



**Important Academic Rules  
M.Tech. Degree Programme  
In  
Information Technology**

**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 Six Terms and a maximum of FOUR years. For part-time students, the duration will be a minimum of Nine Terms 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

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- (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 term-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 11 credits and spreads over THREE Terms, (normally during 4<sup>th</sup> to 6<sup>th</sup> Terms for full time and 7<sup>th</sup> to 9<sup>th</sup> Terms for part time students or as recommended by BOS). 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 trimester 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 TGPA 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 TGPS, CGPS 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 term, including the dates of registration, mid-term examinations, end-term examination, inter-term vacation, etc. shall be referred to as the Academic Calendar of the term, and announced at least two weeks before the closing date of the previous term.

### PRE-REGISTRATION

- In order to facilitate proper planning of the academic activities of a term, 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 term 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 term. It is an information for planning for next term. 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 term 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 term keeping in mind the minimum and maximum credits allowed for a degree and other requirements i.e. pre-requisite, if any, TGPA & 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 term 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 term.

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- (c) Paid all required advance payments of the university and hostel for the current term.
- (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 term 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 TGPA/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 (one one-credit course and the other a two-credit course) 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 terms during the programme.

### 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 term, 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 term 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 term 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 term 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 term 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-term Examination due to illness and/or any exigencies may give a request for make-up examination within one week after the Mid-term 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-term 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-term 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 permit the MET Examination for the student concerned. The student may subsequently complete all course requirements within the date stipulated by BOS (which may possibly be extended till first week of trimester under special circumstances) and 'I' grade will then be converted to an appropriate Double-letter grade, as per Clause No: G5.9. All the details of such a decision with date of finalizing the grade shall be communicated to DAA. If such an application for the 'I' grade is not made by the student then a double-letter grade will be awarded based on his term performance.

## 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, FF) indicates the level of academic achievement, assessed on a decimal (0-10) scale.

### Letter-Grades and Grade-Points:

LETTER-GRADE	GRADE-POINTS	REMARKS
AA	10	
AB	9	
BB	8	
BC	7	
CC	6	
CD	5	
DD	4	
FF	0	Fail
I	-	Incomplete
U	-	Audited
W	-	Withdrawal
S	-	Satisfactory
N	-	Unsatisfactory

## 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 and is the minimum passing double-letter grade.
- The 'FF' grade denotes very poor performance, i.e. failure in a course, and the Course Instructor is supposed to take utmost care while awarding this lowest double-letter grade.

- A student, who obtains 'FF' grade in a core course, has to repeat (re-register) that core course, in subsequent trimesters/sessions whenever the course is offered, until a passing grade is obtained. However, for an elective course in which 'FF' grade has been obtained, the student may either repeat the same course, or register for any other elective course.
- An 'I' grade denotes incomplete performance in any course due to absence at the end term examination (see also Clause No: G7.4). When the 'I' grade is converted to a regular double letter grade, a penalty of ONE Grade-Point is imposed, by awarding the double-letter grade that is immediately below the one that the student would have otherwise received except when the student has 95% attendance record in the subject concerned. For example, if on the basis of the performance including MET Examination, a student gets AB grade, he will be awarded BB grade if not under exception rule.
- '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 term.
- '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 at least two quizzes for a theory course in a term-one before Mid-term Examination and the other there after. 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 feedback will be given through the laboratory records which are required to be submitted after performing the experiment in the next laboratory class.

### EVALUATION

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

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End-term Examination	:	50%
Mid-term Examinations	:	30%
Quizzes, Tutorials, Assignments, etc. (Several over the term)	:	20%
Total	:	100%

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

Conduct of Experiments (as per syllabus)	:	40%
Lab Record	:	10%
Quizzes/Viva Voice	:	20%
End-term Examination	:	30%
Total	:	100%
- The University shall conduct the End-term examination for all theory courses being taught in the term.
- The answer books of all Mid-term Examination and End-term 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.
- If a student is not satisfied with the award of the grade after the announcement of the grades, he may appeal on a Grievance Form duly filled in along with the fee receipt for this purpose to the HOD of the parent department within one week of the following term. The HOD will forward the form along with his recommendation based on the records of the case to DAAB within the date specified in the Academic Calendar.

### SCHEME OF EXAMINATION

- The duration of examinations for a theory course will be 3 hours for end-term examination 1½ hours for mid-term examination.
- The pattern of question paper/examination will be as under:
- **Theory Courses:**  
The University shall conduct the End-term examination for all theory courses being taught in the term.
  - (a) There will be eight questions in all distributed over all the units in a course syllabus. The question paper will be in three parts with weightage 20 percent, 40 percent and 40 percent respectively.
  - (b) Part-A will be short answer type with multiple parts covering all the units in the syllabus, which will be compulsory.
  - (c) Part-B will have three questions from any three units, which will have long answers of derivation/descriptive type. Two questions are to be answered from this part.
  - (d) Part-C will consist of four questions from the remaining four units and they will be of problem solving type in order to measure

ability on comprehension /analysis /synthesis / application. The relevant data will be made available. The student is required to solve two questions. However, for Part-C, the external examiner may select the questions from the question bank supplied by LU.

- Students are allowed in the examination the use of single memory, non-programmable calculator. However, sharing of calculator is not permitted.
- **Laboratory Courses:**
  - (a) The End-term Examination in laboratory course will be conducted jointly by an external examiner (other than the instructor) and an internal examiner (the coordinator / instructor) jointly.
  - (b) The student will be given randomly an experiment to perform from within the list of experiments in the course.
  - (c) No change in the experiment will be permitted after the draw, if the student had performed the same in the class.
- **Mid-Term Examination:**  
Question 1 is compulsory covering all topics taught till then. Question 2 and 3 will be essay type, out of which student will answer any one. Question 4 and 5 will be to measure to ability of analysis / comprehension / synthesis / application. The student will answer any one.

#### TRANSPARENCY

- The answer books of all Mid-term Examination and End-term 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 shall be displayed on the notice board for ONE day, (the date of which will be indicated in the academic calendar). A student can approach the concerned course instructor(s) for any clarification within Two days of display. 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 TGPA at the end of the term, 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) **TGPA** which is the Term Grade Point Average
  - (ii) **CGPA** which is the Cumulative Grade Point Average

**TGPA for a Term is computed as follows:**

$$TGPA = \frac{\sum C_i G_i}{\sum C_i}$$

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 term.

**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 terms 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:

DIVISION	CONDITIONS TO BE FULFILLED
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:
  - University Requirements:**
    - Minimum Earned Credit Requirement for Degree which is 90.
    - Securing a CGPA of at least 5.5.
    - Satisfactory completion of Seminars & Teaching Practice
  - 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.
  - The Maximum duration for a student for complying to the degree requirement from the date of registration for his first Term, is FOUR years for full-time registration and FIVE years for part-time registration.

### GRADE IMPROVEMENT

- A student may be allowed to improve CGPA in an appropriate term 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:
  - If a student fails to earn the minimum credits specified below:

#### (i) Full-time student

Check Point	Credit Threshold *
End of FIRST year	20

#### (ii) Part-time student

Check Point	Credit Threshold *
End of FIRST year	15
End of SECOND year	30

\* 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.

- If a student is absent for more than 4 (Four) weeks in a Term without sanctioned leave.
  - 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 term or more, on the grounds of prolonged illness or grave calamity in the family, etc., provided:
  - He applies to the LU stating fully the reasons for withdrawal together with supporting documents and endorsement from his parent / guardian
  - There are no outstanding dues or demands, from the Departments / LU / Hostels / Library and any other centers;
  - Scholarship holders are bound by the appropriate Rules applicable to them.
  - 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.

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**Scheme of Studies  
and  
Syllabus**

**M. Tech. (Regular/Part Time)  
Information Technology**

**M. Tech.  
Information Technology**

**OBJECTIVES**

The course contents are meticulously engineered to enable a student to acquire the knowledge of and or competency in:

1. To deliver and support the organizational strategic plan and individual department business objectives through the effective use of information technology,
2. To reduce the overall cost of technology through system integration,
3. To deliver services that meet established performance standards (in Education/Industry),
4. To automate the organization's use of internal information to ensure that data is organized and shared in a manner that adds value and enhances productivity,
5. To design, develop, maintain and strengthen a reliable and secure communication and database infrastructure with the capacity to address the changing service demands.
6. To become aware of the latest developments in the areas of communications, database, presentation techniques (including animation and multimedia) for quick and effective information dissemination and motivate him to contribute to these areas by means of research and developments.

**Scheme of Studies  
M.Tech. Information Technology  
(Full Time)**

1 <sup>st</sup> Year				
TERM – I				
S.N.	Course No.	Course Name	L-T-P	Cr.
1	MA-501	Numerical Techniques	5-1*-0	4
2	IT-501	Communication Systems	5-1*-0	4
3	IT-502	Advanced Database Management System	5-1*-0	4
4	IT-551	Simulation Lab	0-0-4	2
5	IT-552	Advanced Database Management System Lab	0-0-4	2
<b>15-3-8 (26)</b>				<b>16</b>

TERM – II				
S.N.	Course No.	Course Name	L-T-P	Cr.
1	IT-503	Advanced Computer Architecture	5-1*-0	4
2	IT-504	Advanced Data Structure	5-1*-0	4
3	IT-505	Dataware Housing And Data Mining	5-1*-0	4
4		Elective - I	5-0-0	3
5	IT-554	Advanced Data Structure Lab	0-0-4	2
<b>20-3-4(27)</b>				<b>17</b>

TERM – III				
S.N.	Course No.	Course Name	L-T-P	Cr.
1	IT-514	Software Engineering	5-1*-0	4
2	IT-515	Network Management And Security	5-1*-0	4
3		Elective - II	5-0-0	3
4	IT-574	Seminar-I	0-0-2	1
5	IT-564	Software Engineering Lab	0-0-4	2
<b>15-2-6 (23)</b>				<b>14</b>

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(Full Time)**

2 <sup>nd</sup> Year				
TERM – IV				
S.N.	Course No.	Course Name	L-T-P	Cr.
1	IT-601	Multimedia Technologies	5-1*-0	4
2	IT-602	E-Commerce & ER P	5-1*-0	4
3	IT-651	Multimedia Technologies Lab	0-0-4	2
4	IT-653	Dissertation Preliminary **	0-0-10	(5)
5	IT-654	Seminar-II	0-0-4	2
<b>10-2-18 (30)</b>				<b>12</b>

TERM – V				
S.N.	Course No.	Course Name	L-T-P	Cr.
1	IT-605	IT Management	5-1*-0	4
2	IT-656	Seminar - III	0-0-4	2
3	IT-657	Dissertation Phase-I **	0-0-12	(6)
4	IT-658	Minor Project	0-0-6	3
<b>5-1-22 (28)</b>				<b>9</b>

