UNIVERSITY OF DELHI
NETAJI SUBHAS INSTITUTE OF TECHNOLOGY

CHOICE BASED CREDIT SYSTEM

SCHEME OF COURSES FOR
M.TECH. (INFORMATION SYSTEMS)
FULL-TIME AND PART TIME

"This M. Tech. course has been passed in FOT meeting held on 24th February 2016."
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PREAMBLE

I. INTRODUCTION

Higher education is very important for the growth and development of any country. It is a living organ and requires continuous changes to ensure the quality of education. National Knowledge Commission and University Grants Commission have recommended many academic reforms to address the challenges of today’s networked globalized world. People are coming together with the help of new technologies which is resulting towards new aspirations, expectations, collaborations and associations. The concept of “work in isolation” may not be relevant and significant anymore. The UGC guidelines on adoption of Choice Based Credit System may be an important step to revamp the processes, systems and methodologies of Higher Educational Institutions (HEIs). The teacher centric mode be changed to learner centric mode. Classroom teaching and learning be made effective; relevant and interesting. Concepts and theories be explained with examples, experimentation and related applications.

A culture of discussions, arguments, interpretations, counter-interpretations, re-interpretations, opposing interpretations must be established. Research should not only be confined to redefinition, extension and incremental change. Innovation & creativity should become an epicentre for all research initiatives. The most important capital is the human capital and thus the ultimate objective is to develop good human beings with utmost integrity & professionalism for this new world.

The Choice Based Credit System supports the grading system which is considered to be better than conventional marks system. It is followed in many reputed institutions in India and abroad. The uniform grading system facilitates student mobility across the institutions within and across the countries and also enable potential employers to assess the performance of the students. The Choice Based Credit System makes the curriculum interdisciplinary and bridge the gap between professional and liberal education.

II. CHOICE BASED CREDIT SYSTEM

The Indian Higher Education Institutions have been moving from the conventional annual system to semester system. Currently many of the institutions have already introduced the choice based credit system. The semester system accelerates the teaching-learning process and enables vertical and horizontal mobility in learning. The credit based semester system provides flexibility in designing curriculum and assigning credits based on the course content and hours of teaching. The choice
based credit system provides a ‘cafeteria’ type approach in which the students can take courses of their choice, learn at their own pace, undergo additional courses and acquire more than the required credits, and adopt an interdisciplinary approach to learning. It is desirable that the HEIs move to CBCS and implement the grading system.

A. Types of Courses

Courses are the subjects that comprise the M.Tech. programme.

1. A course may be designed to comprise lectures, tutorials, laboratory work, field work, outreach activities, project work, vocational training, viva voce, seminars, term papers, assignments, presentations, self-study etc. or a combination of some of these components.

2. The learning objectives and learning outcomes of each course will be defined before the start of a semester.

3. Courses are of two kinds: Core and Elective.
   
   i. **Core Course (CC)**: This is a course which is to be compulsorily studied by a student as a core requirement to complete the requirement of B.E. Computer Engineering.

   ii. **Elective Course**: An elective course is a course which can be chosen from a pool of subjects. It is intended to support the discipline of study by providing an expanded scope, enabling exposure to another discipline/domain and nurturing a student’s proficiency/skill. An elective may be of following types:

   a) **Discipline Centric Elective (ED)**: It is an elective course that adds proficiency to the students in the discipline.

   b) **Open Elective (EO)**: It is an elective course taken from other engineering disciplines that broadens the perspective of an Engineering student.

4. Each course contributes certain credits to the programme. A course can be offered either as a full course (4 credits) or as a half course (2 credits). A full course is conducted with 3 hours of lectures and either 1 hour of tutorial or 2 hours of practical work per week. A half course is conducted with 2 hours of lectures.

5. A student of Postgraduate programme has to accumulate about 40% credits from the Core Courses and the remaining credits from the Elective Courses to become eligible for the award of degree/ diploma/ certificate programmes.

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6. A course (full/half) may also be designed without lectures or tutorials. However, such courses may comprise Field work, Outreach activities, Project work, Vocational Training, Seminars, Self-study etc. or a combination of some of these.

7. A Project work/Dissertation is considered as a special course involving application of the knowledge gained during the course of study in exploring, analyzing and solving complex problems in real life applications. A candidate completes such a course on his own with an advisory support by a teacher/faculty member.

B. Examination and Assessment

The following system will be implemented in awarding grades and CGPA under the CBCS system.

1. **Letter Grades and Grade Points:** A 10-point grading system shall be used with the letter grades as given in Table 1 below:

<table>
<thead>
<tr>
<th>Letter Grade</th>
<th>Grade point</th>
</tr>
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<tbody>
<tr>
<td>O (Outstanding)</td>
<td>10</td>
</tr>
<tr>
<td>A+ (Excellent)</td>
<td>9</td>
</tr>
<tr>
<td>A (Very Good)</td>
<td>8</td>
</tr>
<tr>
<td>B+ (Good)</td>
<td>7</td>
</tr>
<tr>
<td>B (Above average)</td>
<td>6</td>
</tr>
<tr>
<td>C (Average)</td>
<td>5</td>
</tr>
<tr>
<td>P (Pass)</td>
<td>4</td>
</tr>
<tr>
<td>F (Fail)</td>
<td>0</td>
</tr>
<tr>
<td>Ab (absent)</td>
<td>0</td>
</tr>
</tbody>
</table>

2. **Mapping of marks and grades:** In consonance with the absolute grading system, the marks obtained by a student will be converted to grades. The following mapping is given in Table 2, shall be used for awarding grades under the absolute grading system:
3. **Fail grade:** A student obtaining Grade F shall be considered failed and will be required to reappear in the examination. If the student does not want to reappear in an elective subject (that is ED or EO but not CC courses) then he/she can re-register afresh for a new elective subject.

4. **Non-credit course:** For non-credit courses, ‘Satisfactory’ or ‘Unsatisfactory’ shall be indicated instead of the letter grade and this will not be counted for the computation of SGPA/CGPA.

5. **Fairness in Assessment:** The CBCS promotes continuous evaluation system where end semester examinations weightage should not be more than 60%. The Departments should design their own methods for continuous evaluation. They have the flexibility and freedom in designing the examination and evaluation methods that best fits the curriculum, syllabi & teaching, learning methods. In this regard, checks and balances will be implemented to fair and effective assessment and examination process.

6. **Computation of SGPA and CGPA:** The following procedure be used to compute the Semester Grade Point Average (SGPA) and Cumulative Grade Point Average (CGPA):

   i. The SGPA is the ratio of sum of the product of the number of credits with the grade points scored by a student in all the courses taken by a student and the sum of the number of credits of all the courses undergone by a student, that is:

   \[
   SGPA(S_i) = \frac{\sum C_j \times G_j}{\sum C_j}
   \]

   Where \(S_i\) is the \(i^{th}\) semester \(C_j\) is the number of credits of the \(j^{th}\) course of the semester and \(G_j\) is the grade point scored by the student in the \(j^{th}\) course.

   ii. The CGPA is also calculated in the same manner taking into account all the courses undergone by a student overall the semesters of a programme, that is:

   \[
   CGPA = \frac{\sum C_i \times SGPA(S_i)}{\sum C_i}
   \]

   Where \(S_i\) is the SGPA of the \(i^{th}\) semester and \(C_i\) is the total number of credits in that semester.

   iii. The SGPA and CGPA shall be rounded off to 2 decimal points and reported in the transcripts.

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iv. CGPA shall be converted into percentage of marks, if required, by multiplying CGPA with 10.

III. PROGRAMME STRUCTURE

1. The M.Tech. Information Systems programme consists of 4 semesters, normally completed in 2 years for Full-Time and 6 semesters, normally completed in 3 years for Part-Time. The total span period cannot exceed 4 years for Full-Time and 5 years for Part-Time.

