design and Analysis of Computer Algorithms".
3.Kleinberg and Tardos."Algorithm Design".

END

(B458305) ADVANCED COMPUTER ARCHITECTURE (PC - III)

M.Tech CSE/CS I Year II Sem.	**L**	**T**	**P**	**C**
	3	**0**	**0**	**3**

Prerequisites: Computer Organization
Course Objectives:
1.To impart the concepts and principles of parallel and advanced computer architectures.
2.To develop the design techniques of Scalable and multithreaded Architectures.
3.To Apply the concepts and techniques of parallel and advanced computer architectures to design modern computer systems
Course Outcomes: Gain knowledge of
1.Computational models and Computer Architectures.
2.Concepts of parallel computer models.
3.Scalable Architectures, Pipelining, Superscalar processors

UNIT - I
Theory of Parallelism, Parallel computer models, The State of Computing, Multiprocessors and Multicomputers, Multivector 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
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
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
Parallel and Scalable Architectures, Multiprocessors and Multicomputers, Multiprocessor system interconnects, cache coherence and synchronization mechanism, Three Generations of Multicomputers, Message-passing Mechanisms, Multivetor and SIMD computers.

UNIT - V
Vector Processing Principles, Multivector Multiprocessors, Compound Vector processing, SIMD computer Organizations, The connection machine CM-5.

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

REFERENCES:
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.

****END****

(B458407) ENTERPRISE CLOUD CONCEPTS (Professional Elective - III)

M.Tech CSE/CS I Year II Sem	**L**	**T**	**P**	**C**
	3	**0**	**0**	**3**

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

Course Outcomes:

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

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

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

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

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

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

TEXT BOOKS:

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

REFERENCES:

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

****END****

(B458408) ADVANCED COMPUTER NETWORKS (Professional Elective - III)

	L	T	P	C
M.Tech CSE/CS I Year II Sem.	**3**	**0**	**0**	**3**

Prerequisites: Data Communication, Basic Networking Principles, Computer Networks

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

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

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

TEXT BOOKS:
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.

REFERENCES:

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

END

(B458409) EDGE ANALYTICS (Professional Elective - III)

M.Tech CSE/CS I Year II Sem.

L	T	P	C
3	0	0	3

Prerequisites
A basic knowledge of "Python Programming"

Course Objectives
1.The aim of the course is to introduce the fundamentals of Edge Analytics.
2.The course gives an overview of – Architectures, Components, Communication Protocols and tools used for Edge Analytics.

Course Outcomes
1.Understand the concepts of Edge Analytics, both in theory and in practical application.
2.Demonstrate a comprehensive understanding of different tools used at edge analytics.
3.Formulate, Design and Implement the solutions for real world edge analytics .

UNIT - I
Introduction to Edge Analytics
What is edge analytics, Applying and comparing architectures, Key benefits of edge analytics, Edge analytics architectures, Using edge analytics in the real world.

UNIT - II
Basic edge analytics components, Connecting a sensor to the ESP-12F microcontroller, KOM-MICS smart factory platform, Communications protocols used in edge analytics, Wi-Fi communication for edge analytics, Bluetooth for edge analytics communication, Cellular technologies for edge analytics communication, Long-distance communication using LoRa and Signfox for edge analytics.

UNIT - III
Working with Microsoft Azure IoT Hub, Cloud Service providers, Microsoft Azure, Exploring the Azure portal, Azure ioT Hub, Using the Raspberry Pi with Azure IoT edge, Connecting our Raspberry Pi edge device, adding a simulated temperature sensor to our edge device.

UNIT - IV
Using Micropython for Edge Analytics, Understanding Micropython, Exploring the hardware that runs MicroPython, Using MicroPython for an edge analytics application, Using edge intelligence with microcontrollers, Azure Machine Learning designer, Azure IoT edge custom vision.