TERM – VI				
S.N.	Course No.	Course Name	L-T-P	Cr.
1	IT-659	Dissertation Phase-II	0-0-24	12+5+6
2	IT-660	Teaching Practice-I***		(2)
3	IT-661	Teaching Practice-II		2+2
<b>0-0-24 (24)</b>				<b>27</b>

**Scheme of Studies  
M.Tech. Information Technology  
(Full Time)**

**List of Electives**

Elective – I				
S.N.	Course No.	Course Name	L-T-P	Cr.
	IT-506	Wireless Mobile Networks	5-0-0	3
	IT-507	Blue Tooth Technologies	5-0-0	3
	IT-508	Advanced Computer Graphics	5-0-0	3
	IT-509	Digital Signal Processing	5-0-0	3
	IT-510	Neural Networks	5-0-0	3
	IT-511	Genetic Algorithms	5-0-0	3
	IT-512	Soft computing	5-0-0	3
	IT-513	Software Project Management	5-0-0	3

Elective – II				
S.N.	Course No.	Course Name	L-T-P	Cr.
	IT-516	Cellular and Mobile Communications	5-0-0	3
	IT-517	Digital Image Processing	5-0-0	3
	IT-518	Virtual Reality and Animation	5-0-0	3
	IT-519	Robotics Engineering	5-0-0	3
	IT-520	Pattern Recognition	5-0-0	3
	IT-521	Cyber Security	5-0-0	3
	IT-522	Fuzzy Logic	5-0-0	3
	IT-523	Software Testing	5-0-0	3

(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 (5/6) through evaluation will be added in Term-VI under the course IT-659 Dissertation Phase-II.
- \*\*\* Credits earned (2) through evaluation will be added under course IT-661 Teaching Practice-II. It is a mandatory learning course.

**Scheme of Studies  
M.Tech. Information Technology  
(Part Time)**

**1st Year**

TERM – I				
S.N.	Course No.	Course Name	L-T-P	Cr.
1	MA-501	Numerical Technique	5-1*-0	4
2	IT-501	Communication System	5-1*-0	4
3	IT-551	Simulation Lab	0-0-4	2
<b>10-2-4(16)</b>				<b>10</b>

TERM – II				
S.N.	Course No.	Course Name	L-T-P	Cr.
1	IT-502	Advanced Database Management System	5-1*-0	4
2	IT-503	Advanced Computer Architecture	5-1*-0	4
3	IT-552	Advanced Database Management System Lab	0-0-4	2
<b>10-2-4 (16)</b>				<b>10</b>

TERM – III				
S. N.	Course No.	Course Name	L-T-P	Cr.
1	IT-504	Advanced Data Structure	5-1*-0	4
2	IT-505	Dataware Housing and Data Mining	5-1*-0	4
3	IT-554	Advanced Data Structure Lab	0-0-4	2
<b>10-2-4 (16)</b>				<b>10</b>

**Scheme of Studies  
M.Tech. Information Technology  
(Part Time)**

**2<sup>nd</sup> Year**

<b>TERM – IV</b>				
<b>S.N.</b>	<b>Course No.</b>	<b>Course Name</b>	<b>L-T-P</b>	<b>Cr.</b>
1	IT-514	Software Engineering	5-1*-0	4
2		Elective-1	5-0-0	3
3	IT-564	Software Engineering Lab	0-0-4	2
<b>10-1-4 (15)</b>				<b>9</b>

<b>TERM – V</b>				
<b>S.N.</b>	<b>Course No.</b>	<b>Course Name</b>	<b>L-T-P</b>	<b>Cr.</b>
1	IT-601	Multimedia Technologies	5-1*-0	4
2		Elective-II	5-0-0	3
3	IT-651	Multimedia Lab	0-0-4	2
<b>10-1-4 (15)</b>				<b>9</b>

<b>TERM – VI</b>				
<b>S.N.</b>	<b>Course No.</b>	<b>Course Name</b>	<b>L-T-P</b>	<b>Cr.</b>
1	IT-515	Network Management and Security	5-1*-0	4
2	IT-658	Minor Project	0-0-6	3
3	IT-574	Seminar-I	0-0-2	1
<b>5-1-8 (14)</b>				<b>8</b>

**Scheme of Studies  
M.Tech. Information Technology  
(Part Time)**

**3<sup>rd</sup> Year**

<b>TERM – VII</b>				
<b>S.N.</b>	<b>Course No.</b>	<b>Course Name</b>	<b>L-T-P</b>	<b>Cr.</b>
1	IT-602	E-Commerce and ERP	5-1*-0	4
2	IT-653	Dissertation Preliminary **	0-0-10	(5)
3	IT-654	Seminar-II	0-0-4	2
<b>5-1-14 (20)</b>				<b>6</b>

<b>TERM – VIII</b>				
<b>S.N.</b>	<b>Course No.</b>	<b>Course Name</b>	<b>L-T-P</b>	<b>Cr.</b>
1	IT-605	IT Management	5-1*-0	4
2	IT-657	Dissertation Phase-I**	0-0-12	(6)
3	IT-656	Seminar-III	0-0-4	2
<b>5-1-16 (22)</b>				<b>6</b>

<b>TERM – IX</b>				
<b>S.N.</b>	<b>Course No.</b>	<b>Course Name</b>	<b>L-T-P</b>	<b>Cr.</b>
1	IT-659	Dissertation Phase-II	0-0-24	12+5+6
2	IT-660	Teaching Practice –I***		(2)
3	IT-661	Teaching Practice –II		2+2
<b>0-0-24 (24)</b>				<b>27</b>

**Scheme of Studies**  
**M.Tech. Information Technology**  
**(Part Time)**

**List of Electives**

<b>Elective – I</b>				
<b>S.N.</b>	<b>Course No.</b>	<b>Course Name</b>	<b>L-T-P</b>	<b>Cr.</b>
	IT-506	Wireless Mobile Networks	5-0-0	3
	IT-507	Blue Tooth Technologies	5-0-0	3
	IT-508	Advanced Computer Graphics	5-0-0	3
	IT-509	Digital Signal Processing	5-0-0	3
	IT-510	Neural Networks	5-0-0	3
	IT-511	Genetic Algorithms	5-0-0	3
	IT-512	Soft computing	5-0-0	3
	IT-513	Software Project Management	5-0-0	3

<b>Elective – II</b>				
<b>S.N.</b>	<b>Course No.</b>	<b>Course Name</b>	<b>L-T-P</b>	<b>Cr.</b>
	IT-516	Cellular and Mobile Communications	5-0-0	3
	IT-517	Digital Image Processing	5-0-0	3
	IT-518	Virtual Reality and Animation	5-0-0	3
	IT-519	Robotics Engineering	5-0-0	3
	IT-520	Pattern Recognition	5-0-0	3
	IT-521	Cyber Security	5-0-0	3
	IT-522	Fuzzy Logic	5-0-0	3
	IT-523	Software Testing	5-0-0	3

**FINAL EVALUATION IN GRADES**

- \* Period will be used for self study resulting in submission of Term Paper.
- \*\* Credits earned (5/6) through evaluation will be added in Term-IX under course IT-659 Dissertation Phase-II.
- \*\*\* Credits earned (2) through evaluation will be added under course IT-661 Teaching Practice-II. It is a mandatory learning course.

IT-501	COMMUNICATION SYSTEM	L T P	Cr
		5 1 0	4

- 1. INTRODUCTION TO DATA COMMUNICATIONS AND NETWORKING:** Introduction; history of data communication; data communication network architecture; protocols and standards; standards organizations for data communications; layered networks architecture; open systems interconnection; data communication circuits; serial and parallel data transmission; data communication circuit arrangements; data communication networks, alternate protocol suites.
- 2. SIGNALS, NOISE, MODULATION AND DEMODULATION:** Introduction; signal analysis; electrical noise and signal-to-noise ratio; analog modulation systems; information capacity, bits, bit rate, baud, and m-ary encoding; digital modulation.
- 3. CLASSIFICATION OF SIGNALS & SYSTEMS:** Fourier series, Fourier transforms and their applications to system analysis. Representations of random signals, Concept of Probability, Probability distribution Function, Probability density Function, Gaussian, Binomial, Raleigh and Poisson's distribution, Random Process, Correlation Function, Power Spectral Density, Response of Linear systems to random signals. Gaussian distribution, Central Limit theorem, Ergodicity, co-variance.
- 4. ANALOG MODULATION METHODS:** Amplitude modulation: generation and demodulation of AM waves; DSBSC waves; coherent detection of DSBSC signal; angle modulation: frequency & phase modulation; BW of FM waves; generation & demodulation of FM waves; comparison of AM, fm & PM.
- 5. PULSE ANALOG MODULATION:** Sampling theorem; sampling of low pass and band pass signals; aliening; aperture effect; PAM, PWM and PPM generation and demodulation; TDM.
- 6. PULSE DIGITAL MODULATION:** Pulse code modulation signal to quantization noise ratio; companding; DPCM, prediction filter; dm and adm modulators and demodulators; data modem; data encoding methods: ASK, FSK, PSK, QAM, m-ary systems; line coding; inter symbol interference; multiplexing methods: time division multiplexing (TDM), STDM, CDMA, FDM.
- 7. INTRODUCTION TO INFORMATION THEORY:** Discrete messages; the concept of amount of information; entropy; information rate mutual information; shannon's source coding theorem; huffman code; lempel – ziv code; channel coding and channel capacity theorem; coding to increase average information per bit; shannon's theorem; capacity of a gaussian channel; bandwidth –S/N tradeoff; use of orthogonal signals to attain Shannon's limit.

#### REFERENCE BOOKS

1. Taub & Schilling, "Principles of Communication Systems", TMH, 2nd Edition, 2001.
2. Haykin, S. "Analog and Digital Communication", Wiley., 2002.