2. The courses offered in each semester are given in the Semester-wise Course Allocation.

3. The discipline centric subjects under CC and ED categories are listed for each discipline separately.

4. A course may have prerequisite course(s) that are given in the Semester-wise Course Allocation. A student can opt for an elective only if he/she has fulfilled its pre-requisite(s).

5. A student has to register for all electives before the start of a semester.

IV. COURSE CODIFICATION

The codes for various Postgraduate Programme are as follows:

i. Department of Electronics and Communication Engineering:
   1. Signal Processing-SP
   2. Embedded System and VLSI-ES

ii. Department of Computer Engineering:
   1. Information System-IS

iii. Department of Instrumentation and Control Engineering:
   1. Process Control-PC
   2. Industrial Electronics-IE
   3. Mechatronics-MT

iv. Department of Biotechnology: BT
   1. Biochemical Engineering -BCE
   2. Bioinformatics-BICS

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v. Manufacturing processes and Automation Engineering: MPAE
   1. CAD CAM-CDCM
   2. Manufacturing process and Automation Engineering-MPA
   3. Production Engineering-PE
   4. Engineering Management-EM
   5. Nanotechnology-NT

The codes for Departmental core subjects and Domain-specific Electives are specific to each Discipline. The first two characters are derived from Departmental codes listed above.
Table 2: Semester wise Course Codes

<table>
<thead>
<tr>
<th>a) Semester - I</th>
<th>b) Semester - II</th>
</tr>
</thead>
<tbody>
<tr>
<td>ISC01</td>
<td>ISC03</td>
</tr>
<tr>
<td>ISC02</td>
<td>ISC04</td>
</tr>
<tr>
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<td>ISD-***</td>
</tr>
<tr>
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<td>ISD-***</td>
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</tr>
<tr>
<td>EO-***</td>
<td>EO-***</td>
</tr>
<tr>
<td>ISD-*** Elective</td>
<td>ISD-*** Elective</td>
</tr>
<tr>
<td>ISD-*** Elective</td>
<td>ISD-*** Elective</td>
</tr>
<tr>
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<td>ISD-*** Elective</td>
</tr>
<tr>
<td>EO-*** Open Elective</td>
<td>EO-*** Open Elective</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>c) Semester - III</th>
</tr>
</thead>
<tbody>
<tr>
<td>ISD-*** Elective</td>
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<td>ISD-*** Elective</td>
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<td>ISD-*** Elective</td>
</tr>
<tr>
<td>ISC05</td>
</tr>
<tr>
<td>ISC06</td>
</tr>
<tr>
<td>ISC05 Seminar</td>
</tr>
<tr>
<td>ISC06 Major Project</td>
</tr>
</tbody>
</table>

*** Code as specified in the Table 3 and Table 4 of discipline centric electives.

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V. EVALUATION SCHEME

The courses are evaluated on the basis of continuous assessments, mid-semester exams and end-semester exams. The weightage of each of these modes of evaluation for the different types of courses are as follows.

<table>
<thead>
<tr>
<th>Type of Course</th>
<th>Continuous Assessment (CA)</th>
<th>Mid-Semester Exam (MS)</th>
<th>End-Semester Exam (ES)</th>
<th>Continuous Assessment (CA)</th>
<th>End-Semester Exam (ES)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CC/ED/EO Theory with Tutorial</td>
<td>25</td>
<td>25</td>
<td>50</td>
<td>Nil</td>
<td>Nil</td>
</tr>
<tr>
<td>CC/ED/EO Theory with Practical</td>
<td>15</td>
<td>15</td>
<td>40</td>
<td>15</td>
<td>15</td>
</tr>
<tr>
<td>Major Project and Dissertation</td>
<td>Nil</td>
<td>Nil</td>
<td>Nil</td>
<td>40</td>
<td>60</td>
</tr>
</tbody>
</table>

VI. DECLARATION OF RESULTS

The M.Tech. (ES) programme consists of 82 credits. CGPA will be calculated on the basis of the best 78 credits earned by the student.

VII. EVALUATION AND REVIEW COMMITTEE

The Committee of Courses and Studies in each department shall appoint one or more Evaluation-cum-Review Committees (ERC), each committee dealing with one course or a group of courses. This ERC consists of all faculty members who are likely to teach such courses in the group. Normally Head of the department shall be ERC Chairman. The ERC has the following functions:

(i) To recommend appointment of paper setters/examiners of various examinations at the start of each semester.

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(ii) To prepare quizzes, assignments, test papers etc. for Continuous Assessment (CA), Mid-Semester examination (MS) and End Semester (ES) examination and to evaluate them. Normally, each concerned faculty member, who is also a member of ERC, will do this job for his/her class. However, in exceptional circumstances any part of the work may be entrusted to some other member of the ERC.

(iii) To consider the individual representation of students about evaluation and take remedial action if needed. After scrutinizing, ERC may alter the grades awarded upward/downward. The decision of the ERC shall be final.

(iv) To moderate assignments, quizzes etc. for courses given by each of the concerned faculty members for his/her class with a view to maintain uniformity of standards.

(v) To review and moderate the MS and ES results of each course with a view to maintain uniformity of standards.

(vi) To lay guidelines for teaching a course.

VIII. ATTENDANCE, PROMOTION AND DETENTION RULES

1. A student should normally attend all the classes. However, a student will be allowed to appear in the examination if he/she has put in a minimum of 75% attendance separately in each course for which he/she has registered. A relaxation up to a maximum of 25% may be given on the production of satisfactory evidence that (a) the student was busy in authorized activities, (b) the student was ill.

2. A student should submit the evidence to the fact 1(a) and/or 1(b) above within seven working days of resuming the studies. Certificates submitted later will not be considered.

3. No relaxation in attendance beyond 25% is permitted in any case.

4. A student may re-register for a course if he/she wants to avoid a decrement in the grades.

5. There shall be no supplementary examinations. A student who has failed in a course will have to re-register for the course in a subsequent year.

6. If the student does not want to reappear in an elective course (that is, ED, EO, but not CC courses) then he/she can re-register afresh for a new elective course.

IX. DECLARATION OF RESULTS

1. The MTech (IS) program consists of 82 credits. A student will be awarded the degree if he/she has earned all 82 credits.

2. CGPA will be calculated on the basis of the best 78 credits earned by the student.
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3. The candidate seeking re-evaluation of a course shall apply for the same on a prescribed proforma along with the evaluation fee prescribed by the university from time to time only for the End Semester Examination within seven days from the date of declaration of result.

4. The Institution/University may cancel the registration of all the courses in a given semester if
   i. The student has not cleared the dues to the institution/hostel.
   ii. A punishment is awarded leading to cancellation of the student’s registration.

X. CURRICULUM MODIFICATION

The curriculum will be updated regularly within a period of 5 to 10 years since last revision, to keep pace with the advancements in the field of Information Systems.

XI. CENTRAL ADVISORY COMMITTEE

There shall be a Central Advisory Committee consisting of the following:

   a) Dean, Faculty of Technology, Chairman
   b) Dean PGS
   c) Head of Institution
   d) Heads of Departments running M. Tech. Course

XII. PROGRAM EDUCATIONAL OBJECTIVE

1. Program graduates will have successful careers in research and development, academia, industry and entrepreneurship.

2. Program graduates will engage in research and developmental activities to generate creative outputs and add to the body of knowledge in information systems.

3. Program graduates will hold strong professional ethics with good team skills and communication abilities.

4. Program graduates will engage in lifelong learning to acquire new knowledge in an evolving technological landscape.
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PROGRAM OUTCOMES

1. An ability to apply knowledge of computing and mathematics appropriate to the discipline.

2. An ability to analyze a problem, and identify and define the computing requirements appropriate to its solution.

3. An ability to design, implement and evaluate a computer-based system, process, component, or program to meet desired needs.