UNIT - V
Designing a Smart Doorbell with Visual Recognition setting up the environment, Writing the edge code, creating the Node-RED dashboard, Types of attacks against our edge analytics applications, Protecting our edge analytics applications

TEXT BOOK:
1. Hands-On Edge Analytics with Azure IoT: Design and develop IoT applications with edge analytical solutions including Azure IoT Edge by Colin Dow

REFERENCES:

1. Learn Edge Analytics - Fundamentals of Edge Analytics: Automated analytics at source using Microsoft Azure by Ashish Mahajan

END

(B458410) BIOINFORMATICS (Professional Elective - IV)

	L	T	P	C
M.Tech CSE/CS I Year II Sem.	**3**	**0**	**0**	**3**

Course Objectives: Knowledge on concepts of bioinformatics and biological motivations of sequence analysis

Course Outcomes:
1.Understand the Central Dogma & XML (Bio XML) for Bioinformatics
2.Analyze Perl (Bioperl) for Bioinformatics
3.Illustrate Databases technology, architecture and its interfaces
4.Understand Sequence Alignment Algorithms, Phylogenetic Analysis

UNIT -I:
The Central Dogma & XML (Bio XML) for Bioinformatics: Watson's definition, information flow, from data to knowledge, Convergence, the organization of DNA, the organization of Proteins, Introduction, Differences between HTML and XML, fundamentals of XML, fundamentals of XML namespaces. Introduction to DTDs, Document type Declarations, Declaring elements, declaring attributes, working with entities XML Schemas, Essential Concepts, working with simple types, working with complex types, Basic namespaces issues.

UNIT -II:
Perl (Bioperl) for Bioinformatics: Representing sequence data, program to store a DNA sequence, concatenating DNA fragments, Transcription, Calculating the reverse complement in Perl, Proteins, files, reading proteins in files, Arrays, Flow control, finding motifs, counting Nucleotides, exploding strings into arrays, operating on strings, writing to files, subroutines and bugs.

UNIT -III:
Databases: Flat file, Relational, object-oriented databases, object Relational and Hypertext, Data life cycle, Database Technology, Database Architecture, Database Management Systems and Interfaces.

UNIT -IV:
Sequence Alignment Algorithms: Biological motivations of sequence analysis, the models for sequence analysis and their biological motivation, global alignment, local alignment, End free-space alignment and gap penalty, Sequence Analysis tools and techniques.

UNIT -V:
Phylogenetic Analysis: Introduction, methods of Phylogenetic analysis, distance methods, the neighbor-Joining (NJ) method, The Fitch/ Margoliash method, character-based methods, Other methods, Tree evaluation and problems in phylogenetic analysis, Clustering, Protein structure visualization and Protein structure prediction.

TEXT BOOKS:
1.S.C. Rastogi, N. Mendiratta, "Bioinformatics Methods and Applications", CBS publications, 2004
2.James D. Tisdall, "Beginning Perl for Bioinformatics" O'Reilly media, 1st Edition, 2001

REFERENCE BOOKS:

1.D.R. Westhead, J.H. Parish, “Bioinformatics” Viva books private limited, New Delhi (2003)
2.Att Wood, “Bioinformatics” Pearson Education, 2004
3.Bryan Bergeron, M.D, “Bioinformatics Computing” Pearson Education, 2003

****END****

(B458411) NATURE INSPIRED COMPUTING (Professional Elective - IV)

	L	T	P	C
M.Tech CSE/CS I Year II Sem.	**3**	**0**	**0**	**3**

Course Objectives: Knowledge on significance of intelligence, genetic algorithms Ant Colony algorithms

Course Outcomes:
1.Familiar with Genetic algorithm and its applications.
2.Compare different Ant Colony Optimization algorithmic models.
3.Compare different Artificial Bee Colony Optimization algorithmic models.
4.Illustrate Particle swam optimization algorithm with an example.

UNIT - I:
Models of Life and Intelligence - Fundamentals of bio-inspired models and bio-inspired computing. Evolutionary models and techniques, Swarm models and its self-organization, swarm and evolutionary algorithms. Optimisation problems – single and multi-objective optimisation, heuristic, meta-heuristic and hyper heuristic functions.

UNIT - II:
Genetic algorithms - Mathematical foundation, Genetic problem solving, crossover and mutation. genetic algorithms and Markov process, applications of genetic algorithms

UNIT - III:
Ant Colony Algorithms - Ant colony basics, hybrid ant system, ACO in combinatorial optimisation, variations of ACO, case studies.

UNIT - IV:
Particle Swarm algorithms - particles moves, particle swarm optimisation, variable length PSO, applications of PSO, case studies. Artificial Bee Colony algorithms - ABC basics, ABC in optimisation, multi-dimensional bee colony algorithms, applications of bee algorithms, case studies.