3. Hancocok, J.C., "An Introduction to the Principles of Communication Theory", TMH, 2002.
4. Tomasi, "Electronic Communication Systems", 4th ed., Pearson Education, 2001.
5. Stallings, William, "Data & Computer Communications", PHI (6th Ed.).
6. Forouzan, "Data Communication & Networking" McGraw Hill, 2nd Edition, 1999

IT-502	ADVANCED DATABASE MANAGEMENT SYSTEM	L T P	Cr
		5 1 0	4

- 1 RELATIONAL DATABASES:** Integrity constraints revisited; extended er diagram; relational algebra and calculus; functional multivalued and join dependency; normal forms; rules about functional dependencies.
- 2 QUERY PROCESSING AND OPTIMIZATION VALUATION OF RELATIONAL OPERATIONS:** Transformation of relational expressions; indexing and query optimization; limitations of relational data model; null values and partial information.
- 3 DEDUCTIVE DATABASES:** Datalog and recursion; evaluation of datalog program; recursive queries with negation.
- 4 OBJECTED ORIENTED AND OBJECT RELATIONAL DATABASES:** Modeling complex data semantics; specialization; generalization; aggregation and association; objects; object identity; equality and object reference; architecture of object oriented and object relational databases
- 5 PARALLEL AND DISTRIBUTED DATABASES:** Distributed data storage – fragmentation and replication; location and fragment transparency distributed query processing and optimization; distributed transaction modeling and concurrency control; distributed deadlock; commit protocols; design of parallel databases; parallel query evaluation.
- 6 ADVANCED TRANSACTION PROCESSING:** Nested and multilevel transactions; compensating transactions and saga; long duration transactions; weak levels of consistency; transaction work flows; transaction processing monitors.
- 7 ACTIVE DATABASE AND REAL TIME DATABASES:** Triggers in sql; event constraint and action: eca rules; query processing and concurrency control; compensation and databases recovery

#### REFERENCE BOOKS

1. Elmarsi, Navathe, Gupta, Somayajulu, "Fundamentals of Database Systems", 4<sup>th</sup> Edition, Pearson Education, 2007.
2. Garcia, Ullman, Widom, "Database Systems the Complete Book", Pearson Education, 2007.
3. Ramakrishnan, R, "Database Management Systems", McGraw Hill International Editions 1998.
4. Date, Kannan, Swaminathan, "An Introduction to Database Systems", 8<sup>th</sup> Edition Pearson Education, 2007.

5. Singh, S.K., "Database System Concepts, Design and Application", Pearson Education, 2006.
6. Silberschatz, Korth, Sudarshan, "Database System Concepts", Mcgraw Hil, 6<sup>th</sup> Edition, 2006.
7. Kim, W., "Modern Database Systems", 1995, ACM Press, Addison – Wesley.
8. Maier, D. "The Theory of Relational Databases", 1993, Computer Science Press, Rokville, Maryland.
9. Ullman, J. D., "Principals of Database Systems", Galgotia publications, 1999.
10. Oracle Xi Reference Manual.

IT-503	ADVANCED COMPUTER ARCHITECTURE	LTP	Cr
		5 1 0	4

- 1 **PARALLEL COMPUTER MODELS:** The state of computing; classification of parallel computers; multiprocessors and multicomputers; multivector and simd computers.
- 2 **PROGRAM AND NETWORK PROPERTIES:** Conditions of parallelism; data and resource dependences; hardware and software parallelism; program partitioning and scheduling; grain size and latency; program flow mechanisms; control flow versus data flow; data flow architecture; demand driven mechanisms; comparisons of flow mechanisms.
- 3 **SYSTEM INTERCONNECT ARCHITECTURES:** Network properties and routing; static interconnection networks; dynamic interconnection networks; multiprocessor system interconnects; hierarchical bus systems; crossbar switch and multiport memory; multistage and combining network.
- 4 **ADVANCED PROCESSORS:** Advanced processor technology; instruction-set architectures; cisc scalar processors; risc scalar processors; superscalar processors; vliw architectures; vector and symbolic processors.
- 5 **PIPELINING:** Linear pipeline processor; nonlinear pipeline processor; instruction pipeline design; mechanisms for instruction pipelining; dynamic instruction scheduling; branch handling techniques; branch prediction; arithmetic pipeline design; computer arithmetic principles; static arithmetic pipeline; multifunctional arithmetic pipelines.
- 6 **MEMORY HIERARCHY DESIGN:** Cache basics and cache performance; reducing miss rate and miss penalty; multilevel cache hierarchies; main memory organizations; design of memory hierarchies.
- 7 **MULTIPROCESSOR ARCHITECTURES:** Symmetric shared memory architectures; distributed shared memory architectures; models of memory consistency; cache coherence protocols (msi; mesi; moesi); scalable cache coherence; overview of directory based approaches; design challenges of directory protocols; memory based directory protocols; cache based directory protocols; protocol design tradeoffs; synchronization.

## REFERENCE BOOKS

1. Hwang ,Kai, "Advanced computer Architecture", TMH. 2000
2. D. A. Patterson and J. L. Hennessey, "Computer Organization and Design", Morgan Kaufmann, 2nd Ed. 2002.
3. Hayes, J.P, "Computer Architecture and Organization", MGH. 1998.
4. Harvey G.Cragon, "Memory System and Pipelined Processors", Narosa Publication, 1998.
5. V.Rajaranam , V. and Murthy, C.S.R., "Parallel Computer", PHI, 2002.
6. Ghose, R.K., Moona ,Rajan,Moona and Gupta, Phalguni, "Foundation of Parallel Processing", Narosa Publications, 2003.
7. Hwang Kai and Zu,, "Scalable Parallel Computers Architecture", MGH, 2001.
8. Stalling W, "Computer Organisation and Architecture", PHI, 2000.
9. Sima, D.,Fountain, T, Kasuk, P., "Advanced Computer Architecture-A Design space Approach",Addison Wesley,1997.
10. Flynn, M.J, "Computer Architecture Pipelined and Parallel Processor Design", Narosa Publishing. 1998.
11. Patterson, D.A., Hennessy, J.L., "Computer Architecture :A Quantitative Approach", Morgan Kauffmann feb,2002.
12. Hwan and Briggs, "Computer Architecture and Parallel Processing", MGH , 1999.

IT-504	ADVANCED DATA STRUCTURE	LTP	Cr
		5 1 0	4

- 1 **INTRODUCTION TO ALGORITHM:** The role of algorithms in computing; asymptotic notation; asymptotic analysis of recurrence relations; probabilistic analysis and randomized algorithm; the hiring problem; indicator random variables.
- 2 **DIVIDE AND CONQUER PARADIGM:** Merge sort; inversion counting dynamic programming – matrix chain multiplication; longest common subsequence; optimal binary search trees.
- 3 **GREEDY ALGORITHM:** Activity selection problem; theoretical foundation of greedy algorithm; task scheduling problem; comparison of dynamic programming and greedy algorithm with knapsack as case study.
- 4 **GRAPHS:** Review of graphs (representation, depth first search, breath first search, kruskal and prim algorithm, dijkstra's algorithm) flow networks; ford-fulkerson method; comparison networks,;zero-one principle; bitonic sorting network; merging network; sorting network.
- 5 **MATRIX OPERATION** (Properties, strassen's algorithm, solution of linear equation, matrix inversion) polynomial and fft; representation of polynomials; the dft and fft; efficient fft implementation.
- 6 **NUMBER:** Theoretic algorithm; elementary number-theoretic notion; greatest common divisor; modular arithmetic; solving modular linear equation; the chinese remainder theorem.

- NP-completeness; polynomial time; polynomial time verification; np-completeness and reducibility; np-completeness proofs approximation algorithms- the vertex-cover problem; the traveling-salesman problem; the set covering problem.

**REFERENCE BOOKS**

- Cormen, T. H. , Leiserson, C. E. Rivest, R.L. , Stein C., "Introduction to Algorithms", 2<sup>nd</sup> Edition, PHI.
- Aho, A.V., Hopcroft, J. E., Ulman, J.D., "The Design and Analysis of Computer Algorithms", Addison Wesley.
- Manber, V., "Introduction to Algorithms – A Creative Approach", Addison Wesley.
- Harwitz ,vand Sahani ,Sartaz, "Fundamentals of Computer Algorithms", Galgotia Publications.

IT-505	DATAWARE HOUSING AND DATA MINING	L T P	Cr
		5 1 0	4

- DATA WAREHOUSING:** introduction to data warehousing; evolution of data warehousing; data warehousing concepts; benefits of data warehousing; comparison of OLTP and data warehousing; problems of data warehousing.
- DATA WAREHOUSING ARCHITECTURE:** Operational data and data-store; load manager; warehouse manager; query manager; detailed data; lightly and highly summarized data; archive/backup data; meta-data; architecture model; 2-tier; 3-tier and 4-tier data warehouse; end user access tools.
- DATA WAREHOUSING TOOLS AND TECHNOLOGY TOOLS AND TECHNOLOGIES:** Extraction; cleaning and transformation tools; data warehouse DBMS; data warehouse meta-data; administration and management tolls; operational vs. Information systems; OLAP and DSS support in data warehouse.
- DISTRIBUTED DATA WAREHOUSE:** Types of distributed data warehouses; nature of development efforts; distributed data warehouse development; building the warehouse on multiple levels.
- TYPES OF DATA WAREHOUSES AND DATA WAREHOUSE DESIGN:** Host based; single stage; LAN based; multistage; stationary distributed and virtual data-warehouses; data warehousing design: designing data warehouse database; database design methodology for data warehouses; data warehousing design using oracle; OLAP and data mining; online analytical processing; data mining.
- FUNDAMENTALS OF MINING:** Data mining functionalities; classification of data mining systems; major issues in data mining; data warehouse and OLAP technology for data mining data warehouse; multidimensional data model; data warehouse architecture; data warehouse implementation; further development of data cube technology; from data warehousing to data mining.

- DATA MINING PRIMITIVES:** Languages and system architectures; data mining primitives; data mining query languages; designing gui based on a data mining query language architectures of data mining systems; cluster analysis introduction: types of data in cluster analysis; a categorization of major clustering methods; partitioning methods; density-based methods; grid-based methods; model-based clustering methods; outlier analysis

**REFERENCE BOOKS**

- Raj Poonia ,Paul, "Fundamentals of Data Warehousing", John Wiley and Sons, 2003.
- Anahony ,Sam, "Data Warehousing in the Real World: A Practical Guide for Building Decision Support Systems", John Wiley, 2004
- Inmon, W. H. "Building the Operational Data Store", 2<sup>nd</sup> Ed., John Wiley, 1999
- Kamber and Han, "Data Mining Concepts and Techniques", Hartcourt India P. Ltd., 2001

IT-506	WIRELESS MOBILE NETWORK	L T P	Cr
		5 0 0	3

- INTRODUCTION TO PERSONAL COMMUNICATION SERVICES (PCS):** pcs architecture; mobility management; networks signaling.
- GLOBAL SYSTEM FOR MOBILE COMMUNICATION (GSM) SYSTEM OVERVIEW:** GSM architecture; mobility management, network signaling.
- GENERAL PACKET RADIO SERVICES (GPRS):** GPRS architecture; gprs network nodes.
- MOBILE DATA COMMUNICATION:** WLAN (Wireless LANs) IEEE 802.11 standard; mobile ip.
- WIRELESS APPLICATION PROTOCOL (WAP):** The mobile internet standard; wap gateway and protocols; wireless markup languages (wml)
- THIRD GENERATION (3G) MOBILE SERVICES:** Introduction to international mobile Telecommunications 2000 (IMT 2000) vision, wideband code division multiple access (W-CDMA); and CDMA 2000, quality of services in 3G.
- WIRELESS LOCAL LOOP (WLL):** Introduction to WLL architecture; WLL technologies. global mobile satellite systems: case studies of iridium and globalstar systems; bluetooth technology and Wi-Max.

