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ABBREVIATIONS/DEFINITIONS

- "AC" means, Academic Council of the University.
- "BOM" means, the Board of Management of the University.
- "BOS" means, the Board of Studies of the Department.
- "CAU/AUC-option" CAU/AUC means change from Credit to Audit option / change from Audit to Credit option
- "Class/Course Committee" means, the Class/Course Committee of a class/course.
- "Course" means, a specific subject usually identified by its course-number and course-title, with a specified syllabus / course-description, a set of references, taught by some teacher(s) / course-instructor(s) to a specific class (group of students) during a specific academic-semester.
- "Course Instructor" means, the teacher or the Course Instructor of a Course.
- "Curriculum" means the set of Course-Structure and Course-Contents.
- "DAA" means, the Dean of Academic Affairs.
- "DAAB" means Departmental Academic Appeals Board.
- "DEC/PEC" means Dissertation Evaluation Committee / Project Evaluation committee.
- "Department" means a group in the University devoted to a specific discipline also called a School. Department and School are used interchangeably.
- "DSA" means, Dean Student Affairs.
- "ESE" means End-Semester Examination.
- "Faculty Advisor/Class Counsellor" means, the Faculty Advisor or the Panel of Faculty Advisors, in a Parent Department, for a group (admission-batch) of students. Also known as Class Counsellor.
- "Grade Card" means the detailed performance record in a semester/programme.
- "He" means both genders “he” and “she”; similarly "his" and/or "him" includes "her" as well, in all the cases.
- "HOD" means, the Head of the Department.
- "MES" means Make-up End Semester.
- "MLC" means Mandatory Learning Course.
- "MSE" means Mid-Semester Examination.
- "Parent Department" or "Degree Awarding Department" means, the department that offers the degree programme that a student undergoes.
- "Project Guide" means, the faculty who guides the Major Project of the student.
- "Regulations" means, set of Academic Regulations.
- "University" or “LU” means, Lingaya’s University, Faridabad
- "VC" means, the Vice Chancellor, Lingaya’s University, Faridabad.
CODE OF CONDUCT AND ETHICS FOR STUDENTS

1. Wear decent dress respecting his/her modesty as well as that of others.
2. Expected to respect and show regard for teachers, staff and fellow students.
3. Inculcate civic sense and sensitivity for environment protection.
4. Not to resort to collection of funds for any use without written permission of VC.
5. To exhibit exemplary behaviour, discipline, diligences, and good conduct and are a role model to other students.
6. Not to indulge in offences of cognizable nature.
7. Not to practice casteism, communalism.
8. Not to indulge in any other conduct unbecoming of a professional student of the University.
9. Not to outrage the status, dignity and honour of any person.
10. Not to get involved in physical assault or threat, and use of physical force against any body.
11. Not to expose fellow students to ridicule and contempt that may affect their self esteem.
12. Not to form any kind of student’s Union, etc.
13. Not to take active or passive part in any form of strikes/protests.
14. To observe all safety precautions while working.
15. Not to disfigure/damage the University property, building, furniture, machinery, library books, fixtures, fittings, etc. (Damage / loss caused shall have to be made good by the students).
16. Use of mobile/video camera phones is strictly prohibited inside the examination halls, class rooms, laboratories and other working places. LU has the right to confiscate the mobile phones in case of any violation.
17. Not to indulge in ragging/teasing, smoking, gambling, use of drugs or intoxicants, drinking alcohol, rude behavior, and use of abusive language.
18. Not to resort to violence, unruly travel in buses, bullying, threatening and coercing others for undesirable act, such as preventing from attending classes, writing exam. / tests, etc.
19. All the students of the LU shall be under the disciplinary control of the VC.
20. Students are deemed to be under the care & guidance of parents. It is obligatory for the former to appraise their progress (given by the CC) to the parents.
21. Fine, if ever imposed, is only to improve discipline and shall be paid promptly.
22. While on campus, students have to take care of their belongings and no responsibility for any loss or damage can be held by the University.
23. Every student shall produce the I-Card on demand, and if lost, get a duplicate issued.
24. The students must attend all lectures, tutorials and practical classes in a course punctually (The attendance will be counted course-wise).
25. To abide by the rules and regulations of the University stipulated from time to time.
IMPORTANT ACADEMIC RULES
M.Tech. Degree Programme

GENERAL

- The Regulations may evolve and get revised/refined or updated or amended or modified or changed through approvals from the Academic Council from time to time, and shall be binding on all parties concerned, including the Students, Faculty, Staff, Departments, University Authorities and officers. Further, any legal disputes shall be limited to the legal jurisdiction determined by the location of the University and not that of any other parties.
- If, at any time after admission, it is found that a candidate had not in fact fulfilled all the requirements stipulated in the offer of admission, in any form whatsoever, including possible misinformation etc., the matter will be reported to the AC, recommending revoking the admission of the candidate.
- The LU reserves the right to cancel the admission of any student at any stage of his study programme in the University on the grounds of unsatisfactory academic performance or indiscipline or any misconduct.
- Medium of Instruction shall be English.

PROGRAMME

- For full-time students, the duration of study shall be a minimum of Four Semesters and a maximum of FOUR years. For part-time students, the duration will be a minimum of Six Semesters and a maximum of FIVE years.
- There are three types of student status in the M.Tech. Degree Programme:
  (a) Full-time student of GATE-Scholarship (FTG)
  (b) Full-time/Part-time sponsored student from Industry or other Organizations including Educational Institutions (FTS/PTS)
  (c) Full-time/Part time non-sponsored non-scholarship student (FTN/PTN)
- The course content for an M.Tech. Degree Programme will typically consist of the following components.
  (a) Two-Letter Grade Courses
      (i) Compulsory Courses
      (ii) Programme Core Courses
      (iii) Elective Courses*
      (iv) Dissertation
  (b) Non-Two-Letter Grade Courses
      (i) Seminar
      (ii) Teaching Practice
  * Some electives may be pre-requisite for another elective course.
- The exact credits offered for the programme for the above components, the Semester-wise distribution among them, as well as the syllabi of all postgraduate courses offered by the department are given in the ‘Scheme of Studies and Syllabus’.
- The minimum credit requirement for the M.Tech. Degree is 90.
Dissertation

- The Dissertation carries 27 credits and spreads over TWO Semesters. The progress of the Dissertation shall be monitored by the guide.
- Under special circumstances a student can be allowed to undertake dissertation work in industry/research laboratory/other University. The place of work has to be approved by AC.
- A candidate shall submit 5 copies of the Dissertation duly recommended by the guide after assessment by the committee to the Chairman, DEC, on or before the specified date. The Report shall be in the format prescribed by the University.
- The earliest date for the submission of dissertation shall be three weeks before the closure of the semester in which the dissertation work credits have been registered for, and is expected to be completed, or as announced by the DAA.
- Extension of time beyond the announced last date for submission of the Dissertation may be granted by the DAA on recommendation from the HOD.
- The final evaluation is done by a Dissertation Evaluation Committee (DEC) constituted by the pertinent BOS. There shall be an open seminar followed by a viva-voice examination as part of the final evaluation. After the final evaluation, appropriate double-letter grade is recommended to DAA, for necessary action.
- If in the opinion of DEC, the Dissertation needs some minor modifications DEC will report to DAA along with recommended grade. The DAA shall instruct the candidate suitably to incorporate the necessary modifications and to resubmit it to the Chairman, DEC. After such resubmission, the chairman, DEC will certify that the necessary modifications have been incorporated and recommend to DAA for the acceptance and award of the grade as recommended by DEC.
- The title of the Dissertation shall be indicated in the Transcript.
- The dissertation grades will be considered for SGPA and CGPA calculation.

Non Two-Letter Grade Courses

- These are courses that must be completed by the student at appropriate time as suggested by the Faculty Advisor. The ‘S’ grade is awarded for satisfactory completion of the course and ‘N’ grade is awarded for non-completion of the course. In case ‘N’ grade is awarded, the student has to re-register for the same course wherein he has no alternative options. However, he can opt for other courses if he has been provided with multiple options. The ‘S’ and ‘N’ grades do not carry grade-points and hence not included in the SGPA, CGPA computations.