4. An ability to function effectively on teams to accomplish a common goal.

5. An understanding of professional, ethical, legal, security, and social issues and responsibilities.

6. An ability to communicate effectively with a range of audiences.

7. An ability to analyze local and global impact of computing on individuals, organizations and society.

8. Recognition of the need for, and an ability to engage in, continuing professional development.

9. An ability to use current techniques, skills, and tools necessary for computing practices.

10. Provide students with the understanding of processes that support the delivery and management of information systems within a specific application environment.

11. An ability to effectively create and update Project Management Plan deliverables.

12. An understanding of the principles of information security and how to employ them in a manner to effectively secure the information and supporting infrastructure in an organization.
### SCHEME SEMESTER-WISE COURSE ALLOCATION – FULL TIME

**M.TECH. INFORMATION SYSTEMS (Full Time) SEMESTER I**

<table>
<thead>
<tr>
<th>CODE</th>
<th>TYPE</th>
<th>COURSE OF STUDY</th>
<th>L</th>
<th>T</th>
<th>P</th>
<th>C</th>
<th>EVALUATION SCHEME Percentage (Weightage)</th>
</tr>
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<tbody>
<tr>
<td></td>
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<td></td>
<td></td>
<td></td>
<td><strong>Theory</strong></td>
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<tr>
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<td></td>
<td><strong>Practical</strong></td>
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<tr>
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<td></td>
<td></td>
<td></td>
<td><strong>CA</strong></td>
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<tr>
<td>ISC01</td>
<td>CC</td>
<td>Behaviour Oriented Conceptual Modeling</td>
<td>3</td>
<td>0</td>
<td>2</td>
<td>4</td>
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<tr>
<td>ISC02</td>
<td>CC</td>
<td>Distributed Computing</td>
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<td>0</td>
<td>2</td>
<td>4</td>
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<td>ISD**</td>
<td>ED</td>
<td>Elective #</td>
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<td>2</td>
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<td>ED</td>
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<td>Elective #</td>
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<td>0</td>
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<tr>
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<td>3</td>
<td>6</td>
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#: The LTP allocation, evaluation scheme and pre-requisites for electives are given in Table 3-4. The course code will depend upon student’s choice of electives.

$: The actual weekly load will depend upon the electives chosen by the student.
## M.TECH. INFORMATION SYSTEMS (Full Time) SEMESTER II

<table>
<thead>
<tr>
<th>CODE</th>
<th>TYPE</th>
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<th>T</th>
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<tr>
<td>ISC03</td>
<td>CC</td>
<td>Software Testing</td>
<td>3</td>
<td>0</td>
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<td>4</td>
</tr>
<tr>
<td>ISC04</td>
<td>CC</td>
<td>Advances in Computer Architecture</td>
<td>3</td>
<td>0</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>ISD**</td>
<td>ED</td>
<td>Elective *</td>
<td>3</td>
<td>0</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>ISD**</td>
<td>ED</td>
<td>Elective *</td>
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<td>1</td>
<td>0</td>
<td>4</td>
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<td>ISD**</td>
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<td>3</td>
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### EVALUATION SCHEME

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<th>Theory</th>
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</table>

#: The LTP allocation, evaluation scheme and pre-requisites for electives are given in table 3-4. The course code will depend upon student’s choice of electives.

$: The actual weekly load will depend upon the electives chosen by the student.
M.TECH. INFORMATION SYSTEMS (Full Time) SEMESTER III

<table>
<thead>
<tr>
<th>CODE</th>
<th>TYPE</th>
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<th>T</th>
<th>P</th>
<th>C</th>
<th>EVALUATION SCHEME Percentage (Weightage)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ISD**</td>
<td>ED</td>
<td>Elective #</td>
<td>3</td>
<td>0</td>
<td>2</td>
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#: The LTP allocation, evaluation scheme and pre-requisites for electives are given in table 3-4. The course code will depend upon student’s choice of electives.

$: The actual weekly load will depend upon the electives chosen by the student.
M.TECH. INFORMATION SYSTEMS (Full Time) SEMESTER IV

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"This M. Tech. course has been passed in FOT meeting held on 24th February 2016."
### SCHEME SEMESTER-WISE COURSE ALLOCATION-PART TIME

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$: The actual weekly load will depend upon the electives chosen by the student.
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$: The actual weekly load will depend upon the electives chosen by the student.
**SCHEME OF COURSES – M.TECH. (INFORMATION SYSTEMS)**

**M.TECH. INFORMATION SYSTEMS (Part Time) SEMESTER III**

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#: The LTP allocation, evaluation scheme and pre-requisites for electives are given in table 3-4. The course code will depend upon student’s choice of electives.

$: The actual weekly load will depend upon the electives chosen by the student.
M.TECH. INFORMATION SYSTEMS (Part Time) SEMESTER IV

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#: The LTP allocation, evaluation scheme and pre-requisites for electives are given in table 3-4. The course code will depend upon student’s choice of electives.

$: The actual weekly load will depend upon the electives chosen by the student.
M.TECH. INFORMATION SYSTEMS (Part Time) SEMESTER V

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$: The actual weekly load will depend upon the electives chosen by the student.

# The LTP allocation, evaluation scheme and pre-requisites for electives are given in table 3-4. The course code will depend upon student’s choice of electives.

"This M. Tech. course has been passed in FOT meeting held on 24th February 2016."
M.TECH. INFORMATION SYSTEMS (Part Time) SEMESTER VI

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#: The LTP allocation, evaluation scheme and pre-requisites for electives are given in table 3-4. The course code will depend upon student’s choice of electives.<br>$: The actual weekly load will depend upon the electives chosen by the student.
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"This M. Tech. course has been passed in FOT meeting held on 24th February 2016."
TABLE 4: LIST OF OPEN ELECTIVES EO***

<table>
<thead>
<tr>
<th>Code</th>
<th>Name of Elective</th>
<th>Pre-Requisites</th>
</tr>
</thead>
<tbody>
<tr>
<td>EO001</td>
<td>Technical Communication</td>
<td>None</td>
</tr>
<tr>
<td>EO002</td>
<td>Disaster Management</td>
<td>None</td>
</tr>
<tr>
<td>EO003</td>
<td>Basics of Finance Management</td>
<td>None</td>
</tr>
<tr>
<td>EO004</td>
<td>Basics of Human Resources Management</td>
<td>None</td>
</tr>
<tr>
<td>EO005</td>
<td>Project Management</td>
<td>None</td>
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<tr>
<td>EO006</td>
<td>Basics of Corporate Law</td>
<td>None</td>
</tr>
<tr>
<td>EO007</td>
<td>Biological computing</td>
<td>None</td>
</tr>
<tr>
<td>EO008</td>
<td>Basic of Social Science</td>
<td>None</td>
</tr>
<tr>
<td>EO009</td>
<td>Entrepreneurship</td>
<td>None</td>
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<tr>
<td>EO010</td>
<td>Social Work</td>
<td>None</td>
</tr>
<tr>
<td>EO011</td>
<td>Intellectual Property and Patenting</td>
<td>None</td>
</tr>
<tr>
<td>EO012</td>
<td>Supply Chain Management, Planning and Logistics</td>
<td>None</td>
</tr>
<tr>
<td>EO013</td>
<td>Organization Development</td>
<td>None</td>
</tr>
<tr>
<td>EO014</td>
<td>Industrial Organization and Managerial Economics</td>
<td>None</td>
</tr>
<tr>
<td>EO015</td>
<td>Global Strategy and Technology</td>
<td>None</td>
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<tr>
<td>EO016</td>
<td>Engineering System Analysis and Design</td>
<td>None</td>
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<tr>
<td>EO017</td>
<td>Biology for Engineers</td>
<td>None</td>
</tr>
<tr>
<td>EO018</td>
<td>Energy, Environment and Society</td>
<td>None</td>
</tr>
<tr>
<td>EO019</td>
<td>Public Policy and Governance</td>
<td>None</td>
</tr>
</tbody>
</table>