**REFERENCE BOOKS**

- Lin, Yi –Bing, Chlamatac ,Imrich "Wireless and mobile Networks Architecture," by, John Wiley and Sons, 2001.
- Pandya ,Raj,"Mobile and Personnel Communication Systems and Services", Prentice Hall India, 2001.
- Rappaport, Theodore ,S. "Wireless Communication- Principles and Practices," 2nd Ed., Pearson Education Pvt. Ltd, 2003.
- Schiller, Jochen, "Mobile communications", Pearson Education Pvt. Ltd., 2002.

- Singhal and Bridgman et. al "The Wireless Application Protocol", Pearson Education, 2004.
- Hensmann, Merk and Stober, "Principles of Mobile Computing" 2nd Ed, Springer International Edition, 2003.
- Talukdar, Yaragal, "Mobile Computing", TMH, 2005.
- Smith, Collins "3G Wireless Networks", TMH, 2007.

IT-507	BLUETOOTH TECHNOLOGY	L T P	Cr
		5 0 0	3

- INTRODUCTION TO WIRELESS TECHNOLOGIES:** WAP services; serial and parallel communication; asynchronous and synchronous communication; FDM; TDM; TFM; spread spectrum technology
- INTRODUCTION TO BLUETOOTH:** Specification; core protocols; cable replacement protocol Bluetooth radio: type of antenna; antenna parameters; frequency hopping
- BLUETOOTH NETWORKING:** Wireless networking; wireless network types; devices roles and states; Ad-hoc Network; scatternet
- CONNECTION ESTABLISHMENT PROCEDURE:** Notable aspects of connection establishment; mode of connection; Bluetooth security; security architecture; security level of services; profile and usage model: generic access profile (gap), SDA, serial port profile; secondary Bluetooth profile
- HARDWARE:** Bluetooth implementation; baseband overview; packet format; transmission buffers; protocol implementation: link manager protocol; logical link control adaptation protocol; host control interface; protocol interaction with layers
- PROGRAMMING WITH JAVA:** Java programming; J2ME architecture; Javax; Bluetooth package interface; classes; exceptions, Javax. Obex package: interfaces, classes
- BLUETOOTH SERVICES REGISTRATION AND SEARCH APPLICATION;** Bluetooth Client and Server Application. Overview of IRDA, homeRF, Wireless LANS, JINI

#### REFERENCE BOOKS

- Reddi, A.P. and Prabhu, C.S.R., , "Bluetooth Technology"; PHI
- Jochen Schiller, "Mobile Communications", Pearson Education, 5<sup>th</sup> Edition, 2002
- Nathan J. Muller "Bluetooth Demystified", Tata McGraw Hill, 2001

IT-508	ADVANCE COMPUTER GRAPHICS	L T P	Cr
		5 0 0	3

- LINE DRAWING AND TRANSFORMATION:** Basic Raster Graphical Algorithm for 2d primitives; line drawing algorithm; 2d and 3d transformation .
- CLIPPING:** Window; view-port; clipping algorithm.

- CURVES AND SURFACES:** Circle drawing algorithm; ellipse drawing algorithm; bezier curve; b-spline curve; surfaces; solid modeling .
- PROJECTION:** Parallel projection; perspective projection ; computation of vanishing point .
- VISIBLE SURFACE DETERMINATION:** Z-buffer algorithm; scan line algorithm; area subdivision algorithm; raytracing algorithm .
- SHADING:** Illumination mode; specular reflection model; shading models for curve surfaces; radiosity method; rendering; recursive ray tracing; texture mapping.
- ADVANCED MODELING TECHNIQUES:** Procedural models; fractal models; grammar based models; particle systems animation: 3d animation; morphing; simulation of key frames.

#### REFERENCE BOOKS

- Foley, "Computer Graphics Principles and Practice", 2<sup>nd</sup> edition. Pearson Education., 2000
- Roger and Adams, "Mathematical Element for Computer Graphics" 2<sup>nd</sup> edition, Tata McGraw Hill, 1989
- David F. Rogers, "Procedural Element for Computer Graphics", McGraw Hill Book Company, 1985.
- Hearn and Baker, "Computer Graphics C version". 2<sup>nd</sup> edition, Pearson Education., 1986

IT-509	DIGITAL SIGNAL PROCESSING	L T P	Cr
		5 0 0	3

- INTRODUCTION:** Signals and signal processing; characterization & classification of signals; typical signal processing operations; example of typical signals; typical signals processing applications.
- TIME DOMAIN REPRESENTATION OF SIGNALS & SYSTEMS:** Discrete time signals; operations on sequences; linear shift-invariant systems; stability and causality; linear constant coefficient difference equations; frequency domain representation of discrete-time systems; symmetry properties of the fourier transform; sampling of continuous-time systems.
- TRANSFORMS:** Z-transforms; inverse Z-transform; properties of Z-transform & its applications in system analysis & design; Discrete Fourier Transform (DFT) & its properties; computation of the DFT of real sequences; Linear Convolution using the DFT.
- DIGITAL FILTER STRUCTURE:** Block diagram representation; signal flow graph representation; equivalent structures; basic FIR digital filter structures: direct forms, transposed forms, cascaded forms; poly phase realization and linear phase FIR structures.
- BASIC IIR FILTER STRUCTURES:** Direct forms; transposed forms; cascaded realizations and parallel realizations; all pass filters; digital sine-cosine generator.

- DIGITAL FILTER DESIGN:** Design of IIR digital filters from analog filters; properties of FIR digital filters; design of FIR filters using windows; computer aided design of FIR filters; comparison of IIR and FIR digital filters.
- COMPUTATION OF DISCRETE FOURIER TRANSFORM:** Complexity of the DFT computation by direct method; Goertzel algorithm; decimation-in-time FFT algorithms; decimation-in frequency FFT algorithms.

**REFERENCE BOOKS**

- Alan V. Oppenheim, Alan V & Ronald W. Schafer, Ronald W., " Digital Signal Processing" ,PHI, 2002.
- Mitra, Sanjit K., " Digital Signal Processing: A computer based approach" ,TMH, Second Edition, 2003.
- Chen, Chi-Tsong , " Digital Signal Processing, Spectral Computation and Filter Design", Oxford University Press, 2001.
- Hayes, Monson H. , " Schaum's Outline of Digital Signal Processing", TMH, 1999.
- Hammming, Richard W. , "Digital Filters", Dover Publications, 1998.
- Wanhammar, Lars , " DSP Integrated Circuits", Academic Press, First edition, 1999.
- Haykin, Simon S. , " Adaptive Filter Theory", Prentice Hall, 3rd Edition.

IT-510	NEURAL NETWORK	LTP	Cr
		500	3

- BACKGROUND:** Biological analogy; architecture classification; neural models; learning paradigm and rule; single unit mapping and the perception.
- SINGLE LAYER PERCEPTION CLASSIFIER:** Classification model; features and decision regions; training and classification using discrete perceptron; algorithm; single layer continuous perceptron networks for linearly separable classifications.
- MULTI-LAYER FEED FORWARD NETWORKS:** Linearly non-separable pattern classification; delta learning rule for multi-perceptron layer; generalized delta learning rule; error back-propagation training; learning factors; examples.
- SINGLE LAYER FEED BACK NETWORKS:** Basic concepts; hopfield networks; training and examples
- ASSOCIATIVE MEMORIES:** Linear association; basic concepts of recurrent auto associative memory; retrieval algorithm; storage algorithm; bi-directional associative memory; architecture; association encoding and decoding; stability.
- NEURAL NETWORK BASED APPROACHES:** PCA, LVQ, adaptive resonance networks, rbf networks.
- APPLICATIONS OF ARTIFICIAL NEURAL NETWORKS:** Regression; applications to function approximation, classification, blind source separation

**REFERENCE BOOKS**

- Haykin ,S., "Neural Networks-A Comprehensive Foundations", Prentice-Hall International, New Jersey, 1999.
- Anderson ,J.A., "An Introduction to Neural Networks", PHI, 1999.
- Hertz J, Krogh , Palmer, A, R.G, "Introduction to the Theory of Neural Computation", Addison-Wesley, California, 1991.
- Hertz J, Krogh , Palmer, A, R.G. , "Introduction to the Theory of Neural Computation", Addison-Wesley, California, 1991.
- Freeman ,J.A., Skapura, D.M., "Neural Networks: Algorithms, Applications and Programming Techniques", Addison-Wesley, Reading, Mass, (1992).
- Golden ,R.M., "Mathematical Methods for Neural Network Analysis and Design", MIT Press, Cambridge, MA, 1996.
- Cherkassky, V., F. Kulier, "Learning from Data-Concepts, Theory and Methods", John Wiley, New York, 1998.
- Anderson ,J.A., E. Rosenfield, "Neurocomputing: Foundatiions of Research", MIT Press, Cambridge, MA, 1988.
- Kohonen,T., "Self-Organizing Maps", 2<sup>nd</sup> Ed., Springer Verlag, Berlin, 1997.
- Patterson ,D.W., "Artificial Neural Networks: Theory and Applications", Prentice Hall, Singapore, 1995.
- Vapnik ,V.N., "Estimation of Dependencies Based on Empirical Data", Springer Verlag, Berlin, 1982.
- Vapnik, V.N., "The Nature of Statistical Learning Theory", Springer Verlag, New York, 1995.
- Vapnik ,V.N., "Statistical Learning Theory: Inference from Small Samples", John Wiley, 1998.