Association

- Every Post Graduate student of the University shall be associated with the Parent Department, throughout his study period.
- The schedule of academic activities for a semester, including the dates of registration, mid-semester examinations, end-semester examination, inter-semester vacation, etc. shall be referred to as the Academic Calendar of the semester, and announced at least two weeks before the closing date of the previous semester.
PRE-REGISTRATION

- In order to facilitate proper planning of the academic activities of a semester, it is essential for the students to declare their intent to register for a course well in advance, before the actual start of the academic session, through the process of Pre-Registration, which is mandatory for all those students of second or subsequent semester who propose to deviate from recommended scheme of studies.

- Pre-registration is an expression of intention of a student to pursue particular course(s) in the next semester. It is an information for planning for next semester. Every effort will be made to arrange for a course opted by the student. However, it is not obligatory on the part of the university to offer the course(s) and no course may be offered if the number of students opting for the course is less than 15 or 25 percent of the admission strength whichever is less.

- If a student fails to pre-register it will be presumed that he will follow suggested normal scheme of studies provided that he is progressing at a normal pace. For remaining students the HOD of the parent department will plan for courses as per the convenience of the department.

REGISTRATION TO COURSES

- Every Student after consulting his Faculty-Advisor is required to register for the approved courses with the HOD of parent department at the commencement of each semester on the days fixed for such registration as notified in the academic calendar.

- A student shall register for courses from amongst the courses being offered in the semester keeping in mind the minimum and maximum credits allowed for a degree and other requirements i.e. pre-requisite, if any, SGPA & CGPA after consulting the Faculty Advisor. No registration will be valid without the consent of HOD of the parent department.

- A student will be permitted to register in the next semester as per the suggested normal scheme only if he fulfills the following Conditions:
  (a) Satisfied all the Academic Requirements to continue with the programme of studies without termination.
  (b) Cleared all university, library and hostel dues and fines (if any) of the previous semester.
  (c) Paid all required advance payments of the university and hostel for the current semester.
  (d) Not been debarred from registering on any specific ground by the university.

- The students will be permitted to register for course(s) being offered in a semester other than his normal suggested scheme provided that the time table permits.

- The registration in the critical cases will be done as per the priority given below:
  (a) Fulfillment of minimum credit requirement for continuation,
  (b) The completion of programme in minimum period needed for degree, (Those who need to improve SGPA/CGPA)
  (c) The fulfillment of pre-requisite requirement of courses.

- Students who do not register on the day announced for the purpose may be
permitted LATE REGISTRATION up to the notified day in academic calendar on payment of late fee.
• REGISTRATION IN ABSENTIA will be allowed only in exceptional cases with the approval of the DAA after the recommendation of HOD through the guardian of the student.
• Credits will be awarded in registered courses only.

TEACHING PRACTICE
• A Student is required to do two courses (each of two credits) for Teaching Practice under the guidance of HOD. Here the student is required to be engaged in teaching of two UG courses of his choice each for two hours per week in any of the two semesters during the programme.
• For the Part Time Programme the Courses Teaching Practice-I and Teaching Practice-II carrying 4 (2+2) credits are to be replaced by an Elective Course (3 Credits) + Term Paper (1 Credit).

REGISTRATION- REVISION
• A student has the option to ADD courses for registration till the date specified for late registration in the Academic Calendar.
• On recommendation of the Teaching Department as well as the Parent Department, a student has the option to DROP courses from registration until two weeks after the commencement of the classes in the semester, as indicated in the Academic Calendar.
• A student can register for auditing a course, or a course can be converted from credit to audit or from audit to credit, with the consent of the Faculty Advisor and Course Instructor within two weeks after the commencement of the classes in the semester as indicated in the Academic Calendar. However, CORE Courses shall not be available for audit.

ATTENDANCE REQUIREMENTS
• LU academic programmes are based primarily on the formal teaching-learning process. Attendance in classes, participating in classroom discussions and participating in the continuous evaluation process are the most essential requirements of any academic programme.
• Attendance will be counted for each course scheduled teaching days as per the academic calendar.
• The attendance requirement for appearing in end semester examination shall be a minimum of 75% of the classes scheduled in each course.

LEAVE OF ABSENCE
• The leave of absence must be authorized as per regulations.
• A student short of attendance in a course (less than needed after leave of absence and condonation by VC) will be awarded ‘FF’ grade in the course.
• All students must attend all lecture, tutorial and practical classes in a course. The attendance will be counted course wise.
• To account for approved leave of absence e.g. representing the University in sports, games or athletics; professional society activities, placement activities,
NCC/NSS activities, etc. and/or any other such contingencies like medical emergencies, etc., the attendance requirement shall be a minimum of 75% of the classes scheduled in each course to appear in the examination.

- A student with less attendance in a course during a trimester, in lectures, tutorials and practicals taken together as applicable, shall be awarded ‘FF’ grade in that course, irrespective of his academic performance, and irrespective of the nature of absence.

- If the period of leave is more than three days and less than two weeks, prior application for leave shall have to be submitted to the HOD concerned, with the recommendation of the Faculty-Advisor, stating fully the reasons for the leave requested, along with supporting documents.

- If the period of leave is two weeks or more, prior application for leave shall have to be made to the DAA with the recommendations of the Faculty-Advisor, HOD concerned stating fully the reasons for the leave requested, along with the supporting documents. The DAA may, on receipt of such application, grant leave or decide whether the student be asked to withdraw from the course for that particular semester because of long absence.

- If a student fails to apply and get sanction for absence as in (a) and (b) above, his parent/guardian may apply to the VC with reasons duly recommended by the faculty advisor, HOD and DAA and explain in person to the VC the reasons for not applying in time. The VC will consider on merit and decide to grant the leave or withdrawal from the course for that particular semester subject to any condition that he may like to impose. The decision of the VC shall be final and binding.

**ABSENCE DURING EXAMINATIONS**

- A student who has been absent during Mid-semester Examination due to illness and/or any exigencies may give a request for make-up examination within one week after the Mid-semester Examination to the HOD with necessary supporting documents in person. The HOD may consider such requests depending on the merits of the case, and after consultation with the course instructor, may permit the Make-up examination for the Student concerned. However, no makeup examination will be permitted if the attendance in the course is less than 60% till the date of examination.

- In case of absence from End-Semester Examination of a course(s) on Medical ground and/or other special circumstances, the student can apply for award of ‘I’ grade in the course(s) with necessary supporting documents and certifications by an authorized person to the HOD within one week after the End-Semester Examination. The HOD may consider the request, depending on the merit of the case, and after consultation with the Course(s) Instructor(s)/faculty advisor may forward the case to DAA with his recommendation for the award of ‘I’ grade. After permission by DAA in writing, the ‘I’ Grade is converted into a regular double letter grade on the basis of the students’ marks in Mid-Semester Test and Class Work. However, if a student has scored 50% or more marks in Mid-Semester Test plus Class work his/her marks will be increased by 50% before awarding the grade. This applies to both theory and practical courses.
M.Tech. Degree Programme

COURSE CREDIT ASSIGNMENT
- Every Course comprises of specific Lecture-Tutorial-Practical (L-T-P) Schedule. The credits for various courses are shown in the Schemes of Studies & syllabus.
- The Academic Performance Evaluation of a Student shall be according to a Letter Grading System, based on the Class Performance Distribution.
- The double-letter grade (AA, AB, BB, BC, CC, CD, DD, EE, FF) indicates the level of academic achievement, assessed on a decimal (0-10) scale.

Letters-Grade and Grade-Points

<table>
<thead>
<tr>
<th>LETTER-GRADE</th>
<th>GRADE-POINTS</th>
<th>REMARKS</th>
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<tbody>
<tr>
<td>AA</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>AB</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>BB</td>
<td>8</td>
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<td>BC</td>
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<td>CC</td>
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<tr>
<td>CD</td>
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<tr>
<td>DD</td>
<td>4</td>
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<tr>
<td>EE</td>
<td>2</td>
<td></td>
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<tr>
<td>FF</td>
<td>0</td>
<td>Fail</td>
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<tr>
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<td>W</td>
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<td>Withdrawal</td>
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<tr>
<td>S</td>
<td></td>
<td>Satisfactory</td>
</tr>
<tr>
<td>N</td>
<td></td>
<td>Unsatisfactory</td>
</tr>
</tbody>
</table>

EARNED CREDITS
- This refers to the credits assigned to the programme in which a student has obtained either ‘S’ grade or any one of the double-letter grades ‘AA’, ‘AB’, ‘BB’, ‘BC’, ‘CC’, ‘CD’, ‘DD’ (but not ‘EE’ or ‘FF’). While “0” credits will be earned in respect of a course, where obtained grade is ‘FF’; it will be half the credits assigned to the course, in which obtained grade is ‘EE’.