UNIT - V:
Selected nature inspired techniques - Hill climbing, simulated annealing, Gaussian adaptation, Cuckoo search, Firey algorithm, SDA algorithm, bat algorithm, case studies. Other nature inspired techniques - Social spider algorithm, Cultural algorithms, Harmony search algorithm, Intelligent water drops algorithm, Artificial immune system, Flower pollination algorithm, case studies.

TEXT BOOKS:
1.Albert Y.Zomaya - "Handbook of Nature-Inspired and Innovative Computing", Springer, 2006
2.Floreano, D. and C. Mattiussi -"Bio-Inspired Artificial Intelligence: Theories, methods, and Technologies" IT Press, 2008

REFERENCES:
1.Leandro Nunes de Castro - " Fundamentals of Natural Computing, Basic Concepts, Algorithms and Applications", Chapman & Hall/ CRC, Taylor and Francis Group, 2007

2.Marco Dorrigo, Thomas Stutzle -" Ant Colony Optimization", Prentice Hall of India, New Delhi, 2005
3.Vinod Chandra S S, Anand H S - "Machine Learning: A Practitioner's Approach", Prentice Hall of India, New Delhi, 2020.

END

(B458412) ROBOTIC PROCESS AUTOMATION (Professional Elective - IV)

M.Tech CSE/CS I Year II Sem.

L	T	P	C
0	0	4	2

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

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

TEXT BOOKS:
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.

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

(B458502) ADVANCED ALGORITHMS LAB (Lab - III)

M.Tech CSE/CS I Year II Sem.

L	T	P	C
0	0	4	2

Course Objective: The student can able to attain knowledge in advanced algorithms.

Course Outcomes: The student can able to analyze the performance of algorithms

List of Experiments

1.Implement assignment problem using Brute Force method

2.Perform multiplication of long integers using divide and conquer method.

3.Implement a solution for the knapsack problem using the Greedy method.

4.Implement Gaussian elimination method.

5.Implement LU decomposition

6.Implement Warshall algorithm

7.Implement the Rabin Karp algorithm.

8.Implement the KMP algorithm.

9.Implement Harspool algorithm

10.Implement max-flow problem.

TEXT BOOK:

1. Design and Analysis of Algorithms, S.Sridhar, OXFORD University Press

REFERENCES:

1.Introduction to Algorithms, second edition, T.H. Cormen, C.E. Leiserson, R.L. Rivest and C. Stein, PHI Pvt. Ltd./ Pearson Education.
2.Fundamentals of Computer Algorithms, Ellis Horowitz, Satraj Sahni and Rajasekharam, Universities Press.
3.Design and Analysis of algorithms, Aho, Ullman and Hopcroft, Pearson education.

****END****

(B458506) ENTERPRISE CLOUD CONCEPTS LAB (Professional Elective - III Lab)

M.Tech CSE/CS I Year II Sem.

L	T	P	C
0	0	4	2

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

Course Outcomes:
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.

List of Experiments:
1.Install Virtualbox/VMware Workstation with different flavors of linux or windows OS on top of windows7 or 8.
2.Install a C compiler in the virtual machine created using virtual box and execute Simple Programs
3.Install Google App Engine. Create a hello world app and other simple web applications using python/java..
4.Find a procedure to transfer the files from one virtual machine to another virtual machine.
5.Find a procedure to launch virtual machine using trystack (Online Openstack Demo Version)
6.Install Hadoop single node cluster and run simple applications like word count.

E-Resources:
1. https://www.iitk.ac.in/nt/faq/vbox.htm 2.
3. https://www.cloudsimtutorials.online/cloudsim/
4.https://edwardsamuel.wordpress.com/2014/10/25/tutorial-creating-openstack-instance-in-trystack/
5. https://www.edureka.co/blog/install-hadoop-single-node-hadoop-cluster.