IT-511	GENETIC ALGORITHM	LTP	Cr
		500	3

- INTRODUCTION:** A brief history of evolutionary computation; elements of genetic algorithms; a simple genetic algorithm; applications of genetic algorithms
- GENETIC ALGORITHMS IN SCIENTIFIC MODELS:** Evolving computer programs; data analysis and prediction; evolving neural networks; modeling interaction between learning and evolution; modeling sexual selection; measuring evolutionary activity.
- THEORETICAL FOUNDATION OF GENETIC ALGORITHM:** Schemas and two-armed and k-armed problem; royal roads, exact mathematical models of simple genetic algorithms; statistical- mechanics approaches.
- COMPUTER IMPLEMENTATION OF GENETIC ALGORITHM:** Data structures, reproduction; crossover and mutation; mapping objective functions to fitness form, fitness scaling, coding; a multi-parameter; mapped, fixed point coding; discretization and constraints.
- SOME APPLICATIONS OF GENETIC ALGORITHMS:** The risk of genetic algorithms; de jong and function optimization; improvement in basic techniques; current application of genetic algorithms

- 6 **ADVANCED OPERATORS IN GENETIC SEARCH:** Dominance; duplicity; and abeyance; inversion and other reordering operators. other micro operators,
- 7 **TECHNIQUES IN GENETIC SEARCH:** Niche and speciation; multi objective optimization; knowledge based techniques; genetic algorithms and parallel processors.

**REFERENCE BOOKS**

1. E. Goldberg, David, "Genetic Algorithms in Search, Optimization and Machine Learning" Pearson Education, 2006
2. Mitchell, Melanle "An introduction to Genetic Algorithms", Prentice Hall India, 2002.
3. Michael , Vose, D. , "The Simple Genetic Algorithm Foundations and Theory", Prentice Hall India, 1999.
4. Sakawa ,Masatoshi, "Genetic Algorithms and Fuzzy Multiobjective Optimization", Kluwer Academic Publisher, 2001.
5. Quagliarella, D.Periaux J, Poloni , C and Winter, G, "Genetic Algorithms in Engineering and Computer science", John Wiley and Sons, First ed, 1997.
6. Mzumder, Pinaki, Raudnick, Elizabeth ,M. "Genetic Algorithms for VLSI design, layout and test automation", Pearson Education, 2006.

IT-512	SOFT COMPUTING	L T P	Cr
		5 0 0	3

- 1 **NEURAL NETWORKS:** History, overview of biological neuron – system; mathematical models of neurons; ann architecture; learning rules; learning paradigms-supervised; unsupervised and reinforcement learning ann training algorithms-perceptions; training rules; delta; back propagation algorithm; multilayer perception model; hopfield networks; associative memories; applications of artificial neural networks
- 2 **FUZZY LOGIC:** Introduction to fuzzy logic; classical and fuzzy sets: overview of classical sets, membership function; fuzzy rule generation.
- 3 **OPERATIONS ON FUZZY SETS:** Compliment; intersections; unions; combinations of operations; aggregation operations.
- 4 **FUZZY ARITHMETIC:** Fuzzy numbers; linguistic variables; arithmetic operations on intervals and numbers; lattice of fuzzy numbers; p fuzzy equations. classical logic; multi-valued logics; fuzzy propositions; fuzzy qualifiers, linguistic hedges.
- 5 **UNCERTAINTY BASED INFORMATION:** Information and uncertainty; non specificity of fuzzy and crisp sets, fuzziness of fuzzy sets.
- 6 Swarm intelligent and ant colony optimization.
- 7 Introduction to chaos and rough set theory

**REFERENCE BOOKS**

1. Haykin , Simon, "Neural Networks: A Comprehensive Foundation", 2<sup>nd</sup> Edition, Prentice Hall PTR

2. Kosko B , "Neural Networks and Fuzzy Systems: A Dynamical Systems Approach to Machine Intelligence", Prentice-Hall, 1999.
3. Klir, GJ, Yuan, B, "Fuzzy Sets and Fuzzy Logic: Theory and Application", Prentice-Hall, Inc., 1994

IT-513	SOFTWARE PROJECT MANAGEMENT	L T P	Cr
		5 0 0	3

- 1 **INTRODUCTION TO SOFTWARE PROJECT MANAGEMENT:** Software development as a project; stakeholders in software project; software product; process, resources; quality; and cost; objectives; issues; and problems relating to software projects; overview of project planning: steps in project planning; defining scope and objectives; work breakdown structure; deliverables and other products; time, cost, and resource estimation; alternatives in planning.
- 2 **PROJECT EVALUATION:** Strategic assessment; technical assessment; cost-benefit analysis; cash flow forecasting; cost-benefit evaluation techniques; break-even analysis; risk evaluation selection of appropriate project approach: choosing development technology and methodology; choice of process model; rapid application development; waterfall model; v-process model; spiral model; prototyping,; incremental delivery.
- 3 **SOFTWARE EFFORT ESTIMATION:** Problem in software estimation; effort estimation techniques; expert judgement; estimation by analogy; delphi technique; algorithmic methods; top-down and bottom-up estimation; function point analysis; object points; COCOMO model.
- 4 **ACTIVITY PLANNING :** Network planning model; activity-on-arrow network; precedence network; forward pass; backward pass; critical path; slack and float.; risk analysis and management: nature and categories of risk in software development; risk identification; risk assessment; risk mitigation; monitoring; and management; evaluating schedule risk using pert.
- 5 **RECOURSE ALLOCATION:** Nature of project resources; identifying resource requirement of activities; allocating and scheduling resources; cost of resources; standard, planned; and actual cost; cost variance; time-cost trade-off. project tracking and control: measurement of physical and financial progress; earned value analysis; status reports; milestone reports; change control.
- 6 **CONTACT MANAGEMENT:** Outsourcing of products and services; types of contracts; stages in contract placement; terms of contract; contract monitoring; acceptance testing; managing people and organizing teams: organizational behaviour; recruitment and placement; motivation; group behaviour; individual and group decision making; leadership and leadership styles; forms of organizational structures
- 7 **SOFTWARE QUALITY ASSURANCE:** Planning for quality; product versus process quality management; procedural and quantitative approaches; defect analysis and prevention; statistical process control; pareto analysis; causal analysis; quality standards; iso 9000; capability maturity model; quality audit.; **CONFIGURATION MANAGEMENT:**

Configuration management process; software configuration items; version control; change control; configuration audit; status reporting.

**REFERENCE BOOKS**

1. Hughes , Bob and Cotterell, Mike ,“Software Project Management”, Third Edition 2002, McGraw-Hill
2. jalote, Pankaj ,“Software Project Management in Practice”, 2002, Pearson Education Asia.
3. Pressman, Roger,S., “Software Engineering: A practitioner’s Approach”, Fifth Edition 2001 McGraw-Hill
4. Futrell, Robert ,T., Shafer, Donald ,F.,and Shafer, Linda, I., “Quality Software Project Management” 2002, Pearson Education Asia.
5. Gopalaswamy, Ramesh ,“Managing Global Software Projects”, 2003, Tata McGraw-Hill

IT-514	SOFTWARE ENGINEERING	L T P	Cr
		5 1 0	4

- 1 **INTRODUCTION:** Software crisis; software processes and characteristics; software life cycle models; waterfall; prototype; evolutionary and spiral models; overview of quality standards like ISO 9001; SEI – CMM.
- 2 **SOFTWARE REQUIREMENTS ANALYSIS AND SPECIFICATIONS:** Requirement engineering; requirement elicitation techniques like fast; QFD and use case approach; requirements analysis using DFD; data dictionaries and ER diagrams; requirements documentation; nature of SRS; characteristics and organization of SRS.
- 3 **SOFTWARE PROJECT PLANNING:** Size estimation like lines of code and function count; cost estimation models; static single and multivariable models; COCOMO; COCOMO-II; putnam resource allocation model; risk management.
- 4 **SOFTWARE DESIGN:** Cohesion and coupling; classification of cohesiveness and coupling; function oriented design; object oriented design; user interface design.
- 5 **SOFTWARE METRICS:** Software measurements: what and why; token count; halstead software science measures; design metrics; data structure metrics; information flow metrics
- 6 **SOFTWARE TESTING:** Testing process; design of test cases, functional testing: boundary value analysis; equivalence class testing; decision table testing; cause effect graphing; structural testing; path testing, data flow and mutation testing; unit testing; integration and system testing; debugging; alpha and beta testing; regression testing; testing tools and standards.
- 7 **SOFTWARE RELIABILITY:** Importance, hardware reliability and software reliability; failure and faults, reliability models; basic model; logarithmic poisson model; calender time component; **SOFTWARE MAINTENANCE:** Management of maintenance; maintenance process;

maintenance models; reverse engineering; software re-engineering; configuration management; documentation.

**REFERENCE BOOKS**

1. Aggarwal , K. K. and Singh, Yogesh, “Software Engineering”, New Age International, 2001.
2. Pressman, R. S., “Software Engineering – A practitioner’s approach”, 5<sup>th</sup> Ed., McGraw Hill Int. Ed., 2001.
3. Fairley, R., “Software Engineering Concepts”, Tata McGraw Hill, 1997.
4. Jalote P., “An Integrated approach to Software Engineering”, Narosa, 1991.
5. Stephen R. Schach, “Classical and Object Oriented Software Engineering”, IRWIN, 1996.
6. Peter ,James, Pedrycz, “Software Engineering”, John Wiley and Sons., 1999
7. Sommerville, I. “Software Engineering”, Addison. Wesley, 1999.

IT-515	NETWORK MANAGEMENT AND SECURITY	L T P	Cr
		5 1 0	4

- 1 **INTRODUCTION:** Classical security techniques and computer network security concepts; confidentiality and Security; security policy and operations life cycle; security system development and operations
- 2 **SECURE NETWORKING THREATS:** The attack process; attacker types; vulnerability types; attack results; attack taxonomy; threats to security: physical security; biometric systems; monitoring controls; and data security and intrusion and detection systems.
- 3 **ENCRYPTION TECHNIQUES:** Conventional techniques; modern techniques; des, des chaining; triple DES, RSA algorithm; key management; message authentication and hash algorithm; authentication requirements and functions secure hash algorithm; message digest algorithm; digital signatures; aes algorithms.
- 4 **DESIGNING SECURE NETWORKS:** Components of a hardening strategy; network devices; host operating systems; applications. appliance-based network services; rogue device detection; network security technologies the difficulties of secure networking; security technologies; emerging security technologies general design considerations; layer 2 security considerations; IP addressing design considerations; ICMP design considerations; routing considerations; transport protocol design considerations
- 5 **NETWORK SECURITY PLATFORM OPTIONS :** Network security platform options; network security device best practices; common application design considerations; e-mail; DNS; http/https; ftp; instant messaging.
- 6 **IPsec VPN DESIGN CONSIDERATIONS:** VPN basics; types of IPSEC VPNS; IPSEC modes of operation and security options; topology considerations; design considerations; site-to-site deployment examples.

- 7 **SECURE NETWORK MANAGEMENT AND NETWORK SECURITY MANAGEMENT:** Organizational realities; protocol capabilities; tool capabilities; secure management design options; network security management; firewalls; trusted systems; it act and cyber laws.