SCHEME OF COURSES – M.TECH. (INFORMATION SYSTEMS)

This M. Tech. course has been passed in FOT meeting held on 24th February 2016.
Course Contents of Core Courses

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Title of the Course</th>
<th>Course Structure</th>
<th>Pre-Requisite</th>
</tr>
</thead>
<tbody>
<tr>
<td>ISC01</td>
<td>Behavior Oriented Conceptual Modeling</td>
<td>3L-0T-2P</td>
<td>None</td>
</tr>
</tbody>
</table>

**COURSE OUTCOMES**

1. To acquire knowledge of Object-oriented Analysis using UML
2. To acquire Knowledge of Rational Unified Process
3. To acquire Knowledge of Meta-modeling
4. To be able to think analytically and analyze a problem using the techniques learned

**COURSE CONTENT**

Introduction to Conceptual modeling, Structured Vs Object Oriented Modeling.
Review of Structured analysis and Design Techniques.
Detailed study of Unified Modelling Language with applications, object Constraint Language, Estimation using Use Case Points, Object Oriented Metrics, Configuration Management
Introduction to Rational Unified process
Introduction to meta-modelling; meta-data and meta-activity models

**Guidelines for practical/project work:**
Students will implement assignments based upon the concepts covered in the lectures.

**SUGGESTED READINGS**

1. Object Oriented Modeling and Design with UML by Michael R Blaha and James R Rumbaugh, Pearson
2. UML distilled Third Edition by Martin Fowler, Pearson
3. The Unified Software Development Process by Jacob so, Booch and Rumbaugh, Pearson Education

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SCHEME OF COURSES – M.TECH. (INFORMATION SYSTEMS)

<table>
<thead>
<tr>
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<th>Pre-Requisite</th>
</tr>
</thead>
<tbody>
<tr>
<td>ISC02</td>
<td>Distributed Computing</td>
<td>3L-0T-2P</td>
<td>None</td>
</tr>
</tbody>
</table>

COURSE OUTCOMES
1. Understand the concepts of distributed computing systems along with design and implementation issues.
2. Acquire skills to analyze design and implement distributed algorithms.

COURSE CONTENT

**Distributed computing systems:** Introduction, DCS design goals: Transparencies, Fundamental issues.

**Distributed coordination:** Temporal ordering of events, Lamport’s logical clocks, Vector clocks; Ordering of messages, Physical clocks, Global state detection.

**Process synchronization:** Distributed mutual exclusion algorithms, Performance matrix, Inter-process communication.

**Deadlocks, load scheduling and balancing techniques:** Deadlock in distributed systems, Round robin load balancing, client side load balancing, server side load balancing, applications (such as routers).

**Distributed system models:** System Architectures & Client-Server Models.

**Distributed algorithms and programming systems:** Search Engines, Page ranking, leader election, Hashing, Caching, Remote Procedure Call.

**Discussion on distributed computing platforms** such as CORBA/ DCOM/ Java RMI/ Hadoop Map-Reduce.


**Distributed filesystems:** Data-Intensive Computing, Distributed Hash Tables, Consistency Models, Fault Tolerance, Many-core Computing.

**Guidelines for practical/project work:**
Programming using RPC mechanisms using Java RMI/CORBA/DCOM, Map Reduce Programming with Hadoop / Spark Programming with message passing for implementing distributed algorithms. Project work to build a cluster.

SUGGESTED READINGS

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SCHEME OF COURSES – M.TECH. (INFORMATION SYSTEMS)


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</tr>
</thead>
<tbody>
<tr>
<td>ISC03</td>
<td>Software Testing</td>
<td>3L-0T-2P</td>
<td>None</td>
</tr>
</tbody>
</table>

COURSE OUTCOMES
1. Learn the various concepts and methods that can be used to test software before it is delivered to the end user.
2. Learn about various challenges and difficulties faced during the process of software testing and approach for tackling them.

COURSE CONTENT
**Introduction to Software Testing**: Definition, Goals, Test metrics, Effective Software Testing versus Exhaustive Software Testing.

**Software Testing Terminology: Role** of testing in SDLC, Discussion of testing terminology such as error, bug and failure, test case and Test plan, V-Testing Life Cycle Model.

**Software Verification**: Verification and validation Activities, Role of verification and Validation in Testing Strategy. Verification methods: Inspections, Walkthroughs and reviews, SRS document verification, SDD document verification.

**Overview of Test Generation Strategies**: Types of Testing-White box and Black Box testing, Test case generation from source code, test generation from requirements, Test generation from finite state models, test generation from combinatorial designs.

**Static White Box Testing Techniques**: Inspections, structured walkthroughs and Technical reviews.

**Structural/Dynamic White Box Testing Techniques**: Logic Coverage Criteria, Basis Path Testing, Loop testing, Data Flow Testing, slice based testing, Mutation Testing.

**Dynamic Black Box Testing Techniques**: Boundary Value Analysis(BVA), Equivalence Class Testing, State-Table Based Testing, decision Table Based Testing, Cause-Effect Graphing Based Testing.

**Essentials of Graph Theory**: What is graph, matrix representation of graph, paths and independent paths, generation of a graph from a program, identification of independent paths selection.
Test Selection and Test minimization and Prioritization of Test Cases for Regression Testing: What is Regression testing, Regression test case selection, reducing the number of test cases, Risk analysis, code coverage prioritization.

Introduction to Object Oriented Testing: Path testing, state based testing class testing,

Testing Tools: Static Testing Tools, Dynamic testing Tools

Outline of practical work for Software Testing:
1. Create a test plan document for any application
2. Study of any Testing Tool (Win Runner), any Test Management Tool (QA Complete)
3. Automate the Test cases using Test Automation tool (using QA Complete)
4. Learn how to raise and report Bugs using Bug tracking tool (Bugzilla, Jira using QA Complete)
5. Study of any open source testing tool.

SUGGESTED READINGS

<table>
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</thead>
<tbody>
<tr>
<td>ISC04</td>
<td>Advances in Computer Architecture</td>
<td>3L-0T-2P</td>
<td>None</td>
</tr>
</tbody>
</table>

COURSE OUTCOMES
1. To gain an appreciation of the wide variety of hardware architectures and platforms for building computer and information systems and their applications.
2. To continue to keep abreast of the latest developments in the domain of computer system architectures.
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<table>
<thead>
<tr>
<th>COURSE CONTENT</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Overview of languages for systems design:</strong></td>
<td>hardware definition languages (VHDL/Verilog/System-C, hardware verification languages (Open-VERA/Sugar), Languages for parallel reactive systems (Esterelle), System specification languages (Z/LOTOS)</td>
</tr>
<tr>
<td><strong>Hardware software systems:</strong></td>
<td>Hardware software co-design flow: co-specification/ co-synthesis/ co-design/ co-verification, different computing and communication platforms for implementation of hardware-software systems, techniques and tools for co-design steps, distributed embedded systems</td>
</tr>
<tr>
<td><strong>Emerging VLSI architectures:</strong></td>
<td>Emerging VLSI architectures: Reconfigurable FPGA architectures, dynamic FPGA architectures, SOC architectures, approaches and CAD tools for VLSI processes such partitioning/ placement/ routing/ testing, applications.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SUGGESTED READINGS</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Web resources for various languages.</td>
<td></td>
</tr>
<tr>
<td>3. Processor Design, System-On-Chip Computing for ASICs and FPGAs, Nurmi, Jari</td>
<td></td>
</tr>
</tbody>
</table>

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Course Contents of Discipline Centric Electives

<table>
<thead>
<tr>
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<th>Course Structure</th>
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</tr>
</thead>
<tbody>
<tr>
<td>ISD01</td>
<td>Machine Learning</td>
<td>3L-0T-2P</td>
<td>Computer Programming</td>
</tr>
</tbody>
</table>

**COURSE OUTCOMES**

1. To develop an understanding of the fundamentals of machine learning and statistical pattern recognition.
2. To gain an insight into the various components of machine learning such as supervised learning, unsupervised learning, learning theory, reinforcement learning and adaptive control.
3. To acquire skills that can be applied to various components of machine learning to applications like robotic control, data mining, autonomous navigation, bioinformatics, speech recognition, and text and web data processing.