END

(B458507) ADVANCED COMPUTER NETWORKS LAB (Professional Elective - III Lab)

M.Tech CSE/CS I Year II Sem.	**L**	**T**	**P**	**C**
	0	**0**	**4**	**2**

Prerequisites: Data communication, Basic networking principles, Computer Networks

Course Objectives:
1.Understand and analyze the existing protocols
2.Understand the use of network packet capturing tools

Course Outcomes: Ability of acquiring the practical exposure to existing protocols

List of Experiments:

1.Implement the IP fragmentation and reassembly algorithm.
2.Implement the IP forwarding algorithm.
3.Implement the simplest sliding window protocol of TCP.
4.Connect two systems using a switch and configure private IP addresses to the systems and ping them from each other. Using Wireshark, capture packets and analyze all the header information in the packets captured.
5.Install Telnet on one of the systems connected by a switch and telnet to it from the other system. Using Wireshark, capture the packets and analyze the TCP 3-way Handshake for connection establishment and tear down.
6.Start packet capture in wireshark application and then open your web browser and type in an URL of the website of your choice. How long did it take from when the HTTP GET message was sent until the HTTP OK reply was received for the web page you visited in your web browser.

(B458508) EDGE ANALYTICS LAB (Professional Elective - III Lab)

M.Tech CSE/CS I Year II Sem.

L	T	P	C
0	0	4	2

Course Objectives:

1. Understand the concept of edge computing
2. Understand the Edge computing Architecture
3. Implement the edge computing in IOT
4. Understand the concept of multi-access edge computing
5. Implement edge computing in MEC

Course Outcomes:

1.Identify the benefits of edge computing
2.Develop the microservices in iofog
3.Develop user defined services in the edge
4.Create use cases in IOT with edge computing
5.Develop services in MEC
6.Implement use cases in MEC

List of Experiments:

1.Set up the Arduino IDE for ESP8266-12 module and program it to blink a LED light.
2.Installation tools to create and manage ECN's
3.Deploy micro services and writing your own microservices
4.Setup the Communication Parameters
5.Implement any two Communications protocols
6.Deploy modules to a Windows IoT Edge device
7.Create an IoT hub.
8.Register an IoT Edge device to your IoT hub.
9.Install and start the IoT Edge for Linux on Windows runtime on your device.
10.Remotely deploy a module to an IoT Edge device and send telemetry.
11.Python based basic programs using Raspberry Pi.
12.Deploy a module Manage your Azure IoT Edge device from the cloud to deploy a module that sends telemetry data to IoT Hub.
13.Publishing Data using HTTP.
14.Sensor Interfacing and Logging using MQTT.
15.File IO Example - # Example code to demonstrate writing and reading data to/from files
16.write code to turn on one of the LEDs on the board (Breadboard)

Additional Exercises on IOT Edge Analytics Applications

17.Temperature Logger
18.Home Automation

TEXT BOOKS:

1.Hands-On Edge Analytics with Azure IoT: Design and develop IoT applications with edge analytical solutions including Azure IoT Edge by Colin Dow
2.MicroPython for the Internet of Things A Beginner's Guide to Programming with Python on Microcontroller, Charles Bell, A Press.

REFERENCE BOOKS:

1.Learn Edge Analytics - Fundamentals of Edge Analytics: Automated analytics at source using Microsoft Azure by Ashish Mahajan
2.Peter Waher, "Mastering Internet of Things: Design and create your own IoT applications using Raspberry Pi 3", First Edition, Packt Publishing, 2018
3.John C. Shovic, "Raspberry Pi IoT Projects: Prototyping Experiments for Makers", Packt Publishing, 2016
4.Python for Microcontrollers: Getting Started with MicroPython Paperback – 16 December 2016, by Donald Norris, McGraw-Hill Education TAB
5.Programming with MicroPython: Embedded Programming with Microcontrollers and Python, by Nicholas H. Tollervey, O'Reilly
6.R. Buyya, S.N. Srirama (2019), Fog and Edge Computing: Principles and Paradigms, Wiley-Blackwell, 2019.

END

(B458413) DIGITAL FORENSICS (Professional Elective - V)

M.Tech CSE/CS II Year I Sem.

L	T	P	C
3	0	0	3

Pre-Requisites: Cybercrime and Information Warfare, Computer Networks

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: On completion of the course the student should 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
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
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
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
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
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

TEXT BOOKS:

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

REFERENCES:

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.