**REFERENCE BOOKS**

1. Convery, Sean, " Network Security Architectures", Published by Cisco Press, First Ed. 2004
2. Stalling, William, "Cryptography and Network Security" Fourth Ed., Prentice Hall, 2006
3. Pflieger, Charles P. , Pflieger, Shari Lawrence, "Security in Computing" 3<sup>rd</sup> Edition, Prentice Hall, 2003.
4. Crume, Jeff, "Inside Internet Security" Addison Wesley, 2003.

IT-516	CELLULAR AND MOBILE COMMUNICATION	L T P	Cr
		5 0 0	3

- 1 **INTRODUCTION TO CELLULAR MOBILE SYSTEMS:** A basic cellular system; performance criteria; uniqueness of mobile radio environment; operation of cellular systems; planning of cellular system; overview of generations of cellular systems
- 2 **ELEMENTS OF CELLULAR RADIO SYSTEMS DESIGN AND INTERFERENCE:** General description of the problem; Concept of frequency reuse channels; Co-channel interference reduction factor; desired c/i from a normal case in an omni directional antenna system; cell splitting; consideration of the components of cellular systems; introduction to co-channel interference; co-channel measurement design of antenna system; antenna parameter and their effects.
- 3 **CELL COVERAGE FOR SIGNAL AND ANTENNA STRUCTURES:** General introduction; obtaining the mobile point to point mode; propagation over water or flat open area; foliage loss; propagation near in distance; long distance propagation; point to point prediction model-characteristics; cell site; antenna heights and signal coverage cells; mobile to mobile propagation
- 4 **CHARACTERISTICS OF BASIC ANTENNA STRUCTURE:** Antenna at cell site; mobile antennas; frequency management and channel assignment; hand off and dropped calls frequency management; fixed channel assignment; non-fixed channel assignment; traffic and channel assignment; why hand off; types of hand off and their characteristics; dropped call rates and their evaluation.
- 5 **MODULATION METHOD AND CODING FOR ERROR DETECTION AND CORRECTION:** Introduction to digital modulation techniques; modulation methods in cellular wireless systems; OFDM; block coding; convolution coding and turbo coding.
- 6 **MULTIPLE ACCESS TECHNIQUES:** FDMA; TDMA; CDMA; time-division multiple access (TDMA); code division multiple access (CDMA);

CDMA capacity; probability of bit error considerations; CDMA compared with TDMA

- 7 **SPREAD SPECTRUM TECHNIQUES:** Direct sequence spread spectrum; frequency hopping spread spectrum techniques

**REFERENCE BOOKS**

1. Lee, C. Y., and William, "Mobile Cellular Telecommunications", 2<sup>nd</sup> Edition, McGraw Hill. 2001
2. Schwartz, Mischa, "Mobile Wireless Communications", Cambridge Univ. Press, UK, 2005.
3. Mobile Communication Hand Book, 2<sup>nd</sup> Edition, IEEE Press. 2002
4. Rappaport, Theodore S, "Wireless Communication Principles and Practice", 2<sup>nd</sup> Edition, Pearson Education. 2002
5. Lawrence Harte, "3G Wireless Demystified", McGraw Hill Publications. 2000

IT-517	DIGITAL IMAGE PROCESSING	L T P	Cr
		5 0 0	3

- 1 **INTRODUCTION AND DIGITAL IMAGE FUNDAMENTALS:** The origins of digital image processing; examples of fields that use digital image processing; fundamentals steps in image processing; elements of digital image processing systems; image sampling and quantization; some basic relationships like neighbours; connectivity; distance measures between pixels; linear and non linear operations.
- 2 **IMAGE ENHANCEMENT IN THE SPATIAL DOMAIN:** some basic gray level transformations; histogram processing; enhancement using arithmetic and logic operations; basics of spatial filters; smoothing and sharpening spatial filters; combining spatial enhancement methods; image enhancement in the frequency domain.
- 3 **FOURIER TRANSFORM:** Introduction; frequency domain; smoothing and sharpening frequency domain filters; homomorphic filtering; image restoration
- 4 **MODEL OF THE IMAGE DEGRADATION / RESTORATION PROCESS:** Noise models; restoration in the presence of noise only spatial filtering; periodic noise reduction by frequency domain filtering; linear position-invariant degradations; estimation of degradation function; inverse filtering; wiener filtering; constrained least square filtering; geometric mean filter; geometric transformations
- 5 **IMAGE COMPRESSION:** Coding; interpixel and psychovisual redundancy; image compression models, elements of information theory, error free comparison, lossy compression, image compression standards.
- 6 **IMAGE SEGMENTATION:** Detection of discontinuities; edge linking and boundary detection; thresholding; region oriented segmentation; motion based segmentation

- 7 **REPRESENTATION AND DESCRIPTION:** Representation; boundary descriptors; regional descriptors; use of principal components for description; introduction to morphology; some basic morphological algorithms.
- 8 **OBJECT RECOGNITION:** Patterns and pattern classes; decision-theoretic methods; structural methods

#### REFERENCE BOOKS

- Gonzalez , Rafael C. ,and Woods, Richard E. , "Digital Image Processing", 2<sup>nd</sup> edition, Pearson Education, 2004
- Jain, A.K. , "Fundamental of Digital Image Processing", Prentice Hall of India, 2003
- Rosenfeld, Kak, Avinash C. , "Digital Picture Processing", Academic Press, 1999.
- Pratt, W.K. , "Digital Image Processing", John Wiley & Sons, Inc., 2000

IT-518	VIRTUAL REALITY AND ANIMATION	L T P	Cr
		5 0 0	3

- INTRODUCTION TO THE MODULE:**What is virtual reality? sensing in vr and vr hardware;vr development languages; vr past, present, and future.
- DEVELOPMENT ISSUES:** Development cycle and development tools;organising the code; scenes and scene graphs; creating and navigating the virtual world; gravity and collision; geometry, standard units, co-ordinate systems and transformations.
- ADDING USER INTERACTION:** Events and time; sensors and routes; object oriented nature of vrml programming – prototypes, nodes, fields; structure of a vr object;creating prototypes and objects;interface declaration semantics; definition semantics;rules for mapping; scoping rules;external prototype semantics;static and dynamic instantiation.
- ADDING PROCESSING CAPABILITIES TO VR MODELS:** Scripting, script languages, script execution; initialize and shutdown; events processed; scripts with direct outputs; asynchronous scripts;eventin handling;accessing fields and events;accessing fields and eventouts of the script;accessing eventins and eventouts of other vrml nodes;sending eventouts.
- ADDING AUDIO-VISUAL EFFECTS 1:** Animation and light; interpolators;common principles;colour interpolator; scalar interpolator; orientation interpolator; position interpolator; dynamic scaling: directional, point, and spot light.
- ADDING AUDIO-VISUAL EFFECTS 2:** Texture and sound;textures and texture maps; application of textures to different geometric objects; level of detail;sound and its spatial aspect.
- CREATING VR MODELS WITH EMERGENT BEHAVIOUR:** Using Java with VRML - scripting in java;creating and driving a virtual world from an external java code - external authoring interface.

#### REFERENCE BOOKS

- Carey,R., Bell,G.," The Annotated VRML 2.0 Reference", Addison-Wesley, 1997.
- McCarthy,M., Descartes,A.," Reality Architecture: Building 3D Worlds In Java and VRML", Prentice Hall, 1998.
- Diehl,S.," Distributed Virtual Worlds : Foundations and Implementation Techniques Using VRML, Java, and Corba.", Springer Verlag, 2001.

IT-519	ROBOTIC ENGINEERING	L T P	Cr
		5 0 0	3

- MANIPULATOR KINEMATICS:** Kinematics: introduction; solvability; algebraic solution by reduction to polynomial; standard frames; repeatability and accuracy; computational considerations.
- MANIPULATOR DYNAMICS:** Introduction; acceleration of rigid body; mass distribution; newton's equation; euler's equation; iterative newton-euler dynamic formulation; closed dynamic equation; lagrangian formulation of manipulator dynamics; dynamic simulation; computational consideration.
- TRAJECTORY GENERATION:** Introduction; general considerations in path description and generation; joint space schemes; cartesian space schemes; path generation in runtime; planning path using dynamic model.
- LINEAR CONTROL OF MANIPULATORS:** Introduction; feedback and closed loop control; second order linear systems; control of second-order systems; trajectory following control; modeling and control of a single joint.
- ROBOT PROGRAMMING LANGUAGES AND SYSTEMS:** Introduction; the three level of robot programming; requirements of a robot programming language; problems peculiar to robot programming languages.
- OFF-LINE PROGRAMMING SYSTEMS:** Introduction; central issues in olp system; cimstation; automating subtasks in olp systems.
- Moments of Inertia; Principles Of Nc And Cnc Machines.

#### REFERENCE BOOKS

- Craig, John J. ,"Introduction to Robotics", Addison Wesley publication, 2003.
- Klafter, Richard D. , Chmielewski, Thomas A., Negin, Michael, "Robotic Engineering–An integrated approach", PHI Publication, 2001.
- Yoshikawa, Tsuneo, "Foundations of Robotics", PHI Publication, 2003.
- Staughard, "Robotics and Artificial Intelligence", Prentice Hall of India.
- Grover, Oderey, Wiess, Nagel and, "Industrial Robotics", McGraw Hill.

IT-520	PATTERN RECOGNITION	L T P	Cr
		5 0 0	3

- 1 INTRODUCTION AND BAYERIAN DECISION THEORY:** Introduction to pattern recognition; systems; design cycles; learning and adaptation; bayerian decision theory; minimum error-rate classification; classifiers; discriminant functions and decisions surfaces
- Maximum – likelihood and bayerian parameter estimation bayerian parameter estimation; guarian case and general theory; problems of dimeusability, hidden marker models.
- 3 NONPARAMETER TECHNIQUES:** Density estimation; parazen windows; kn – nearest neighbor; estimation; the nearest neghlaur; rode; metris and nearest – neghron; classification; fuzzy classification; approximation by series expansions.
- 4 LINEAR DISCRIMINANT FUNCTIONS:** Linear discriminant functions and decision surfaces; generadized linear discrminant functions; the two category unicolorly separate case; minimizing the perception criterion function; relaxation procedures; nonreperable behavior; minimum squared-error procedures; the ho – kashyap procedures; support vexter machines; multicategory generatization
- 5 MULTILAYER NEURAL NETWORKS:** Feed forward operations and classifications; Back propagation algorithm; error factors; back propagation as feature and mapping; back propagation; bayer theory and probability; practical techniques for improving back propagation; regularization; complexity adjustment and pruning.
- 6 STOCHASTIC METHODS:** Stochastic search; boltzman learning; boltzman networks of graphical models; evolutionary methods; genetic progrances
- 7 LEARNING TECHNIQUES:** Unsupervised learning and clustering mixture densities and identificability; maximum; likelihood estimation; application to normal mixtures; unemperouses; bayerian learning; data descriptions and controls; criterion function for clusterian; interface; optimization; hierarchical clustering; component analysis; low dimensial representation and multidimensional scaling.