DESCRIPTION OF GRADES
- An ‘AA’ grade stands for outstanding performance, relative to the class which may include performance with previous batches. The Course Instructor is supposed to take utmost care in awarding of this highest double-letter grade.
- The ‘DD’ grade stands for marginal performance, pass in individual course but not adequate for TGPA / CGPA requirement.
- An ‘EE’ grade indicates that the student has attended the course but obtained less than pass marks. In this case he will earn half the credits assigned to the course.
- The ‘FF’ grade denotes very poor performance, i.e. failure in a course, and the Course Coordinator/Instructor is supposed to take utmost care while awarding
this lowest double-letter grade.

- A student, who obtains ‘FF’ grade in a core course due to detention in attendance, has to repeat (re-register) course in subsequent trimesters/sessions whenever the course is offered. In other cases of ‘FF’ Grade, a student has three options as follows:
  a) Repeat the course,
     Or
  b) Only appear in End-Semester Examination in a subsequent semester and evaluated out of 60 marks for new grade computation.
     The new grade will be computed out of 100 marks as follows:
     \[ \text{ESE} = 60 \text{ (against 40 marks for the regular students)} \]
     \[ \text{CW + Attendance} = 30+10, \text{ to be brought forward from the earlier semester.} \]
     Or
  c) Get the course converted into a partially dropped course to earn two grade points but earn only half the credits meant for that course. It could be termed as two letter grade ‘EE’.

- There are four possible ways of clearing backlog courses and improvement of grades: Subsequent Semester; Summer Term; Week Ends; After University hours with the following overriding conditions – (i) There will be minimum 60% of contact hours of a regular course in a semester for doing backlog in any mode, (ii) The attendance requirement shall be a minimum of 75% of the classes scheduled in each course without any condonation.

- An ‘I’ grade denotes incomplete performance in any course due to absence at the End-Semester Examination (see Section “Absence during Examination”).

- ‘U’ grade is awarded in a course that the student opts to register for audit. It is not mandatory for the student to go through the entire regular process of evaluation in an audit course. However, the student has to go through some process of minimal level of evaluation and also the minimum attendance requirement, as stipulated by the Course Instructor and approved by the corresponding BOS, for getting the ‘U’ grade awarded in a course, failing which that course will not be listed in the Grade Card.

- A ‘W’ grade is awarded when the student withdraws from the course. Withdrawal from a course is permitted only under extremely exceptional circumstances (like medical emergencies, family tragedies and/or other unavoidable contingencies) and has to be recommended by the HOD and approved by the DAA. However, no withdrawal is permitted after the finalization of the grades in the semester.

- ‘S’/‘N’ These grades are awarded for the Mandatory Learning Courses. The ‘S’ grade denotes satisfactory performance and completion of a course. The ‘N’ grade is awarded for non-completion of course requirements and the student will have to register for the course until he obtains the ‘S’ grade.

**FEEDBACK TO STUDENTS**

- A student requires feedback on the progress of his learning. For this purpose, the Instructor will conduct three quizzes for a theory course in a semester 1st before MSE-1, 2nd between MSE-1 and MSE-2 and 3rd after MSE-2. The
quizzes will form a component of class work, the other components being tutorials, home assignments or any other mode.

- For a laboratory course, the continuous assessment’s feed back will be given through the laboratory records which are required to be submitted after performing the experiment in the next laboratory class.

EVALUATION

Theory Course:

- The double-letter grade awarded to a student in a course other than a practical course, i.e. L-T-0 course for which he has registered, shall be based on his performance in quizzes, tutorials, assignments etc., as applicable, in addition to two MSEs and ESE. The weightage of these components of continuous evaluation may be as follows:

<table>
<thead>
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<th>Component</th>
<th>Weightage</th>
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<tbody>
<tr>
<td>End-Semester Examination (ESE) (3 hrs)</td>
<td>40%</td>
</tr>
<tr>
<td>Mid-Semester Examinations (MSE) (2×10%; 1 ½ hrs each)</td>
<td>20%</td>
</tr>
<tr>
<td>3Quizzes (3×5), Tutorials, Assignments, etc. (Several over the semester)</td>
<td>30%</td>
</tr>
<tr>
<td>Attendance</td>
<td>10%</td>
</tr>
</tbody>
</table>

Total 100%

Any variation, other than the above distribution, requires the approval of the pertinent BOS.

Laboratory Course

- The double letter grade awarded to the student in a practical course i.e. 0-0-P course is to be based on his performance in regular conduct of experiments, viva voce, laboratory report, quizzes etc. The weightage of the components of continuous evaluation may be as follows:

<table>
<thead>
<tr>
<th>Component</th>
<th>Weightage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conduct of Experiments (as per syllabus)</td>
<td>50%</td>
</tr>
<tr>
<td>Lab Record</td>
<td>20%</td>
</tr>
<tr>
<td>Quizzes/Viva Voice</td>
<td>30%</td>
</tr>
<tr>
<td>Total</td>
<td>100%</td>
</tr>
</tbody>
</table>

Each experiment may be considered as a unit and evaluated to assess formative and cumulative performance say each of the experiments which carries 10 marks with distribution 5+2+3. Finally, the teacher looks at attendance and total earned marks in the experiments done in a Semester and awards the grades relatively.

Any variation, other than the above distribution, requires the approval of the pertinent BOS.
The University shall conduct the End-semester examination for all theory courses being taught in the semester.

**SCHEME OF EXAMINATION**

- The duration of examinations for a theory course will be 3 hours for end-semester examination and 1½ hours for mid-semester examination.
- The pattern of question paper/examination will be as under:

**Theory Courses:**
The University shall conduct the ESE for all theory courses being taught in the semester.

1. There will be eight questions in all distributed over all the units in a course syllabus. The question paper will be in two parts with weightage 20 percent and 80 percent respectively. The paper setter must set the questions such that each question can be answered in about 35 minutes and the paper can be solved in 3 hours by an average student.
2. Part-A will have one question of objective types with multiple choices, covering all the units in the syllabus, which will be compulsory.
3. Part-B will consist of seven questions, one question from each of the seven units, and the students are required to solve any four. Out of seven any three questions will have long answers of comprehensive/derivation/description type and the remaining four questions will be of problem solving type in order to measure ability on analysis/synthesis/application.

If any special instruction(s) is/are required for a particular course, it/they is/are to be specified by the concerned HOD with prior approval of DAA.

- Students are allowed in the examination the use of single memory, non-programmable calculator. However, sharing of calculator is not permitted.

**Mid-Semester Examination:**
The question paper for Mid-Semester Examination will be made by the Course Coordinator from the topics covered till then (Test-1: from start of semester till Test-1 and Test-2, from after Test-1 till Test-2). Each Mid-Semester Examination question paper should have three questions all of which are to be solved but the questions will have internal choice and at least one of these questions must be of analytical type.

*Note:* The Mid-Semester examination will not have multiple choice question (mcq).

**TRANSPARENCY**

- The answer books of all Mid-semester Examination and End-semester Examination will be shown to the students within three days of the last paper. It is the responsibility of the student to check this evaluation and affix his signature in confirmation.
- If the student finds some discrepancy, he should bring it to the notice of the Course Coordinator. The Course Coordinator will look into the complaint and remove the doubts of the student and proceed with the work of grading.
- The entire process of evaluation shall be transparent, and the course instructor
shall explain to a student the marks he is awarded in various components of evaluation.

RESULT
- The final marks and grades shall be displayed on the notice board and a student can approach the Course Instructor(s) concerned for any clarification within the period stipulated in the Academic Calendar. The process of evaluation shall be transparent and the students shall be made aware of all the factors included in the evaluation. In case of any correction, the Course Instructor shall have to incorporate the same before finalization of the grades.
- The Student’s Grade Card shall contain the Letter-Grade for each registered course; along with the SGPA at the end of the semester, and the CGPA at the completion of the programme.