END

(B458414) HIGH PERFORMANCE COMPUTING (Professional Elective - V)

M.Tech CSE/CS II Year I Sem.	L	T	P	C
	3	0	0	3

Prerequisites:
1.Computer Organization & Architecture
2.Operating System Programming

Course Objectives:
1.To Improve the system performance
2.To learn various distributed and parallel computing architecture
3.To learn different computing technologies

Course Outcomes:
1.Understanding the concepts in grid computing
2.Ability to set up cluster and run parallel applications
3.Ability to understand the cluster projects and cluster OS
4.Understanding the concepts of pervasive computing & quantum computing.

UNIT - I
Grid Computing: Data & Computational Grids, Grid Architectures And Its Relations To Various Distributed Technologies. Autonomic Computing, Examples Of The Grid Computing Efforts (IBM).

UNIT - II
Cluster Computing at a Glance: Introduction, A Cluster Computer and its Architecture, Cluster Classifications, Commodity Components for clusters, Network Services/Communication SW, Cluster Middleware and SSI, RMS, Programming Environments and Tools, Cluster Applications.
Lightweight Messaging Systems: Introduction, Latency Bandwidth Evaluation of Communication performance, Traditional Communication Mechanisms for clusters, Lightweight Communication Mechanisms.

UNIT - III
Job and Resource Management Systems: Need of Job management, Components and Architecture.
Scheduling Parallel Jobs on Clusters: Introduction, Rigid Jobs with process migration, Malleable Jobs with Dynamic Parallelism, Communication-Based Coscheduling, Batch Scheduling.
Cluster Operating Systems: COMPaS.

UNIT - IV
Pervasive Computing Concepts & Scenarios: Hardware & Software; Human – Machine Interface.
Device Connectivity: Java For Pervasive Devices; Application Examples.

UNIT - V
Classical Vs Quantum Logic Gates: One, Two & Three Qubit Quantum Gates; Fredkin & Toffoli Gates; Quantum Circuits; Quantum Algorithms.

TEXT BOOKS:

1.Grid Computing, J. Joseph & C. Fellenstien, Pearson Education
2.High Performance Cluster Computing, Raj kumar Buyya, pearson Education.
3.Pervasive Computing, J. Burkhardt et.al, Pearson Education
4.Approaching Quantum Computing Marivesar, Pearson Education.

REFERENCES:

1.The Grid 2: Blue Print for a New Computing Infrastructure, Ian Foster and Carl Kesselman, 2 nd Edition, The Elsevier Series.
2.Quantum computing and Quantum Information, Neilsen & Chung L, Cambridge University Press.
3.A networking approach to Grid Computing, Minoli, Wiley

END

(B458415) QUANTUM COMPUTING (Professional Elective - V)

M.Tech CSE/CS II Year I Sem.

L	T	P	C
3	0	0	3

Course Objectives:
1.To introduce the fundamentals of quantum computing
2.The problem-solving approach using finite dimensional mathematics

Course Outcomes:
1.Understand basics of quantum computing
2.Understand physical implementation of Qubit
3.Understand Quantum algorithms and their implementation
4.Understand The Impact of Quantum Computing on Cryptography

UNIT - I
Introduction to Essential Linear Algebra: Some Basic Algebra, Matrix Math, Vectors and Vector Spaces, Set Theory.
Complex Numbers: Definition of Complex Numbers, Algebra of Complex Numbers, Complex Numbers Graphically, Vector Representations of Complex Numbers, Pauli Matrice, Transcendental Numbers.

UNIT - II
Basic Physics for Quantum Computing: The Journey to Quantum, Quantum Physics Essentials, Basic Atomic Structure, Hilbert Spaces, Uncertainty, Quantum States, Entanglement
Basic Quantum Theory: Further with Quantum Mechanics, Quantum Decoherence, Quantum Electrodynamics, Quantum Chromodynamics, Feynman Diagram Quantum Entanglement and QKD, Quantum Entanglement, Interpretation, QKE.

UNIT - III
Quantum Architecture: Further with Qubits, Quantum Gates, More with Gates, Quantum Circuits, The D-Wave Quantum Architecture.
Quantum Hardware: Qubits, How Many Qubits Are Needed? Addressing Decoherence, Topological Quantum Computing, Quantum Essentials.