**COURSE CONTENT**

**Introduction:** Definition of learning systems. Goals and applications of machine learning.


**Ensemble Learning:** Using committees of multiple hypotheses. Bagging, boosting, and DECORATE. Active learning with ensembles.


**Computational Learning Theory:** Models of learnability: learning in the limit; probably approximately correct (PAC) learning. Sample complexity: quantifying the number of examples needed to PAC learn. Computational complexity of training. Sample complexity for finite hypothesis spaces. PAC results for learning conjunctions, kDNF, and kCNF. Sample complexity for infinite hypothesis spaces, Vapnik-
SCHEME OF COURSES – M.TECH. (INFORMATION SYSTEMS)

Chervonenkis dimension.


**Support Vector Machines**: Maximum margin linear separators. Quadratic programming solution to finding maximum margin separators. Kernels for learning non-linear functions.


**Guidelines for project based work**: Semester long projects, presentations, research work, term papers based on the above topics.

**SUGGESTED READINGS**

<table>
<thead>
<tr>
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</tr>
</thead>
<tbody>
<tr>
<td>ISD02</td>
<td>Computer Vision</td>
<td>3L-0T-2P</td>
<td>Computer Programming, Computer Graphics</td>
</tr>
</tbody>
</table>

**COURSE OUTCOMES**
1. To develop an understanding of the fundamentals of image formation, camera imaging geometry, feature detection and matching, multiview geometry including

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| stereo, motion estimation and tracking, and classification. |
| To gain an insight into the image formation and analysis, as well as the ability to extract information much above the pixel level. |
| To acquire skills that can be applied while operating on images in a context-aware manner or where images from multiple scenarios need to be combined or organized in an appropriate way. |

### COURSE CONTENT


**Depth estimation and Multi-camera views:** Perspective, Binocular Stereopsis: Camera and Epipolar Geometry; Homography, Rectification, DLT, RANSAC, 3-D reconstruction framework; Auto-calibration.

**Feature Extraction:** Edges - Canny, LOG, DOG; Line detectors (Hough Transform), Corners - Harris and Hessian Affine, Orientation Histogram, SIFT, SURF, HOG, GLOH, Scale-Space Analysis- Image Pyramids and Gaussian derivative filters, Gabor Filters and DWT.

**Image Segmentation:** Region Growing, Edge Based approaches to segmentation, Graph-Cut, Mean-Shift, MRFs, Texture Segmentation; Object detection

**Pattern Analysis:** Clustering: K-Means, K-Medoids, Mixture of Gaussians, Classification: Discriminant Function, Supervised, Un-supervised, Semi-supervised; Classifiers: Bayes, KNN, ANN models; Dimensionality Reduction: PCA, LDA, ICA; Non-parametric methods.

**Motion Analysis:** Background Subtraction and Modeling, Optical Flow, KLT, Spatio-Temporal Analysis, Dynamic Stereo; Motion parameter estimation.

**Shape from X:** Light at Surfaces; Phong Model; Reflectance Map; Albedo estimation; Photometric Stereo; Use of Surface Smoothness Constraint; Shape from Texture, color, motion and edges.

**Miscellaneous:** Applications: CBIR, CBVR, Activity Recognition, computational photography, Biometrics, stitching and document processing; Modern trends - super-resolution; GPU, Augmented Reality; cognitive models, fusion and SR&CS.

**Guidelines for project based work:** Semester long projects, presentations, research work, term papers based on the above topics.

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SUGGESTED READINGS

<table>
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<tr>
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</tr>
</thead>
<tbody>
<tr>
<td>ISD03</td>
<td>Semantic Web</td>
<td>3L-0T-2P</td>
<td>Computer Programming, Computer Networks</td>
</tr>
</tbody>
</table>

COURSE OUTCOMES
1. Identify the component technologies of the Semantic Web and understand the concept of Linked Web.
2. Illustrate the design principles of the Ontology and Semantic for developing technologies
3. Understand certain limitations of the Semantic Web technologies, and be aware of the kinds of services it can and cannot deliver.

COURSE CONTENT
Overview and Introduction: Knowledge Representation, Ontologies and Description Logic, Semantic Web in Depth: RDF and RDF Schema, Semantic Web in Depth: OWL.
Applications: Information Integration, Ontology Alignment, Scalable Reasoning and Knowledge Acquisition.

SUGGESTED READINGS

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<table>
<thead>
<tr>
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<th>Pre-Requisite</th>
</tr>
</thead>
<tbody>
<tr>
<td>ISD04</td>
<td>Digital Watermarking and Steganography</td>
<td>3L-0T-2P</td>
<td>Computer Programming</td>
</tr>
</tbody>
</table>

COURSE OUTCOMES
1. Acquire the knowledge of emerging digital watermarking and steganography techniques and their potential impact on society.
2. Understand the significance of digital watermarking in different applications.
3. Analyze the various issues related to security of user data.

COURSE CONTENT
Classification of watermarking techniques: Robust and Fragile Watermarking. Techniques for protection of multimedia data and databases, Security Analysis of watermarking techniques.
Emerging trends: Advance steganography or watermarking techniques, Forensic watermarking and steganography.

SUGGESTED READINGS
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6. Research papers on Digital watermarking and steganography of refereed journals.

<table>
<thead>
<tr>
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</tr>
</thead>
<tbody>
<tr>
<td>ISD05</td>
<td>Soft Computing</td>
<td>3L-0T-2P</td>
<td>Computer Programming, Algorithms</td>
</tr>
</tbody>
</table>

COURSE OUTCOMES
1. An understanding of the complexity of current information systems with their inherent uncertainty and imprecision.
2. Ability to use methodologies that can exploit the tolerance for imprecision to develop robust and cheap solutions for intelligent systems.
3. Skills to apply various components of soft computing such as fuzzy logic, evolutionary computing, probabilistic computing etc. and their combination to implement the solutions.

COURSE CONTENT
**Foundations of soft computing**: Computational issues in intelligent information systems, Fuzzy set theory and Rough Set theory

**Neural networks**: learning process, single layer perceptrons, back propagation algorithm, support vector machines

**Evolutionary Algorithms**: Overview and theory of genetic algorithms, genetic operations, selection methods, tackling multi-objective functions, extensions

**Swarm optimization**: Techniques based on nature-driven optimization such as ant colony, bird flocking, fish schooling, bat algorithm, cuckoo search etc.

**Future trends**: Cooperative agents, adaptive systems applications, emerging methodologies

SUGGESTED READINGS
1. N.K. Sinha and M.M. Gupta, Soft computing and Intelligent systems, Elsevier
### SCHEME OF COURSES – M.TECH. (INFORMATION SYSTEMS)

#### Evolutionary, Neural, and Fuzzy Systems, 2001

<table>
<thead>
<tr>
<th>Course No.</th>
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<th>Pre-Requisite</th>
</tr>
</thead>
<tbody>
<tr>
<td>ISD06</td>
<td>Advances in software Engineering</td>
<td>3L-0T-2P</td>
<td>Software Engineering</td>
</tr>
</tbody>
</table>

#### COURSE OUTCOMES
1. To gain an understanding of emerging concepts, tools and techniques in the field of software engineering.
2. To continue to learn and adopt new developments in software engineering and software practices.