APPEAL FOR REVIEW OF GRADE
- The entire process of evaluation shall be transparent, and the course instructor shall explain to a student the marks he is awarded in various components of evaluation.
- In case of any grievance about the grades, the student may appeal for review of grades to the Departmental Academic Appeals Board (DAAB) before the date specified in Academic Calendar.
- The fee for such an appeal will be decided from time to time. If the appeal is upheld by DAAB, then the fee amount will be refunded to the student without interest.
- VC shall have power to quash the result of a candidate after it has been declared, if
  (a) he is disqualified for using malpractice in the examination;
  (b) a mistake is found in his result;
  (c) he is found ineligible to appear in the examination

AWARD OF DIVISIONS
- The overall performance of a student will be indicated by two indices:
  (i) SGPA which is the Semester Grade Point Average
  (ii) CGPA which is the Cumulative Grade Point Average

SGPA for a Semester is computed as follows:
\[ SGPA = \frac{\sum C_i G_i}{\sum C_i} \]
Where,
\( C_i \) denotes credits assigned to \( i^{th} \) course with double-letter grade, and \( G_i \) denotes the grade point equivalent to the letter grade obtained by the student in \( i^{th} \) course with double-letter grade, including all ‘FF’ grades in that semester.

CGPA is computed as follows:
\[ CGPA = \frac{\sum C_i G_i}{\sum C_i} \]
Where,
\( C_i \) denotes credits assigned to \( i^{th} \) course with double-letter grade, and \( G_i \) denotes the grade point equivalent to the letter grade obtained by the student
in $i^{th}$ course for all courses with double-letter grades, including all ‘FF’ grades in all semesters at the end of the programme.

For CGPA calculation, the following grades are to be counted:

(i) Grades in all core courses,
(ii) The best grades in the remaining eligible courses to fulfill the minimum credits requirement for a programme.

- The degree will be awarded only upon compliance of all the laid down requirements for programme as under:
  (i) There shall be University requirement of earning a minimum credits for a degree, satisfactory completion of mandatory learning courses and other activities as per the course structure.
  (ii) There shall be a minimum earned credit requirement on all Departmental core courses, Elective course and Major Project as specified by BOS.
  (iii) There shall be a maximum duration for complying to the degree requirement.
  (iv) The candidate will be placed in First Division with Honours / First Division with Distinction/First Division/Second Division which will be mentioned on the degree certificate as under:

<table>
<thead>
<tr>
<th>DIVISION</th>
<th>CONDITIONS TO BE FULFILLED</th>
</tr>
</thead>
</table>
| First Division with Honours   | CGPA $\geq 8.5$  
No ‘FF’, N or W grade in any course during the programme |
| First Division with Distinction| CGPA $\geq 8.5$  |
| First Division                | CGPA $\geq 6.75$  |
| Second Division               | CGPA $\geq 5.0$ but $< 6.75$  |

**Note:**
Although, there is no direct conversion from grades to marks, however, for comparison purposes percentage of marks may be assumed to be CGPA multiplied by nine.

**M. TECH. DEGREE REQUIREMENTS**

- The requirements for the M.Tech. degree programme are as follows:
  (a) **University Requirements:**
      (i) Minimum Earned Credit Requirement for Degree which is 90.
      (ii) Securing a CGPA of at least 5.5.
      (iii) Satisfactory completion of Seminars & Teaching Practice
  
  (b) **Programme Requirements:**
      Minimum Earned Credit Requirements on all compulsory courses, Core Courses, Elective Courses and dissertation as specified by the BOS and conforming to Course Structure given above.
      
  (c) The Maximum duration for a student for complying to the degree requirement from the date of registration for his first Semester, is FOUR years for full-time registration and FIVE years for part-time registration.
M.Tech. Degree Programme

GRADE IMPROVEMENT
- A student may be allowed to improve CGPA in an appropriate semester if his CGPA falls below 5.5.

TERMINATION FROM THE PROGRAMME
- A student shall be required to leave the University without the award of the Degree, under the following circumstances:
  (a) If a student fails to earn the minimum credits specified below:

<table>
<thead>
<tr>
<th>CHECK POINT</th>
<th>PERCENTAGE OF CREDITS** (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>End of FIRST year</td>
<td>60</td>
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<tr>
<td>End of SECOND year</td>
<td>70</td>
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</table>

<table>
<thead>
<tr>
<th>CHECK POINT</th>
<th>PERCENTAGE OF CREDITS** (%)</th>
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</thead>
<tbody>
<tr>
<td>End of FIRST year</td>
<td>60</td>
</tr>
<tr>
<td>End of SECOND year</td>
<td>65</td>
</tr>
<tr>
<td>End of THIRD year</td>
<td>70</td>
</tr>
</tbody>
</table>

* If at any stage, a student fails to cross the threshold with a minimum CGPA of 5.5, he will be treated as a critical case and will be advised to improve the grades.

Note: The period of temporary withdrawal is not to be counted for the above Credit Threshold.
(b) If a student is absent for more than 4 (Four) weeks in a Semester without sanctioned leave.
(c) Based on disciplinary action to that effect approved by the AC, on the recommendation of the appropriate committee.

- Under any circumstances of termination, the conditions specified in Permanent Withdrawal shall also apply.

WITHDRAWAL FROM PROGRAMME

Temporarily:
- A student who has been admitted to a degree programme of the University may be permitted to withdraw temporarily, for a period of one semester or more, on the grounds of prolonged illness or grave calamity in the family, etc., provided:
  (i) He applies to the LU stating fully the reasons for withdrawal together with supporting documents and endorsement from his parent / guardian
  (ii) There are no outstanding dues or demands, from the Departments / LU / Hostels / Library and any other centers;
  (iii) Scholarship holders are bound by the appropriate Rules applicable to them.
(iv) The decision of the VC of the LU regarding withdrawal of a student is final and binding.

- Normally, a student will be permitted only one such temporary withdrawal during his tenure as a student and this withdrawal will not be counted for computing the duration of study.

**Permanently:**

- Any student who withdraws permanently admission before the closing date of admission for the Academic Session is eligible for the refund of fee as per the University rules. Once the admission for the year is closed, the following conditions govern withdrawal of admission:
  - A student who wants to leave the LU for good, will be permitted to do so (and take Transfer Certificate from the LU, if needed), only after clearing all the dues for the remaining duration of the course.
  - A student who has received any scholarship, stipend or other form of assistance from the LU shall repay all such amounts, in addition, to those mentioned in clause No. G8.2 (a) above.
  - The decision of the VC regarding all aspects of withdrawal of a student shall be final and binding.

*****
M.Tech. Degree Programme

M.Tech. (Full Time/ Part Time)
Electronics & Communication Engineering

OBJECTIVES

After going through the study programme the students will be proficient to perform hardware design and take up R&D work in the general fields of signal processing, VLSI and wireless network design.

Furthermore, they will be in a position to use advanced software tools such as LABVIEW, MATLAB, QUALNET, VHDL, Pspice and various Embedded Application Tools for solving real life problems and Hardware development work.

Lastly, they can look for a career in the areas of Advance Signal Processing, Wireless and Mobile Communication Engineering. Additionally, they are given an opportunity to teach under graduate students which may lead them to opt for a teaching career.
<table>
<thead>
<tr>
<th>S.N.</th>
<th>Course No.</th>
<th>Course Name</th>
<th>L-T-P</th>
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12-4-6(22) 19

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<tr>
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<td>Advanced Digital Signal Processing</td>
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15-4-12(31) 25
# Scheme of Studies
## Electronics & Communication Engineering
### M.Tech. (Full Time)

#### 2nd Year

<table>
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<td>EC-602</td>
<td>Analog MOS Integrated Circuit for Signal Processing</td>
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<td>EC-605</td>
<td>Statistical Signal Processing</td>
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**Note:**
- L-T-P: Lectures - Tutorials - Practical
- Cr.: Credits
- **: Optional Credits
- ***: Duration in Years
List of Electives

**Elective – I**

<table>
<thead>
<tr>
<th>S.N.</th>
<th>Course No.</th>
<th>Course Name</th>
<th>L-T-P</th>
<th>Cr.</th>
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<tbody>
<tr>
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<td>EC-507</td>
<td>Wireless Communication</td>
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<td>Artificial Intelligence</td>
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<td>EC-509</td>
<td>Optical Fibre Communication System</td>
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**Elective – II**

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<th>Cr.</th>
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<td>Radar System Analysis and Design</td>
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<td>Sonar Signal Processing</td>
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<td>3</td>
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<td>3</td>
<td>EC-514</td>
<td>Digital Image Processing</td>
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</tbody>
</table>

(L-T-P-Cr) - Lectures-Tutorials-Practicals-Credits

**FINAL EVALUATION IN GRADES**

* Period will be used for self study resulting in submission of Term Paper.

** Credits earned (4) through evaluation will be added in Semester-IV under the course Dissertation. The contact hours shown against the Project Course are nominal.