#### REFERENCE BOOKS

- Duda, Richard O., Hart, Peter E., and Stork, David G., "Pattern Classification", 2<sup>nd</sup> Edition, John Wiley, 2003
- Hertz, John, Krogh, Andres and Palmer, Richard G. , "Introduction to the theory of Neural Computation", Addison Wesley, 2001

IT-521	CYBER SECURITY	L T P	Cr
		5 0 0	3

- 1 INTRODUCTION :** Review of TCP/IP and TCP; IP header analysis; introduction to cyber world; cyber attacks and cyber security; information warfare and cyber terrorism; types of cyber attacks; cyber crime and

- digital fraud ; overview of types of computer forensics i.e. media forensics; network forensics (internet forensics); machine forensic; email forensic (e-mail tracing and investigations)
- 2 LIVE DATA COLLECTION AND INVESTIGATING WINDOWS ENVIRONMENT:** Windows registry analysis; gathering tools to create a response toolkit (built in tools like netstat , cmd.exe , nbtstat , arp, md5sum ,regdmp etc and tools available as freeware like fport , pslist etc); obtaining volatile data (tools like coffee , helix can be used) computer forensics in windows environment; log analysis and event viewer; file auditing; identifying rogue machines; hidden files and unauthorized access points; obtaining volatile data (tools like coffee, helix can be used) computer forensics in windows environment; log analysis and event viewer; file auditing; identifying rogue machines; hidden files and unauthorized access points.
  - 3 LIVE DATA COLLECTION AND INVESTIGATING UNIX/LINUX ENVIRONMENT:** Proc file system overview; gathering tools to create a response toolkit ( built in tools like losetup , vnode , netstat , df , md5sum , strace etc and tools available as freeware like encase , carbonite etc ) handling investigations in unix/linux environment: log analysis (network, host, user logging details), recording incident time/date stamps, identifying rogue processes; unauthorized access points; unauthorized user/group accounts
  - 4 FORENSIC TOOLS AND REPORT GENERATION:** Recovery of deleted files in windows and unix; analyzing network traffic; sniffers ; ethical hacking; hardware forensic tools like port scanning and vulnerability assessment tools like nmap; netscan etc. password recovery (tools like John the ripper, l0phtcrack, and THC-Hydra); mobile forensic tools and analysis of called data record template for computer forensic reports
  - 5 IDENTITY THEFT AND PHISHING:** The choice point and lexis-nexis cases; other cases; legislation and lack thereof; financial industry responses – credit card companies, banks, etc
  - 6 WIRELESS AND MOBILE SECURITY :** Security models; threats and solutions; different techniques of authentication; channel interferences
  - 7 NATIONAL RESPONSES:** India; Europe; Japan; Australia; international organisations dealing with cyber crimes.

#### REFERENCE BOOKS

- Mandia, k., Prosize, c., Pepe, M., "Incident Response and Computer Forensics" 2<sup>nd</sup> edition. Tata-McGraw Hill, 2003.
- Nelson, Bill, Phillips, Amelia, Enfinger ,Frank, and Steuart, Chris", Guide to Computer Forensics and Investigations", 2<sup>nd</sup> Edition, Thomson Learning
- Casey, Eoghan, "Digital Evidence and Computer Crime", 2<sup>nd</sup> Edition , Academic Press
- Carrier, Brian , "File System Forensic Analysis" , Addison Wesley, 2005
- Carvey, Harlan, " Windows Forensic Analysis DVD Toolkit", Syngress Publication
- Bunting, Steve," EnCase: The Official EnCase Certified Examiner Study Guide", 2<sup>nd</sup> Edition , Sybex Publication

IT-522	FUZZY LOGIC	L T P	Cr
		5 0 0	3

- CLASSICAL AND FUZZY SETS:** Overview of classical sets; membership function,  $\alpha$ -cuts; properties of  $\alpha$ -cuts; decomposition theorems; extension principle.
- OPERATIONS ON FUZZY SETS:** Compliment; intersections; unions; combinations of operations; aggregation operations.
- FUZZY ARITHMETIC:** Fuzzy numbers; linguistic variables; arithmetic operations on intervals and numbers; lattice of fuzzy numbers; fuzzy equations.
- FUZZY RELATIONS:** Crisp and fuzzy relations; projections and cylindrical extensions; binary fuzzy relations; binary relations on single set; equivalence; compatibility and ordering relations; morphisms; fuzzy relation equations.
- POSSIBILITY THEORY:** Fuzzy measures; evidence and possibility theory; possibility versus probability theory.
- FUZZY LOGIC:** Classical logic; multivalued logics; fuzzy propositions; fuzzy qualifiers; linguistic hedges.
- UNCERTAINTY BASED INFORMATION:** Information and uncertainty; non-specificity of fuzzy and crisp sets; fuzziness of fuzzy sets.

#### REFERENCE BOOKS

- Klir, G.J, Yuan, "Fuzzy Sets and Fuzzy Logic: Theory and applications", Prentice Hall India, 1995.
- Yen, John, Langari, Reza, "Fuzzy Logic Intelligence, Control and Information", Pearson Education, 2006.
- Ross, "Fuzzy Logic with Engineering Applications", 2<sup>nd</sup> Edition, John Wiley, 2004.
- Zimmermann, H., "Fuzzy Set Theory and its applications", 2<sup>nd</sup> Edition, Allied Publishers, 1996.

IT-523	SOFTWARE TESTING	L T P	Cr
		5 0 0	3

- INTRODUCTION:** What is software testing and why it is so hard?; error; fault; failure; incident; test cases; testing process; limitations of testing; no absolute proof of correctness; overview of graph theory.
- FUNCTIONAL TESTING:** Boundary value analysis; equivalence class testing; decision table based testing; cause effect graphing technique
- STRUCTURAL TESTING:** Path testing; DD-paths; cyclomatic complexity; graph metrics; data flow testing; mutation testing.
- REDUCING THE NUMBER OF TEST CASES:** Prioritization guidelines; priority category; scheme; risk analysis; regression testing, slice based testing
- TESTING ACTIVITIES:** Unit testing; levels of testing; integration testing; system testing; debugging; domain testing.

- OBJECT ORIENTED TESTING:** Issues in object oriented testing; class testing; gui testing; object oriented integration and system testing.
- TESTING TOOLS:** Static testing tools; dynamic testing tools; characteristics of modern tools.

#### REFERENCE BOOKS

- Perry, William, "Effective Methods for Software Testing", John Wiley and Sons, New York, 1995.
- Kaner, Cem, Falk, Jack, Quoc, Nguyen, "Testing Computer Software", Second Edition, Van Nostrand Reinhold, New York, 1993.
- Beizer, Boris, "Software Testing Techniques", Second Volume, 2<sup>nd</sup> Edition, Van Nostrand Reinhold, New York, 1990.
- Tamres, Louise, "Software Testing", Pearson Education Asia, 2002
- Aggarwal K.K. , and Singh, Yogesh, "Software Engineering", New Age International Publishers, New Delhi, 2005
- Pressman, Roger S., "Software Engineering –A Practitioner's Approach", Fifth Edition, McGraw-Hill International Edition, New Delhi, 2001.

IT-551	SIMULATION LAB	L T P	Cr
		0 0 4	2

- Introduction to NS2 Network simulator.
- Installation and configuration of NS2 on Linux and Windows
- Basics of TCL/TK Language
- Programming for a basic network simulation.
- Simulation of Aloha protocol
- Simulation of TCP/IP based networks
- Simulation of network with FTP transmission
- Simulation of a network using CBR
- Explanation of Trace file
- Programming and simulation for MPLS based Network.
- Programming using AWK
- Calculate the Throughput, Packet Drop and end-to-end Delay in Wired Network
- Setup a Wireless Network Simulation
- Calculate the throughput, packet drop and end-to-end Delay in Wireless Network in case of CBR traffic.
- Simulation of Multimedia based traffic.

IT-552	ADVANCED DATABASE MANAGEMENT SYSTEM LAB	L T P	Cr
		0 0 4	2

- Installation of oracle, MS SQL or My-SQL, server and client in the lab.
- Study of DDL,DML and DCL commands with an already installed dbms server

3. Study of Transaction Control SQL Commands
4. Study different system defines functions in oracle or SQL server.
5. Study of trigger and procedure.
6. Take a case study of a project (college / institute / organization) and apply first to seven experiment on same project with normalization up to 3<sup>rd</sup> normal form.
7. Perform practically backup and recovery procedures.
8. Create simple Java server page and perform validations.
9. Connect JSP and Java Beans. Take any live example to perform operation.
10. Using JDBC connect Oracle database.
11. To study Spatial Database.
12. To study Temporal Database.
13. To study and implement database connecting using Visual Basic/JAVA.
14. To create an offline XML Database.

<b>IT-554</b>	<b>ADVANCED DATA STRUCTURE LAB</b>	<b>L T P</b>	<b>Cr</b>
		<b>0 0 4</b>	<b>2</b>

1. Write a Program to implement Straight Selection sort method.
2. Write a Program to implement Bubble sort technique.
3. Write a Program to implement Insertion sort method.
4. Write a Program to implement Quick sort technique.
5. Write a Program to implement Shell sort method.
6. Write a Program to implement Merge sort method.
7. Write a Program to implement Radix / Bucket sort method.
8. Write a Program to implement Heap sort technique.
9. Write a Program to implement Binary search method.
10. Write a Program to implement Binary tree sort method.
11. Write a Program to implement Mid Square Hashing method.
12. Write a Program to traverse the Graph using DFS / BFS technique.
13. Write a Program to implement Dijkstra's Algorithm for finding shortest path.
14. Write a Program to find Minimum spanning tree using Prim's / Kruskal's Algorithm
15. Write a Program to implement Knapsack problem.
16. Write a Program to implement N-Queens problem.

<b>IT-564</b>	<b>SOFTWARE ENGINEERING LAB</b>	<b>L T P</b>	<b>Cr</b>
		<b>0 0 4</b>	<b>2</b>

1. Introduction and project definition
2. Software process Configuration Mgmt tool overview
3. Project planning, Management tool
4. Software requirements and Requisite tool
5. Introduction to UML & use case diagrams

6. System modeling
7. Flow of events and activity diagram
8. Object Oriented analysis: discovering Classes
9. Interaction diagrams: sequence & collaboration diagrams
10. Software Design: software architecture and Object Oriented design
11. State Transition Diagram
12. Component and deployment
13. Software testing using Testing tool
14. Presentation on the work done
15. Developing User Manual for the software

<b>IT-574</b>	<b>SEMINAR-I</b>	<b>L T P</b>	<b>Cr</b>
		<b>0 0 4</b>	<b>2</b>

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.