#### COURSE CONTENT
The course will cover the latest topics and techniques in the area of Software Engineering.

#### SUGGESTED READINGS
As suggested by the Instructor.

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<table>
<thead>
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</thead>
<tbody>
<tr>
<td>ISD07</td>
<td>Digital Image Processing</td>
<td>3L-0T-2P</td>
<td>Computer Programming, Algorithms</td>
</tr>
</tbody>
</table>

#### COURSE OUTCOMES
1. To be able to use the algorithms and approaches of digital image processing for developing image based applications.
2. To apply programming skills and tool usage efficiently in developing programs and applications.
3. To conduct research in the area of digital image processing.

#### COURSE CONTENT

Image Enhancement in the Frequency Domain. Introduction to Fourier Transform and the frequency Domain, Smoothing and Sharpening Frequency Domain Filters, Homomorphic Filtering.


Image Segmentation. Detection of Discontinuities, Edge linking and boundary detection, Thresholding, Region Oriented Segmentation, Motion based segmentation.

Representation and Description. Representation, Boundary Descriptors, Regional Descriptors, Use of Principal Components for Description, Introduction to Morphology, Some basic Morphological Algorithms.

Object Recognition. Patterns and Pattern Classes, Decision-Theoretic Methods, Structural Methods.

SUGGESTED READINGS
1. Jayaraman, Digital image processing, Tata Mcgraw Hill, 2011

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>ISD08</td>
<td>Advances in Mobile Computing</td>
<td>3L-OT-2P</td>
<td>Computer Networking</td>
</tr>
</tbody>
</table>

COURSE OUTCOMES
1. Understand the characteristics and limitations of mobile hardware devices including their user-interface modalities.
2. Interface a mobile computing system to hardware and networks.
3. Program applications on a mobile computing system and interact with servers and database systems.
4. Develop an awareness of professional and ethical issues, in particular those relating to security and privacy of user data and user behavior.

**COURSE CONTENT**


**Wireless LAN Overview:** MAC issues, IEEE 802.11, Blue Tooth, Wireless multiple access protocols, TCP over wireless, Wireless applications, data broadcasting, WAP: Architecture, protocol stack, application environment, applications.


**Database Issues** : Hoarding techniques, caching invalidation mechanisms, client server computing with adaptation, power-aware and context-aware computing, transactional models, query processing, recovery, and quality of service issues.

**Data Dissemination:** Communications asymmetry, classification of new data delivery mechanisms, push-based mechanisms, pull-based mechanisms, hybrid mechanisms, selective tuning (indexing) techniques.

**Mobile Agents computing**, security and fault tolerance, transaction processing in mobile computing environment.

**Mobile Ad hoc Networks (MANETs):** Overview, Properties of a MANET, spectrum of MANET applications, routing and various routing algorithms, security in MANETs. Recent Advances in Mobile Computing.

**Outline of practical work:**
1. Study of GSM architecture and signaling techniques.
2. Study of Cellular system and related concepts.
3. Study of GPRS service
4. Study of WAP architecture
5. Study of Bluetooth architecture.
7. Study of Distributed mobile computing.

**SUGGESTED READINGS**

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<tbody>
<tr>
<td>ISD09</td>
<td>Information Security</td>
<td>3L-0T-2P</td>
<td>Computer Programming, Algorithms</td>
</tr>
</tbody>
</table>

COURSE OUTCOMES
1. Understand the principles, techniques and tools used for designing secure information systems.
2. Design, implement and maintain secure computer networks.
3. Safely recover an information system or network from a security attack.

COURSE CONTENT


**Cryptography for Data Security**: Basic Concepts and Historical Overview, Mathematical Foundations of Cryptography, Symmetric Encryption Techniques, Asymmetric Key Encryption Techniques, Public Key Infrastructure (PKI), Authentication, Message Digest & Digital Signature, Kerberos Key Exchange, Encryption standards and case studies.


**Protection of Networks from Attacks**: Firewalls: Packet Filtering, Proxy-Server; Port and Vulnerability Scanning, Packet Sniffing, Intrusion Detection, and Penetration Testing and tools, Honeypot, Anti-virus software, Access control, Trusted OS design, Auditing and Monitoring.

**Wireless / Mobile Network Security**: Security Vulnerabilities of Mobile Devices,
Wireless network attacks and defenses, Secure ad-hoc network routing.


**Guidelines for Practical Work:**
1. Students will develop programs in C/C++/Java/Python to implement the algorithms covered in the course.
2. Assignments will be given to study the modern day tools being used to detect vulnerabilities of systems and ensure their security.

**SUGGESTED READINGS**

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<tbody>
<tr>
<td>ISD10</td>
<td>Software Quality</td>
<td>3L-1T-0P</td>
<td>Software Engineering</td>
</tr>
</tbody>
</table>

**COURSE OUTCOMES**
1. Understand the quantitative aspect of quality.
2. Get acquainted with prevalent quality tools and techniques for measuring quality in traditional manufacturing set up.
3. Get to know how to apply these tools and techniques in the software scenario.
4. Understand the role and relevance of the various quality management tools in the different stages of Software Development life cycle.

**COURSE CONTENT**
**Introduction to Quality:** The Quality Tradition, Origins of Quality Movement, Deming and Crosby’s view of quality, Different Views of Quality: Transcendental, User, Manufacturing, Product, Value based, Total Quality Movement (TQM), Application of TQM to Software Engineering, Why does software fail?
**Software quality**: Definition, How is software quality different? Static quality attributes, Dynamic quality attributes, Software Quality Models, McCalls, Boehms, ISO9126, GQM, Gilb’s template, Quality Management, Quality assurance Standards, ISO standards, CMM, CMMI, 3 Sigma, 6 Sigma Statistical Information Systems (SIS), Seven tools of quality control: Pareto Charts, Graphs, Check sheets, histograms, Scatter Plots, Cause and Effect Diagrams,

**Business Process Redesign (BPR)**: Benefits of BPR in software development, TQM and BPR poised opposite to each other, Quality Function Deployment (QFD), Application of Seven Management and Planning tools for Software Requirements Capturing: Affinity diagrams, Interrelationship diagraphs, Hierarchy diagrams, Matrix diagram, Matrix data analysis, process decision program chart, arrow Diagram/Precedence Diagram

Computer Aided quality engineering (CAQE) and tools for quality management


**SUGGESTED READINGS**
2. Crosby, P., Quality is free

<table>
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<tbody>
<tr>
<td>ISD11</td>
<td>Service Oriented Architecture</td>
<td>3L-1T-0P</td>
<td>Computer Networks</td>
</tr>
</tbody>
</table>

**COURSE OUTCOMES**
1. An understanding of the basic principles of service orientation and service oriented analysis techniques
2. An insight in the technology underlying the service design and learn advanced concepts such as service composition, orchestration and Choreography
3. Skills to apply various components of service oriented architecture such as SOAP,
4. Entity-centric business service design, Application service design etc. and their combination to implement the solutions.

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COURSE CONTENT

**Introduction:** Roots of SOA, Characteristics of SOA, Comparing SOA to client-server and distributed internet architectures, Anatomy of SOA, How components in an SOA interrelate, Principles of service orientation

**Web Services:** Service descriptions, Messaging with SOAP, Message exchange Patterns, Coordination, Atomic Transactions, Business activities, Orchestration, Choreography, Service layer abstraction, Application Service Layer, Business Service Layer

**Service Oriented Analysis:** Business-centric SOA, Deriving business services, service modeling, Service Oriented Design, WSDL basics, SOAP basics, SOA composition guidelines, Entity-centric business service design, Application service design, Task-centric business service design

**SOA Platform Basics:** SOA support in J2EE, Java API for XML-based web services (JAX-WS), Java architecture for XML binding (JAXB), Java API for XML Registries (JAXR) , Java API for XML based RIS (JAX-RIS)

**WS-BPEL basics:** WS-Coordination overview, WS-Choreography, WS-Policy, WS-Security

SUGGESTED READINGS

4. Erl, Thomas , SOA Design Patterns, Prentice Hall.

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Title of the Course</th>
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<th>Pre-Requisite</th>
</tr>
</thead>
<tbody>
<tr>
<td>ISD12</td>
<td>Information Theory and Coding</td>
<td>3L-1T-0P</td>
<td>None</td>
</tr>
</tbody>
</table>

COURSE OUTCOMES

1. To learn the mathematics and logic underlying the principles of information theory and coding
2. To learn and implement the algorithms for different kinds of error control codes and their applications

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COURSE CONTENT


Discrete memoryless channel: channel capacity, BSC and other channels, Information measure for continuous ensembles capacity of AWGN channel.