*** Credits earned (2) through evaluation will be added under course EC-661 Teaching Practice-II. Both the Teaching Practice courses are mandatory learning courses.
## Scheme of Studies

**Electronics & Communication Engineering**  
M.Tech. (Part Time)

### 1st Year

#### SEMESTER – I

<table>
<thead>
<tr>
<th>S.N.</th>
<th>Course No.</th>
<th>Course Name</th>
<th>L-T-P</th>
<th>Cr.</th>
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<tbody>
<tr>
<td>1</td>
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<td>Simulation Lab</td>
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#### SEMESTER– II

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<td>Microprocessor Lab</td>
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9-3-4(16) 14
## Scheme of Studies
### Electronics & Communication Engineering
#### M.Tech. (Part Time)

### 2nd Year

#### SEMESTER– III

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<tr>
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<td>General and Special Purpose Digital Signal Processing</td>
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<td>DSP Processors and Application Lab</td>
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#### SEMESTER– IV

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## Scheme of Studies

**Electronics & Communication Engineering**  
**M.Tech. (Part Time)**

### 3rd Year

#### Semester – VII

<table>
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#### Semester – VIII

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## List of Electives

### Elective – I

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<td>Wireless Communication</td>
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<td>EC-508</td>
<td>Artificial Intelligence</td>
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(L-T-P-Cr) - Lectures-Tutorials-Practicals-Credits

**FINAL EVALUATION IN GRADES**

* Period will be used for self study resulting in submission of Term Paper.

** Credits earned (4) through evaluation will be added in Semester-VI under course Dissertation. The contact hours shown against the Project Course are nominal.

*** Credits earned (2) through evaluation will be added under course EC-661 Teaching Practice-II. Both the Teaching Practices courses are mandatory learning courses.

Notes 1. For the Part Time Programme the Courses Teaching Practice-I and Teaching Practice-II carrying 4 (2+2) credits may be replaced by an Elective Course (3 Credits) + Term Paper (1 Credit).

2. Seminar- 1 is an MLC.
DETAILED SYLLABUS

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<th>T</th>
<th>P</th>
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<tbody>
<tr>
<td>PROBABILITY AXIOMS:</td>
<td>Conditional probability; Baye’s theorem; random variable concept; discrete and continuous random variables; cumulative distribution function (CDF); probability density function (PDF); conditional PDF; expected value; variance; functions of random variable; expected value of the derived random variable.</td>
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<tr>
<td>MULTIPLE RANDOM VARIABLES:</td>
<td>Joint CDF / PDF; Functions of multiple random variable; multiple function of multiple random variables independent / uncorrelated random variables; sums of random variable; moment generating function; random sums of random variable; central limit theorem</td>
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<tr>
<td>RANDOM PROCESS:</td>
<td>Introduction to random process; specification of random processes; nth order joint PDF; stationary and independence; Markov process; Markov property; Gaussian process; Poisson process; Mean and correlation of random processes; stationary; wide sense stationary; ergodic processes; mean square continuity; mean square derivatives.</td>
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<tr>
<td>POWER SPECTRUM:</td>
<td>Random processes as input to linear time invariant systems; power density spectrum; cross-power density spectrum and their properties; relationship between power Spectrum and autocorrelation function; relationship between cross-power spectrum and cross-correlation function; Gaussian process as inputs to LTI system.</td>
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<tr>
<td>NOISE:</td>
<td>Shot noise; thermal noise; white noise; ideal low pass filtered white noise; colored noise; noise equivalent bandwidth; narrow band noise and properties.</td>
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<tr>
<td>MODELING OF NOISE SOURCE:</td>
<td>resistive (Thermal) noise source; effective noise temperature; incremental modeling of noisy network, available power gain; effective input noise temperature; spot noise figures.</td>
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<tr>
<td>ESTIMATION THEORY:</td>
<td>Bayes estimation: mean square error criterion, absolute value criterion, uniform cost function criterion; Cramer’s – Rao inequality for non-random and random parameters.</td>
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</tbody>
</table>

REFERENCE BOOKS

1 **DISCRETE TIME SIGNALS AND SYSTEMS**: Introduction; discrete-time signals - sequences i.e. basic sequences and operations; discrete time systems; memory-less systems; linear time invariant systems; causality; stability properties of linear time-invariant systems; frequency-domain representation of discrete-time signals and systems; Representation of sequences by Fourier transforms; symmetry properties and theorems of Fourier transform; discrete-time random signals.

2 **Z-TRANSFORMS**: Introduction; properties of Z-transform; region of convergence; inverse Z-transform-partial fraction expansion; power series expansion; application of Z-transform; system function; poles and zeros.

3 **STRUCTURES OF DIGITAL FILTERS**: Basic structures of infinite impulse response (IIR) and finite impulse response (FIR); filters – direct form; cascade form; parallel form; feedback in IIR system; transposed forms design of FIR and IIR filters using all standard procedures.

4 **FREQUENCY TRANSFORMATIONS**: Frequency transformations in the analog and digital domain. Discrete Fourier Transform (DFT)- properties of DFT; linear convolution using DFT; computation of DFT using fast Fourier transform (FFT)

5 **ERRORS IN DIGITAL FILTERING**: Errors resulting from rounding and truncation; round-off effects in digital filters; finite word length effects in digital filter.

6 **MULTIRATE DIGITAL SIGNAL PROCESSING (MDSP)**: Sampling rate conversion; multistage implementation of sampling rate conversion; application of multi rate DSP for design of phase shifters; narrow band low pass filters; quadrature mirror filters, digital filter banks.

7 **HARDWARE IMPLEMENTATION OF DSP**: Introduction to DSP processor; architecture of DSP processors; DSP devices : Von Neumann model, Harvard architecture.

**REFERENCE BOOKS**

3 **WAVEFORM CODING TECHNIQUES:** Quantization; pulse code modulation (PCM); PCM generator and receiver; Compounding in PCM; delta modulation; adaptive delta modulation; differential PCM; comparison of digital pulse modulation method.

4 **DIGITAL MODULATION TECHNIQUES:** Introduction; ASK, PSK, FSK, MSK, QPSK, BPSK; detection of binary modulation techniques in the presence of noise; error probability in ASK, PSK, FSK; spread spectrum.

5 **INFORMATION THEORY:** Concept of information and entropy; Shannon theorem; channel capacity self information; discrete and continuous entropy; mutual and joint information; redundancy.

6 **CODING THEORY:** Source encoding & channel encoding; error detection and correction; various codes for channel coding; rate distortion functions.

7 **ERROR CONTROL CODE:** Introduction to block coding and optimal decoding; binary hamming code; structure of linear code; decoding of linear block code; reed muler code; structure of cyclic code; Bose Chaudhary Hocquenghem (BCH) codes; cyclic hamming code.

**REFERENCE BOOKS**


<table>
<thead>
<tr>
<th>EC-505</th>
<th>MICROPROCESSORS AND ITS APPLICATIONS</th>
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</table>

1 **MICROCOMPUTER HARDWARE:** Microprocessor; architecture; system bus; memory organization; I/O; addressing modes; instruction types.

2 **INTERRUPTS:** Timing and machine cycles; peripheral interfacing – DMA controller; CRT controller-8275; floppy disk interface and floppy disk controller-8272.

3 **PROCESS CONTROL COMPUTER SYSTEMS:** Process control languages; types of computers – main frames; minicomputers; microcomputers; performance evaluation techniques.

4 **MICROPROCESSOR AND MICROCOMPUTER SELECTION:** Matching processors and applications; defining the application; software requirements; memory requirements; interfaces; coprocessor; future needs and expandability; power requirements; maintenance; cost effective design.

5 **DEVELOPMENT TOOLS:** Development systems for micros; software tools; logic analyzer; cross assemblers; compilers; and simulators.

6 **DATA COMMUNICATION:** Information coding; asynchronous and synchronous data communication; data communication standards : RS232C and RS485; USART; IEEE-488 GPIB
APPLICATIONS: Stepper motor interface; temperature controller with an analog and digital computer using a temperature sensor; microprocessor based speed-monitoring unit of DC motor; frequency measurement.

REFERENCE BOOKS

EC-506 ADVANCED DIGITAL SIGNAL PROCESSING

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</table>

1. PARAMETRIC METHODS FOR POWER SPECTRUM ESTIMATION: Relationship between the auto correlation and the model parameters; the Yule-Walker method for the AR Model Parameters; the Burg method for the AR model parameters; unconstrained least-squares method for the AR Model parameters; sequential estimation methods for the AR Model parameters; selection of AR model order.