UNIT - IV
Quantum Algorithms: What Is an Algorithm? Deutsch's Algorithm, Deutsch-Jozsa Algorithm, Bernstein-Vazirani Algorithm, Simon's Algorithm, Shor's Algorithm, Grover's Algorithm.

UNIT - V
Current Asymmetric Algorithms: RSA, Diffie-Hellman, Elliptic Curve
The Impact of Quantum Computing on Cryptography: Asymmetric Cryptography, Specific Algorithms, Specific Applications

TEXT BOOKS:
1.Nielsen M. A., Quantum Computation and Quantum Information, Cambridge University Press
2.Dr. Chuck Easttom, Quantum Computing Fundamentals, Pearson

REFERENCES:

1.Quantum Computing for Computer Scientists by Noson S. Yanofsky and Mirco A. Mannucci
2.Benenti G., Casati G. and Strini G., Principles of Quantum Computation and Information, Vol. Basic Concepts, Vol
3.Basic Tools and Special Topics, World Scientific. Pittenger A. O., An Introduction to Quantum Computing Algorithms

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(B458601) OPTIMIZATION TECHNIQUES (Open Elective)

M.Tech CNIS/CN/CYS II Year I Sem.
Prerequisite: Mathematics –I, Mathematics –II
Course Objectives:
1.To introduce various optimization techniques i.e classical, linear programming, transportation problem, simplex algorithm, dynamic programming
2.Constrained and unconstrained optimization techniques for solving and optimizing electrical and electronic engineering circuits design problems in real world situations.
3.To explain the concept of Dynamic programming and its applications to project implementation.

Course Outcomes: After completion of this course, the student will be able to:
1.explain the need of optimization of engineering systems.
2.understand optimization of electrical and electronics engineering problems.
3.apply classical optimization techniques, linear programming, simplex algorithm, transportation problem.
4.apply unconstrained optimization and constrained non-linear programming and dynamic programming.
5.Formulate optimization problems.

UNIT - I
Introduction and Classical Optimization Techniques: Statement of an Optimization problem – design vector – design constraints – constraint surface – objective function – objective function surface -classification of Optimization problems.
Linear Programming: Standard form of a linear programming problem – geometry of linear programming problems – definitions and theorems – solution of a system of linear simultaneous equations – pivotal reduction of a general system of equations – motivation to the simplex method – simplex algorithm.

UNIT - II
Transportation Problem: Finding initial basic feasible solution by north – west corner rule, least cost method and Vogel's approximation method – testing for optimality of balanced transportation problems. Degeneracy.Assignment problem – Formulation – Optimal solution - Variants of Assignment Problem; Traveling Salesman problem.

UNIT - III
Classical Optimization Techniques: Single variable Optimization – multi variable Optimization without constraints – necessary and sufficient conditions for minimum/maximum – multivariable Optimization with equality constraints: Solution by method of Lagrange multipliers – Multivariable Optimization with inequality constraints: Kuhn – Tucker conditions.
Single Variable Nonlinear Unconstrained Optimization: Elimination methods: Uni Model function-its importance, Fibonacci method & Golden section method.

UNIT - IV
Multi variable nonlinear unconstrained optimization: Direct search methods – Univariant method, Pattern search methods – Powell's, Hooke - Jeeves, Rosenbrock's search methods. Gradient methods: Gradient of function & its importance, Steepest descent method, Conjugate direction methods: Fletcher-Reeves method & variable metric method.

UNIT - V

Dynamic Programming: Dynamic programming multistage decision processes – types – concept of sub optimization and the principle of optimality – computational procedure in dynamic programming – examples illustrating the calculus method of solution - examples illustrating the tabular method of solution.

TEXTBOOKS:

1.Optimization Techniques & Applications by S.S.Rao, New Age International.
2.Optimization for Engineering Design by Kalyanmoy Deb, PHI

REFERENCES:

1.George Bernard Dantzig, Mukund Narain Thapa, "Linear programming", Springer series in Operations Research 3rd edition, 2003.
2.H. A. Taha, "Operations Research: An Introduction", 8th Edition, Pearson/Prentice Hall, 2007.
3.Optimization Techniques by Belegundu & Chandrupatla, Pearson Asia.
4.Optimization Techniques Theory and Practice by M.C. Joshi, K.M. Moudgalya, Narosa Publications

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