Error control coding: The channel coding Theorem, Application to BSC, Source Coding with fidelity criteria

Types of codes: error and error control strategies, Linear block codes, syndrome and error detection, Minimum distance, Error detecting and correcting capabilities of a block code, Syndrome decoding, Hamming codes, Cyclic codes, Generator and parity – check matrices, encoding, syndrome computation and error detection and decoding. BCH codes, decoding, of the BCH codes, Introduction to RS codes, Convolution codes, Maximum likelihood decoding The Viterbi algorithm. Introduction to Turbo codes. Current trends and future directions

Seminar and talks

SUGGESTED READINGS
1. Information Theory, R Ash, Dover Science Publications.
2. Elements of Information Theory, Cover and Thomas, John Wiley & Sons.

Course No. | Title of the Course | Course Structure | Pre-Requisite
--- | --- | --- | ---
ISD13 | Digital Forensic | 3L-1T-0P | Computer Networks

COURSE OUTCOMES
1. Conduct digital investigations that conform to accepted professional and ethical standards of conduct, including impartiality and the protection of personal privacy and are based on the standard investigative process: identification, preservation, examination, analysis and reporting.
2. Identify and document potential security breaches of computer data that suggest violations of legal, ethical, moral, policy and/or social standards.

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3. Apply a solid foundational grounding in computer networks, operating systems, file systems, hardware and mobile devices to digital investigations and to the protection of computer network resources from unauthorized activity.
4. Work collaboratively with clients, management and/or law enforcement to advance digital investigations or protect the security of digital resources.

### COURSE CONTENT

#### Introduction

#### Legal Issues:
- Stages of Investigative Process, Applying Forensic Science procedures to digital resources
- File Systems, File Structures, Boot Processes and Systems logs of various popular operating systems (Windows, Linux, Macintosh), State-of-the art Computer Forensics Tools, Role of Image Files and Multimedia Files in digital forensics,

#### Network Forensics:
- Digital Evidence on Physical, Data-Link Layers, Network and Transport Layers, Internet Application Services; Live Acquisitions, Investigating Intrusions, Cell Phone and mobile device forensics, Virtual Machine and Cloud Forensics

#### Digital Evidence in the Courtroom:

#### Anti-forensics:
- Counter measures to impair forensics analysis
- Current development in the field and research Challenges

Students will be allotted a study project that will require them to explore the new dimensions in this area and present their work at the end of course.

### SUGGESTED READINGS

### Scheme of Courses – M.Tech. (Information Systems)

<table>
<thead>
<tr>
<th>Course No.</th>
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</thead>
<tbody>
<tr>
<td>ISD14</td>
<td>IT Law and Ethics</td>
<td>3L-1T-0P</td>
<td>None</td>
</tr>
</tbody>
</table>

**COURSE OUTCOMES**
1. An understanding of the law that governs the development and dissemination of software.
2. An understanding of the law that governs the dissemination of digitized information.
3. An understanding of ethics related to the IT profession.

**COURSE CONTENT**

**Introduction:**

**Scope of Patent Rights:**
Government rules for licensing and transfer of technology within country, government rules for licensing and transfer of technology from other country, Patent information and documentation.
Legal framework for infringement actions and remedies.

**Administration of Patent System:**
New Development in IPR, IPR of Biological systems, Computer software, Machinery etc.
Case studies.

**Protection of databases:**

**Overview of Indian IT laws**
Current trends and future directions.

**SUGGESTED READINGS**
### COURSE OUTCOMES
1. To appreciate the benefits of design and architectural patterns in object oriented software development.
2. To learn the use of various design patterns and architectural patterns.

### COURSE CONTENT
**Introduction:** Patterns and Motivation for using patterns

**Design patterns:** Facade, adaptor, strategy, bridge, decorator, publisher-subscriber, factory method, factory, template, singleton, object pool and their implementation in Object Oriented languages such as C# / Java.

**Architectural patterns:** Architectural patterns used in various applications such as interactive applications (Model View Controller MVC and Presentation-Abstraction-Control PAC), distributed architectures (Broker, pipes and filters), Adaptable systems (Reflection), Communication (Proxy) and other architectural patterns.

**Guidelines for project work:** Project / seminars / talks / presentations / research work / term papers based on the above topics.

### SUGGESTED READINGS
1. Pattern oriented software architecture, Frank Buschmann et al, Wiley India.
2. Design Patterns: Elements of Reusable Object-Oriented, Software by Erich Gamma, Richard Helm, Ralph Johnson, and John Vlissides (the Gang of Four).
3. Software architectural patterns, O'Reilley media.

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</thead>
<tbody>
<tr>
<td>ISD15</td>
<td>Design and Architectural Patterns</td>
<td>3L-1T-0P</td>
<td>Software Engineering</td>
</tr>
</tbody>
</table>

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### COURSE OUTCOMES
1. To learn the new developments in the ever-evolving field of

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<th>Pre-Requisite</th>
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</thead>
<tbody>
<tr>
<td>ISD17</td>
<td>Emerging Trends in Information Systems</td>
<td>3L-1T-0P</td>
<td>None</td>
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</tbody>
</table>

**COURSE CONTENT**
The course will cover the latest topics and techniques in the area of Computational Intelligence.

**SUGGESTED READINGS**
As suggested by the Instructor.

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<tbody>
<tr>
<td>ISD18</td>
<td>Embedded Systems</td>
<td>3L-1T-0P</td>
<td>Computer Architecture, Microprocessors</td>
</tr>
</tbody>
</table>

**COURSE OUTCOMES**
1. To gain knowledge of the various trends and developments in the ever-evolving area of Information Systems and apply them in developing new applications.

**COURSE CONTENT**
The course will cover the latest concepts, topics and techniques in the emerging areas of Information systems.

**SUGGESTED READINGS**
As suggested by the Instructor.

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system using micro-controllers or other platforms.

<table>
<thead>
<tr>
<th>COURSE CONTENT</th>
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<tbody>
<tr>
<td><strong>Embedded Systems &amp; HW-SW Co-Design:</strong> Introduction to embedded systems: Evolution, Issues and Challenges, Co-design Flow methodologies, Design exploration, Co-specification, Co-verification, Validation and testing, Co-simulation, Physical design.</td>
</tr>
<tr>
<td><strong>Embedded System Architectures:</strong> (i) Microcontroller Architecture based on 8051/AVR/ARM with interfacing of Memory and Peripheral Devices, Interrupts Processing, Interfacing with sensors and actuators. (ii) Alternative architectures: Programmable Logic Devices (PLD), Application Specific Integrated Circuits (ASIC), Application Specific Instruction Processors (ASIP), Field Programmable Gate Arrays (FPGA), Reconfigurable devices, Systems On Chip (SOC), VLIW architectures</td>
</tr>
<tr>
<td><strong>Embedded System Software:</strong> Modeling UML and RT-UML, Software Development: Flow, Environments and Tools; RTOS Fundamentals</td>
</tr>
<tr>
<td><strong>Embedded System Design Issues:</strong> Performance Analysis and Optimization: Speed, Power and Area Optimization; System Reliability, Safety and Security.</td>
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<tr>
<th>Guidelines for Assignments:</th>
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<tbody>
<tr>
<td>Programming on Microcontroller kits</td>
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<tr>
<td>Interfacing input/output devices with micro-controller kits</td>
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<tr>
<td>Developing micro-controller based system/sandwriting control programs</td>
</tr>
<tr>
<td>FPGA based hardware/software systems: programming, simulation and emulation.</td>
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<tbody>
<tr>
<td>ISD19</td>
<td>Information Storage and Retrieval</td>
<td>3L-1T-0P</td>
<td>Database Management Systems</td>
</tr>
</tbody>
</table>

COURSE OUTCOMES
1. To gain an understanding of how information systems deal with large-scale collections of data as objects to be stored, searched over, selected, and transformed for use.