2. FOURIER TRANSFORM: Multi-dimensional Fourier transform; Fourier transform: power and limitations; short time Fourier transform; Gabor transform: discrete time Fourier transform and filter banks.

3. ADAPTIVE SIGNAL PROCESSING: FIR adaptive filters; steepest descent adaptive filter; LMS algorithm; convergence of LMS algorithms; application: noise cancellation; channel equalization; adaptive recursive filters; recursive least squares.

4. MULTIRATE SIGNAL PROCESSING: Decimation by a factor D; interpolation by a factor I; filter design and implementation for sampling rate conversion: Direct form FIR filter structures; polyphase filter structure.

5. WIENER FILTERING: Introduction, The principal of orthogonality; IIR Wiener filters; FIR Wiener filters Wiener Prediction; the Levinson; Durbin algorithm; Lattice Wiener filtering; lattice predictor properties.

6. WAVELET TRANSFORMS: Continuous wavelet transform; wavelet transform ideal case; perfect reconstruction filter banks and wavelets; recursive multi-resolution decomposition; Haar wavelet; Daubechies wavelet.

7. HOMOMORPHIC SIGNAL PROCESSING: Introduction; homomorphic system for convolution; properties of complex spectrum.

REFERENCE BOOKS
M.Tech. Degree Programme


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<tr>
<th>EC-507</th>
<th>WIRELESS COMMUNICATION</th>
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1. **INTRODUCTION**: Introduction to wireless communication system; various generation wireless networks; cellular concepts; interface and system capacity; trunking and grade of service improving coverage and capacity in cellular system.
2. **FADING AND MOBILE CHARACTERISTICS REPRESENTATION**: Small scale fading; frequency selective fading; fading effect due to Doppler spread; coherence BW and coherence time; Rayleigh fading distribution; Ricean fading; Nakagami distribution; level crossing.
3. **CODING**: Diversity; coding and equalization.
4. **MODULATION TECHNIQUES**: Modulation technique for mobile radio; pulse shaping techniques; linear modulation techniques; constant envelope modulation; spread spectrum modulation techniques; rake receiver.
5. **MULTIPLE ACCESS TECHNIQUES**: Multiple Access Technique for wireless communication; FDMA, TDMA, CDMA, spectral effect of multiple access Schemes.
6. **GSM SERVICES AND FEATURES**: Architecture; frame structure; GSM channel; signal processing in GSM
7. **DESIGN PARAMETERS OF MOBILE UNIT**: Design Parameter at base and mobile unit; Antenna configurations; Noise, power and field stren.

**REFERENCE BOOKS**
EC-508 | ARTIFICIAL INTELLIGENCE | L T P | Cr
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<tr>
<td>1</td>
<td><strong>PREDICATE CALCULUS IN AI:</strong> Introduction; the Propositional calculus; the predicate calculus; expressions using interference rules; knowledge representation through predicate calculus.</td>
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<td>2</td>
<td><strong>STRUCTURES AND STRATEGIES FOR STATE SPACE SEARCH:</strong> Introduction; graph theory; strategies for state space search; heuristic search; algorithms for heuristic search; admissibility; monotonicity and informedness; game playing (minimax) using heuristic; back tracking strategies; graph search strategies; heuristic graph search; control strategies of state space search; recursion-based search; pattern- directed search production systems.</td>
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<td>3</td>
<td><strong>KNOWLEDGE REPRESENTATION:</strong> Issues in knowledge representation; a brief illustration of AI representational systems; knowledge representation using predicate logic; semantics net; concept of frames; meta knowledge.</td>
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<td>4</td>
<td><strong>RULE BASED SYSTEMS:</strong> A forward deduction system; backward deduction system; combination of forward and backward system; control knowledge for rule based deduction systems.</td>
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<td>5</td>
<td><strong>ARTIFICIAL NEURAL NETWORKS:</strong> Introduction; different learning laws and architectures; learning through error back propagation; radial basis function; neural computing model: Hopfield net, Boltzman machine.</td>
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<td>6</td>
<td><strong>UNCERTAINTY HANDLING:</strong> Bayesian networks; Dempster-shafer theory; certainty factors; introduction to fuzzy logic.</td>
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<td>7</td>
<td><strong>EXPERT SYSTEMS:</strong> Introduction; architecture of expert system; knowledge acquisition and representation methods in expert systems; few applications of expert systems. Prolog Programming: an introduction and brief overview of the language.</td>
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**REFERENCE BOOKS**

EC-509 | OPTICAL FIBRE COMMUNICATION SYSTEM | L T P | Cr
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<td>1</td>
<td><strong>OVERVIEW:</strong> Overview of Optical Communication Systems.</td>
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</table>
M.Tech. Degree Programme

2 REVIEW OF OPTICS: Wave theory of light; reflection/refraction of plane waves; Fresnel’s formulas; interface; diffraction; optical coherence; polarization of light.

3 PROPAGATION OF LIGHT IN FIBERS: Concepts of multi modes and single mode fibers; dispersion and attenuation in fibers; comparison of different types of fibers and optical choice of fibers.

4 OPTICAL WAVE GUIDE: Planar Conducting waveguides; planar dielectric wave guides; optical fiber wave guides.

5 OPTICAL SOURCES AND TRANSMITTERS: LED, semiconductor lasers and their characteristics.

6 OPTICAL DETECTORS AND RECEIVERS: Photo detectors and their characteristics; receiver design; noise and sensitivity issues.

7 SYSTEM DESIGN: Selection of detectors based on speed; sensitivity and signal to noise ratio; determination of crucial parameters for basic optical devices; translate design requirement into system parameters; optical link design; power and noise budget; jitter / rise time budget.

REFERENCE BOOKS

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<th>Course Code</th>
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<tr>
<td>EC-510</td>
<td>DIGITAL SYSTEM DESIGN</td>
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</table>

1 INTRODUCTION TO COMPUTER ADDED DESIGN: Hardware description language (HDL), VHSIC hardware description language (VHDL), data objects, data types, operators.

2 INTRODUCTION TO MODELING: Entity declaration; architecture body; behavioral flow of modeling; assignment sequential case array etc.; structural modeling and data flow modeling.

3 COMBINATIONAL AND SEQUENTIAL CIRCUITS: VHDL models of combinational and sequential circuits; memory implementation of Boolean function; code converter; ALU.

4 HARDWARE AND SOFTWARE OF DESIGN UNIT: Hardware and software firmware consideration in designing control units for arithmetic logical processors; I/O processor with different methods of the data handling, electronics switching; process interface design.
5 PROGRAMMABLE LOGIC DEVICES: Programmable logic arrays (PLA) and designing with PLA, PAL, FPGA, CPLD.

6 APPROACHES TO SEQUENTIAL ANALYSIS AND DESIGN: State diagram; analysis of sequential synchronous circuits; design steps for sequential synchronous circuits; state reduction; design of output decoders; counters; shift registers and memory.

7 ASYNCHRONOUS FINITE STATE MACHINES: Scope; asynchronous analysis; design of asynchronous machines; cycles and races; plotting and Reading the excitation map; essential hazards map entered variable (MEV), MEV approaches to asynchronous design.

REFERENCE BOOKS

<table>
<thead>
<tr>
<th>EC-511</th>
<th>EMBEDDED SYSTEMS AND APPLICATIONS</th>
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1 INTRODUCTION TO EMBEDDED SYSTEM: categories of embedded systems; hardware architecture; CPU; processor architecture interrupts; CISC & RISC; memory; I/O devices; DMA, ADC & DAC; serial peripheral integrate; inter – integrated circuits bus-TCP/IP protocol.

2 SOFTWARE ARCHITECTURE: services provided by an operating system; architecture of embedded operating system; categories of embedded operating system.

3 PROCESS OF EMBEDDED SYSTEM DEVELOPMENT: waterfall model; requirements engineering; design tradeoffs; co-design; hardware design; software design; implementation; integration & testing; configuration management; managing embedded-system development projects.

4 COMMUNICATION INTERFACES: RS-232/UART; RS-422/485; IEEE 1394; USB; Ethernet; wireless interfaces; IEEE 802.11; Bluetooth.

5 REPRESENTATIVE EMBEDDED SYSTEMS: digital thermometer; handheld computer; GPS navigation system; internet phone; software: defined Radio; smart cards; RF tags.

6 EMBEDDED OPERATING SYSTEM: features of O/S; POSIX; difference in various O/S, embedded NT; Windows XP embedded and embedded Linux.