<b>IT-601</b>	<b>MULTIMEDIA TECHNOLOGY</b>	<b>L T P</b>	<b>Cr</b>
		<b>5 1 0</b>	<b>4</b>

- 1 **INTRODUCTION:** Concept of multimedia; media and data stream; main properties of multimedia system; data stream characteristics and for continuous media multimedia applications; hardware software requirements; storage technologies: raid; optical media.
- 2 **COMPONENTS OF MULTIMEDIA AND FILE FORMATS:** Text; basic sound concepts; midi; speech; basic concept of images; graphics format; basic concepts of video and animation; conventional system; computer based animation; authoring tools; categories of authoring tools.
- 3 **COMPRESSION TECHNIQUES:** Lossless and lossy compression; run length coding; statistical coding; transform coding; JPEG; MPEG; text compression using static huffmann technique; dynamic huffmann technique; arithmetic technique.
- 4 **ANIMATION:** Introduction; basic terminology techniques; tweaning and morphing; motion graphics 2D and 3D animation.
- 5 **VIRTUAL REALITY:** Applications of multimedia; intelligent multimedia system; desktop virtual reality; vr operating system; virtual environment displays and orientation making; visually coupled system requirements; intelligent VR software systems.

- 6 **INTRODUCTION TO MAYA(ANIMATING TOOL):** Fundamentals; modeling: NURBS; polygon; organic; animation: key frame animation; reactive animation; path animation; skelton animation etc.; deformers.
- 7 **DYNAMICS:** Soft bodies; rigid bodies and its usages in the scene etc.; rendering: soft; hard rendering; IPR rendering; line and box rendering etc.; special effects: shading and texturing surfaces; lighting; special effects; working with mel: basics and programming.

### REFERENCE BOOKS

- Hillman, David, "Multimedia Technology and Applications", Galgotia Publications, 2000.
- Koegel Buford, John F. , "Multimedia System" , Addison Wesley, 1994
- Chapman, Nigel, Chapman, Jenny, "Digital Multimedia", Wiley Publications, 2000
- Mukherjee, D.P, "Fundamentals of Computer Graphics and Multimedia", PHI, 2001
- Maya Manuals.

IT-602	E-COMMERCE AND ERP	L T P	Cr
		5 1 0	4

- INTRODUCTION TO E-COMMERCE:** Benefits; impact of e-commerce; classification of e-commerce; application of e-commerce technology; business models; framework of e-commerce.; business to business; business to customer; customer to customer; advantages and disadvantages of e-commerce; electronic commerce environment and opportunities: back ground – the electronic commerce environment – electronic market place technologies.
- NETWORK INFRASTRUCTURE OF E-COMMERCE:** Network infrastructure to e-commerce & internet; lan; ethernet ( ieee 802.3); wan; internet; tcp/ip reference model; domain names; internet industry structure; ftp applications; electronic mail; www; protocols required for e-commerce; HTTP; CGI
- SECURING BUSSINESS ON NETWORK:** Security policy; procedures and practices; site security; firewalls; securing web service; secure payment system transaction security (SET); cryptology; crypto logical algorithms; public key algorithms; authentication protocols; digital signatures; security protocols for web commerce.
- ELECTRONIC PAYMENT SYSTEM:** Introduction to electronic cash and electronic payment schemes – internet monitory payment; different models; framework; prepaid and post-paid payment model and security requirements – payment and purchase order process – online electronic cash. search tools: directories; search engines; meta search engines.
- E-BUSSINESS:** Business requirements – concepts; payment processing. launching your e business- marketing an e-business; public relations; consumer communication; news groups & forums; exchanging

- links; web rings; e-business back end systems; business record maintenance; back up procedures and disaster recovery plans.
6. **M-COMMERCE:** Introduction to mobile commerce; framework; applications; design methodology and advantages ; future trends in m-commerce. supply chain management in e-commerce.
7. **7.ADVERTISING & CRM:** Internet Advertising; Models of Internet advertising; sponsoring content; Corporate Website; Weaknesses in Internet advertising; web auctions. E-retailing; Role of retailing in E-Commerce; E-marketing and advertising. CRM in e-commerce.  
**Case Study:** discussion on a Corporate web site. e-commerce legal issues and cyber laws.

### ENTERPRISE RESOURCE PLANNING

- ENTERPRISE RESOURCE PLANNING – ERP overview;** need of ERP; growth of ERP; benefit; business process reengineering; data ware housing; data mining; OLAP; supply chain management.
- ERP AND RELATED TECHNOLOGIES:** Business process reengineering (BPR);management information system (MIS); decision support systems (DSS); executive support systems (ESS); data warehousing, data mining; online analytical processing (OLTP); supply chain management (SCM); customer relationship management (CRM).
- ERP MODULES AND VENDORS:** Finance; production planning, control & maintenance ; sales & distribution; human resource management (HRM); inventory control system; quality management; ERP market
- ERP IMPLEMENTATION LIFE CYCLE:** evaluation and selection of ERP package ;project planning; implementation team training & testing ; end user training & going live; post evaluation & maintenance; introduction to hidden costs, vendors, consultant employees.
- ERP CASE STUDIES:** Post implementation review of ERP packages in manufacturing, services, and other organizations; using ERP tool: either sap or oracle format to case study.
- ERP & E-COMM, FUTURE DIRECTIVES-** in ERP, ERP and internet, critical factors guiding selection and evaluation, strategies for successful implementation, impediments and initiatives to achieve success, critical success and failure factors, integrating ERP into organizational culture.

### REFERENCE BOOKS

- Leon, Alexis, "Enterprise Resource Planning", Tata McGraw-Hill, 1999
- Garg, V.K. ,& Venkitakrishnan, N.K. , "ERP Ware: ERP Implementation Framework"
- Leon, Alexis, "ERP Concepts and Planning", Tata McGraw-Hill
- Motiwalla, Luvai F. , Thompson, Jeff, "Enterprise System for Management", Pearson Education
- Chaffey, Dave, "E-business and E-commerce Management", Pearson Education.
- Kalakota, Ravi, Whinston Andrew B . , "E-Commerce-A Manager's guide", Addison Wesley.
- Kalakota , Ravi, "Ravi", Addison Wesley.

IT-605	IT MANAGEMENT	L T P	Cr
		5-1-0	4

- NATURE AND FUNCTIONS OF MANAGEMENT:** Importance of management; definition of management; management process; roles of manager; management - a science or art, management - a profession.
- PLANNING & DECISION MAKING:** Nature of planning; importance of planning; types of planning; steps on planning; meaning of decision, types of decisions; organization: span of management, principles of organizing, departmentalization.
- DIRECTION:** Requirements of effective direction; motivation; importance of communication; purposes of communication; formal communication; informal communication; barriers to communication; principles of effective communication.
- LEADERSHIP:** Difference between a leader and a manager; characteristics of leadership; functions of a leader; approaches to leadership; effective leadership; leadership style in indian organizations.
- MANAGERIAL CONTROL & SOCIAL RESPONSIBILITIES OF BUSINESS:** Steps in a control process, need for control, types of control methods, essentials of effective control systems; meaning of social responsibility & social responsibilities of business towards different groups.
- INTRODUCTION TO ICT:** Recent IS/ICT trends; ICT management; ICT architectures; principles and models of ICT management; Corporate Performance Management.
- STANDARDS AND STRATEGIES of ICT:** International IT management standards(ITIL,COBIT); ICT governance and performance reference model strategic management of ICT;ICT services management ; Financial management of ICT.

#### REFERENCE BOOKS

- Elmars, Navathe, Gupta, Somayajulu, "Fundamentals of Database Systems", 4<sup>th</sup> Edition, Pearson Education, 2007
- Garcia, Ullman, Widom, "Database Systems, The complete book", Pearson Education, 2007

IT-651	MULTIMEDIA TECHNOLOGY LAB	L T P	Cr
		0 0 4	2

- Write a VRML program of creation of table & chair.
- Write a VRML program of bouncing ball.
- Write a VRML program of Creation of Cube.
- Write a VRML program of switching on & off of bulb.
- Write a VRML program of flight simulation system.
- To study basics of 3-D Animation using Maya/3-D Studio Max.

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- Insert audio to relevant frames that has lighting & rain effect using MAYA/3-D Studio Max.
- Create a cycle & name each part of cycle using different styles & format & animate text using MAYA/3-D Studio Max.
- Draw seed & create small plant with use of at least 4 frames using MAYA/3-D Studio Max.
- Create a forest of tree with flowers & fruits from a small plant using different layers & frame transition time using MAYA/3-D Studio Max.
- To study Image Enhancement and Compression using ACDSee/Photoshop.
- To study Video Editing and Transitions using any video Editing Software on Windows / Apple Macintosh

IT-653	DISSERTATION PRELIMINARY	L T P	Cr
		0 0 10	5

See note as given under course IT-659.

IT-654	SEMINAR-II	L T P	Cr
		0 0 4	2

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.

IT-656	SEMINAR-III	L T P	Cr
		0 0 4	2

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.

IT-657	DISSERTATION PHASE-I	L T P	Cr
		0 0 12	6

See note as given under course IT-659.

IT-658	MINOR PROJECT	L T P	Cr
		0 0 6	3

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.

IT-659	DISSERTATION PHASE-II	L T P	Cr
		0 0 24	12

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 IT-653, IT-657 and IT-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.

IT-660	TEACHING PRACTICE-I	L T P	Cr
			2

See note as given under course IT-661.

IT-661	TEACHING PRACTICE-II	L T P	Cr
			2

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.

MA-501	NUMERICAL TECHNIQUES	L T P	Cr
		5 1 0	4

- 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; B-spline 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; Rayleigh-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

1. Kreyszig, Erwin, "Advanced Engineering Mathematics", John Wiley, 1999.
2. Greenberg, Mchale. D "Advanced Engineering Mathematics" Second Edition, Pearson Education, 1998.
3. Jain, R.K. & Iyengar, S.R.K., "Advanced Engineering Mathematics", Narosa 2002.
4. Gerald, Curtis F & Wheatley, Patrick O, "Applied Numerical Analysis", 5th Ed., Wesley, 1998.
5. Jain, M.K., Iyengar, S.R.K. & Jain, R.K. "Numerical Methods for scientific & Engineering Computation", New Age, 1993

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