7 MICROCONTROLLER ARCHITECTURE: Introduction to PIC microcontrollers, Architecture and pipelining, program memory considerations, Addressing modes, CPU registers, Instruction set; simple operations.

REFERENCE BOOKS
EC-512  |  RADAR SYSTEM ANALYSIS & DESIGN  |  L T P  |  Cr  
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1. **RADAR FUNDAMENTALS**: Radar classifications; range; range resolution; Doppler frequency coherence; radar equation; low pulse repetition frequency (PRF) radar equation; high PRF radar equation; surveillance radar equation; radar losses, noise figure.

2. **CONTINUOUS WAVE (CW) AND PULSED RADARS**: Functional block diagram; CW radar equation; frequency modulation (FM); linear FM CW radar pulsed radar; range and Doppler ambiguities; resolving range ambiguities; resolving Doppler ambiguities.

3. **RADAR DETECTION**: Detection in presence of noise; probability of false alarm; probability of detection; pulse integration; detection of fluctuating targets; probability of detection calculation.

4. **RADAR WAVE PROPAGATION**: Earth atmosphere; refraction; four-third earth model; ground reflection; pattern propagation factor; diffraction; and atmosphere attenuation.

5. **CLUTTER AND MOVING TARGET INDICATOR**: Clutter definition; surface clutter; volume clutter; clutter spectrum; moving target indicator-single delay line canceller; double delay line canceller.

6. **RADAR ANTENNAS**: Directivity, Power gain; effective aperture; near and far fields; general arrays; linear arrays; planer arrays; array scan loss; conventional beam forming.

7. **RADAR CROSS SECTION (RCS)**: RCS definition; dependency on aspect angle and frequency RCS dependence on polarization; RCS of simple objects; simplistic approach to calculating the RCS of complex objects.

**REFERENCE BOOKS**


EC-513  |  SONAR SIGNAL PROCESSING  |  L T P  |  Cr  
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1. **OVERVIEW**: Overview of sonar systems

2. **SONAR BASICS**: Propagation of sound in the ocean; noise in the ocean.

3. **ANALYSIS OF SONAR SIGNALS**: The sonar equation; signal/noise considerations; generation of underwater sound; nonlinear effect of dept.

4. **DETECTION OF SONAR SIGNALS**: Threshold concept; various types of detector; typical problems in detection of sonar signals; adaptive digital filters; digital Doppler nullification.

5. **SONAR ARRAY PROCESSING**: Conventional beamforming; Adaptive beamforming; Beam Steering.
ACTIVE AND PASSIVE SONAR SIGNAL PROCESSING: Review of signal characteristics; ambient noise and platform noise; waveform selection and ambiguity functions.

SONAR SYSTEMS DESIGN IMPLEMENTATION: Passive sonar design consideration; active sonar design consideration.

REFERENCE BOOKS

REFERENCE BOOKS
M.Tech. Degree Programme


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<th>Course Code</th>
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<tr>
<td>EC-552</td>
<td>DIGITAL SIGNAL PROCESSING LAB</td>
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LIST OF EXPERIMENTS USING MATLAB
1. Write a Program for generation of unit impulse, unit step, ramp, exponential, sinusoidal and cosine sequence.
2. Write a Program for computing inverse Z-transform of a rational transfer function.
3. Write a Program for linear convolution.
4. Write a Program for plotting the frequency response of first order system.
5. Write a Program for computing Discrete Fourier Transform (DFT).
7. Design FIR Low pass filter and High pass filter using Rectangular window.
8. Transform an analog filter into a digital filter using Impulse Invariant method.
9. Design a Chebyshev Low pass filter.
11. Determine the execution time of the FFT function.
12. Demonstrate the effectiveness of high-speed convolution FFT algorithm.

Note: Atleast 10 experiments are to be performed from the above list.

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<tr>
<td>EC-553</td>
<td>SIMULATION LAB</td>
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LIST OF EXPERIMENTS
1. Simulate & Study the results of design of the Frequency Response of an RC Coupled Amplifier using P-SPICE.
2. Simulate using S-PICE and verify the Operation of a Differentiator Circuit using 741 Op-amp and show that it acts as a High pass filter.
3. Simulate using S-PICE and verify the Operation of a Integrator Circuit using 741 Op-amp and show that it acts as a Low pass filter.
4. Simulate using P-SPICE the application of Op-amp 741 as a Square Wave Generator.
5. Simulate and find how many cycles are present in the output of a Pulsed Amplifier.
7. Simulate and study the characteristics of Common Source FET Amplifier using P-SPICE.
8. Simulate and study the V-I Characteristics of MOSFET.
9. Simulate & Implement a given logic Expression using PLA with P-SPICE.
10. Simulate 16:1 Multiplexer and 1:16 Demultiplexer and determine its truth table.
11. Simulate 4-bit Comparator using P-SPICE.
13. Simulate using P-SPICE a 3-bit Synchronous Counter & determine its count sequence.
14. Simulate using P-SPICE a 3-bit Shift Register & determine its truth table.

Note: Atleast 10 experiments are to be performed from the above list.

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<th>EC-555</th>
<th>MICROPROCESSOR LAB</th>
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LIST OF EXPERIMENTS
1. Familiarization with architecture and operation of single board microcomputer.
2. Performing mathematical and logical operations on a single board microcomputer.
3. Familiarization with DEBUG program and its commands to execute and debug
1. Assembly Language Programs (ALP).
4. Write a program for a 16 bit processor to
   a. Find the largest number in a data array.
   b. Find the smallest number in a data array.
5. Write a program for a 16 bit processor to find the sum of a series of 16 bit numbers.
6. Write a program for speed control of DC series motor.
7. Design a microprocessor based temperature monitoring unit.
8. Write a program for a traffic light control with emergency control using Interrupts.
10. Write an ALP to generate 10 KHz square wave.
11. Write an ALP to interface Microprocessor and LCD display.
12. Write an ALP to interface one microcontroller with other using serial communication

Note: Atleast 10 experiments are to be performed from the above list.

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The student has to undertake extensive literature survey on a topic with the approval of the course coordinator. The course coordinator shall not be below the rank of Assistant Professor. The work may involve extensive search of print, audio-video materials, internet surfing etc.

The work of monitoring will be done by the course coordinator and evaluation by the course coordinator and the HOD or his nominee.
### M.Tech. Degree Programme

**LIST OF EXPERIMENTS**
1. Write VHDL code for 3 to 8 priority encoder.
2. Write structural code for 16:1 multiplexer.
3. Write VHDL code of full adder using two half adder.
4. Write VHDL code of BCD to 7 segment code converter using Data Style of modeling.
5. Design a three bit up/down counter using T flip flop.
6. Design a four bit synchronous counter with parallel load using T and D flip flops.
7. Write Behavioral VHDL code for module-12 up counter with synchronous reset.
8. Write VHDL Code for left to right shift registers with enable pin.
9. Create an entity that represents 3 to 8 binary encoder using two instances of 2 to 4 entity.
10. Design four bit comparator using Behavioral and Structural type of modeling.
11. Design an ALU capable of performing arithmetic and logical operations.
12. Design a module-6 counter which counts in the sequence 0,1,2,3,4,5,0,1. The counter counts the clock pulse if its enable pin is equal to 1.

Note: Atleast 10 experiments are to be performed from the above list.

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### EC-601 GENERAL & SPECIAL PURPOSE DIGITAL SIGNAL PROCESSORS

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<th>EC-601</th>
<th>GENERAL &amp; SPECIAL PURPOSE DIGITAL SIGNAL PROCESSORS</th>
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1. **INTRODUCTION:** Computer architectures for signal processing; Harvard Architecture; pipelining.
2. **HARDWARE DESIGN:** Hardware multiplier accumulator; special instructions; Replication on chip memory/cache; extended parallelism: SIMD, VLIW and static superscalar processing.
3. **GENERAL PURPOSE DIGITAL SIGNAL PROCESSORS:** Fixed point DSP's; Architecture of first generation fixed point DSP processors; Architecture of second generation fixed point DSP's; Architecture of third generation fixed point DSP's; Architecture of fourth generation fixed point processors; floating point digital signal processors.
4. **SELECTING DIGITAL SIGNAL PROCESSORS:** Architectural features; execution speed; type of arithmetic; word length; support for development tools; packaging of a DSP; Clock frequency and MIPS rating.
5. **IMPLEMENTATION OF DSP ALGORITHMS ON GENERAL PURPOSE DSP's:** FIR digital filtering; IIR digital filtering; FFT processing; multirate processing.
6. **SPECIAL PURPOSE DSP HARDWARE:** Basic requirements of special purpose DSP’s; hardware digital filters; hardware FFT processors; architecture of hardware FFT processors; double buffering in real time FFT.
7. **APPLICATIONS OF DSP:** Speech Coding and Decoding; Speech Encryption and Decryption; Speech Recognition.
REFERENCE BOOKS
4. Sharkawy, Mohammed EL., “Digital Signal Processor Applications with Motorola’s DSP 56002”,

<table>
<thead>
<tr>
<th>EC-602</th>
<th>ANALOG MOS INTEGRATED CIRCUITS FOR SIGNAL PROCESSING</th>
<th>L T P</th>
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<tr>
<td></td>
<td>OVERVIEW OF MOS TECHNOLOGY: Analog signal processing; basic MOS semiconductor devices: n-MOS; p-MOS; CMOS inverter.</td>
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<td>FABRICATION PROCESS: Basic fabrication of MOS, n-MOS, p-MOS, CMOS, Bi-MOS, pn-junction; resistor, capacitor.</td>
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<td>USE OF DEVICE MODELS IN CIRCUIT ANALYSIS: MOS models, Bipolar models; monolithic resistors and capacitors.</td>
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<td>ANALOG CMOS SUB CIRCUIT: MOS switch, CMOS current source, current mirrors – Wilson; cascade.</td>
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<td></td>
<td>DIGITAL TO ANALOG AND ANALOG TO DIGITAL CONVERSION: medium speed, high speed.</td>
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<td>SWITCHED CAPACITOR CIRCUIT: Switch capacitor amplifier; switched capacitor Integrator; Z domain or first order and second order switched capacitor circuit.</td>
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<td>NON-FILTERING APPLICATIONS OF SWITCHED CAPACITOR CIRCUITS: Gain stage; programmable: capacitor arrays; switched: capacitor rectifiers; detectors; oscillators; application in field of signal processing.</td>
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REFERENCE BOOKS

<table>
<thead>
<tr>
<th>EC-605</th>
<th>STATISTICAL SIGNAL PROCESSING</th>
<th>L T P</th>
<th>Cr</th>
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<tbody>
<tr>
<td></td>
<td>INTRODUCTION TO DIGITAL FILTER DESIGN: FIR filter and IIR filter.</td>
<td>3 1 0</td>
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<td></td>
<td>DIGITAL FILTER DESIGN USING LEAST-SQUARE METHOD: Least square error criterion in the design of Pole-zero filters; FIR least squares inverse filters.</td>
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</table>
SPECTRAL ESTIMATION AND ANALYSIS: Non parametric methods: Periodogram; Bartlett and Welch modified period gram; Blackman-Turkey Methods.

SPECTRAL ESTIMATION AND ANALYSIS: Parametric methods: wide sense stationary random process; rational power spectra: auto regressive (AR) process; moving average (MA) process; ARMA process; relationship between the filter parameters and the auto correlation sequence.


WIENER FILTERS FOR FILTERING AND PREDICTION: FIR wiener filter; orthogonality principle in the linear mean-square error (MSE) estimation, IIR wiener filter.

ADAPTIVE ALGORITHMS TO ADJUST COEFFICIENTS OF DIGITAL FILTERS: Least mean square (LMS); recursive least square (RLS) and Kalman filter algorithms.

REFERENCE BOOKS

<table>
<thead>
<tr>
<th>EC-651</th>
<th>DSP PROCESSORS AND APPLICATION LAB</th>
<th>L T P</th>
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<td>0 0 2</td>
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LIST OF EXPERIMENTS
1. Familiarization with the architecture and operation of first generation fixed point DSP Texas Instruments TMS320C10.
2. Familiarization with the architecture and operation of second generation fixed point DSP Texas Instruments TMS320C50.
3. Familiarization with the architecture and operation of third generation fixed point DSP Texas Instruments TMS320C54x.
4. Familiarization with the architecture and operation of fourth generation fixed point DSP Texas Instruments TMS320C62x.
5. Write an assembly language program for TMS320C10 based FIR digital notch filter.
6. Write an assembly language program for TMS320C10 based FIR digital low pass filter.
7. Write an assembly language program for TMS320C10 based FIR digital high pass filter.
8. Write an assembly language program for TMS320C10 based FIR digital band pass filter.
10. Write an assembly language program for TMS 320C25 based FIR digital band pass filter.
12. Write an assembly language program for TMS 320C25 based FIR digital high pass filter.

Note: At least 10 experiments are to be performed from the above list.

<table>
<thead>
<tr>
<th>EC-653</th>
<th>DISSERTATION PRELIMINARY</th>
<th>L T P</th>
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<td></td>
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See note as given under course EC-659.

<table>
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<tr>
<th>EC-654</th>
<th>SEMINAR-II</th>
<th>L T P</th>
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</table>

The work of Dissertation Preliminary is to be presented by the student in the form of Seminars II.
The work of monitoring will be done by the guide and evaluation by the committee consisting of guide, course coordinator and the HOD or his nominee.

<table>
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<tr>
<th>EC-657</th>
<th>MINOR PROJECT</th>
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The student is required to do the design/fabrication/coding/simulation of equipment/process/system of his/her choice and to be approved by the course coordinator.
The course coordinator will evolve the evaluation procedure under the guidance of HOD.

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<th>EC-658</th>
<th>SEMINAR-III</th>
<th>L T P</th>
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The work of Dissertation Phase-I is to be presented by the student in the form of Seminars III.
The work of monitoring will be done by the guide and evaluation by the committee consisting of guide, course coordinator and the HOD or his nominee.
Every student will carry out dissertation under the supervision of a guide. The topic of dissertation shall be approved by a committee constituted by the HOD. The method of evaluation including intermediate assessment shall be as evaluated by the pertinent BOS.

Dissertation work is spread over three terms and coded as EC-653, EC-656 and EC-659. The distribution of amount of work in these three terms is equivalent to 5, 6 and 12 credits respectively. The evaluation of work is continuous but award of grade is for 23 credits in the last term on the basis of total work. The contact hours are Nominal.

See note as given under course EC-661.

Teaching practice comprises of two non-two letter mandatory courses to be done under the guidance of HOD. Here, the student is required to be engaged in teaching of two UG courses (I and II) of his/her choice during the period between IVth to IXth Terms of the M.Tech. Degree Programme. The student shall register for Teaching Practice only at the time he plans to take up teaching of UG course, but the credits earned will be counted in Term-VI for Full Time students and Term-IX for Part Time students.

1. **LINEAR EQUATIONS**- Matrix theory; solution of general linear system of equations, existence & uniqueness of solution, Echelon form of matrix; I, II conditioned matrices Eigen value & Eigen vectors; Unitary, Hermitian & normal matrices; Gauss-elimination method and Gauss-Jordan methods for homogeneous and non-homogeneous systems of linear equations; round off errors

2. **NON-LINEAR EQUATIONS**: Bisection method; linear interpolation methods; Newton’s method; Muller’s method; Bairstow’s methods for the quadratic factors; other methods for the solution of polynomials.
3. **INTERPOLATION PROBLEMS**: Lagrangian polynomial; divided differences; interpolating with cubic spline; bexier curves and B-spline curves; polynomial approximation of the surfaces; least square method.

4. **DIFFERENTIATION & INTEGRATION**: Derivatives from difference table; higher order derivatives; extrapolation techniques; integration formulas- Simpson’s rule, trapezoidal rule, Gaussian quadrature; adaptive integration, multiple integrals.

5. **SOLUTION OF ORDINARY DIFFERENTIAL EQUATION**: Modifier Euler methods; Milne’s methods Adam’s Moulton method; convergence criteria, Errors and error propagation, comparison of different methods.

6. **BOUNDARY VALUE PROBLEMS**: Shooting method; Rayliegh-Ritz method; Collocation and Galerkin method; characteristic value problem, eigen values by iteration and QR method; application of Eigen values.

7. **SOLUTION OF PARTIAL DIFFERENTIAL EQUATION**: Laplace’s equations on a rectangular region; iterative method for the Laplace equation; Poisson equation; A.D.I method; solution of parabolic differential equation by Crank – Nicholson method; theta method; solution of wave equation by Finite differences; wave equation in two dimensions.

**REFERENCE BOOKS:**


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