COURSE CONTENT
We examine both the background theory and practical application of information retrieval, database design and management, data extraction, transformation and loading for data warehouses, and operational applications. We will determine traditional methods of information retrieval and database management as well as new approaches that use massively parallel computation (MapReduce/Hadoop). Through readings, discussion, and hands-on experimentation, students will be prepared to discuss, plan, and implement storage, search and retrieval systems for large-scale structured and unstructured information systems using a variety of software tools. They will also be able to evaluate large-scale information storage and retrieval systems in terms of both efficiency and effectiveness in providing timely, accurate, access to needed and reliable information.

SUGGESTED READING

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<tbody>
<tr>
<td>ISD20</td>
<td>Advances in Databases</td>
<td>3L-1T-0P</td>
<td>Database Management Systems</td>
</tr>
</tbody>
</table>

COURSE OUTCOMES
1. To get acquainted with new models and optimization techniques in digital databases.
2. To conduct research in the domain of databases and acquire the habit of keeping abreast with latest developments.

COURSE CONTENT
Database system architecture, query processing and optimization, transaction

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processing concepts, concurrency control techniques, database recovery techniques, database security and authorization, enhanced data models for advanced applications, Object relational databases, Object oriented databases, Non-SQL databases, Temporal databases, Deductive databases, database technology for decision support systems, Distributed and Web databases, data mining techniques Advanced database concepts, emerging technologies and applications.

**SUGGESTED READINGS**


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<tbody>
<tr>
<td>ISD21</td>
<td>Internet of Things</td>
<td>3L-1T-0P</td>
<td>Computer Networking</td>
</tr>
</tbody>
</table>

**COURSE OUTCOMES**

1. To design full connected-product experiences by integrating Internet services and physical objects.
2. To analyze, design and develop prototypes of Internet-connected products using appropriate tools.
3. To identify, classify and describe different kinds of Internet-connected product concepts.
4. To analyze the challenges and applying adequate patterns for user-interaction with connected-objects.

**COURSE CONTENT**


*Design principles for connected devices:* Calm and ambient technology, privacy, loosely connected devices, graceful degradation.

*Prototyping:* Cost and ease of prototyping, changing embedded platform by moving...
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into the cloud, open source, closed source and mixed source

**Prototyping devices**: sensors, actuator, platforms for IoT design: micro-controllers, systems on a chip, Arduino, Raspberry-pi, Electric Imp

**Integrating internet services**: XML and JSON. HTTP APIs for accessing popular Internet services (Facebook, Twitter, and others). Practical activities.

**User experience and interaction design**: The three levels of user engagement: aesthetics, functional and emotional. Good examples of user interaction design. Designing your own user experience. Practical activities.

**Project development and competition**: Development of a project including: value proposition, physical connected object prototyping, programming the behavior, accessing Internet services and designing the user experience. Project competition.

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**SUGGESTED READINGS**

2. Designing the Internet of Things,
3. Adrian McEwen, Hakim Cassivalli, Wiley.

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<tbody>
<tr>
<td>ISD22</td>
<td>Requirement Engineering</td>
<td>3L-1T-0P</td>
<td>Software Engineering</td>
</tr>
</tbody>
</table>

**COURSE OUTCOMES**

1. To model the real life problem with the help of requirements engineering techniques.
2. To learn about representation of requirements through various requirements engineering techniques.

**COURSE CONTENT**

**Introduction**: What is requirement, Requirements management, Requirements and software life cycle. Processes in Requirements Engineering: Framework for describing

Tools: Concept – Method – Tool view of Requirements Engineering, Role of CASE in Requirements Engineering. Current topics may be included.

Guidelines for Practical Work:
A real life case study/ problem should be selected and all the requirements engineering techniques should be applied and a formal requirements document should be prepared.

SUGGESTED READINGS
1. System Requirements Engineering, P. Loucopoulos and V. Karakostas, McGraw-Hill
2. Software Requirements, K. Weigers, Microsoft Press.
3. Requirements engineering a good practice Guide, Ian Sommerville and P Sawyer, Wiley India.

Course No. | Title of the Course | Course Structure | Pre-Requisite
--- | --- | --- | ---
ISD23 | Real-time Systems | 3L-1T-0P | Operating Systems

COURSE OUTCOMES
1. Understand the real-time system requirements and design analysis.
2. Understand the architectures, operating systems and performance issues of real-time systems.
3. Design a real-time multi-tasking system or an embedded system controller.

COURSE CONTENT
Introduction: Real-time systems models and classification, real-time task characterization, performance measures and estimation techniques.
Real-time process management: Task Scheduling for uniprocessor systems- Rate monotonic, EDF, handling priorities with critical sections and interrupts, reward based scheduling for accuracy-driven tasks
Advanced task scheduling: Scheduling for multiprocessor systems, adaptive scheduling techniques, fault tolerant scheduling

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Programming environment: RTOS, Programming languages, tools and techniques.
Real-time system design: Design techniques for reliability, fault tolerance and other application-specific quality considerations.
Real-time communication: Communication media, network topologies, protocols.
Recent developments: Trends in real-time systems design and development.

SUGGESTED READINGS
1. Phillip A. Laplante, “Real-time systems design and analysis, Wiley India.
2. Jane, W.S. Liu, “Real-time Systems”

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<tbody>
<tr>
<td>ISD24</td>
<td>Human Computer Interface</td>
<td>3L-1T-0P</td>
<td>Computer Architecture</td>
</tr>
</tbody>
</table>

COURSE OUTCOMES
1. To be able to understand the importance of designing interactive products that are usable.
2. To be able to communicate effectively about requirements, design, and evaluation activities relating to interactive products.
3. Evaluate an interactive product using suitable techniques.

COURSE CONTENT
Importance of user Interface – definition, importance of good design. Benefits of good design. A brief history of Screen design.
The graphical user interface – popularity of graphics, the concept of direct manipulation, graphical system, Characteristics, Web user – Interface popularity, characteristics- Principles of user interface.
Design process – Human interaction with computers, importance of human characteristics human consideration, Human interaction speeds, understanding business junctions.

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Components – text and messages, Icons and increases – Multimedia, colors, uses problems, choosing colors.

Guidelines for project based work: Semester long projects/presentations/ research work/ term papers based on the above topics.

SUGGESTED READINGS

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<tbody>
<tr>
<td>ISD25</td>
<td>Rule Based Computing</td>
<td>3L-1T-0P</td>
<td>Algorithms</td>
</tr>
</tbody>
</table>

COURSE OUTCOMES
1. Understand the basic knowledge representation, problem solving, and learning methods.
2. Develop intelligent systems by assembling solutions to concrete computational problems.
3. Understand the role of knowledge representation, problem solving, and rule based learning in intelligent-system engineering.

COURSE CONTENT
Overview: Rule based Reasoning, Production systems, Rule-based Systems, Review of propositional and first order logic, Skolemisation, unification and its algorithms, Goals and sub-goals, forward and backward chaining.
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**Solving Problems:** Solving problems by Searching, Problem-Solving Agents, Searching for Solutions, Uninformed Search Strategies, Informed (Heuristic) Search Strategies. Adversarial Search and Constraint Satisfaction Problems, Study of minimax algorithm

**Building a knowledge base:** Logical agents and Classical Planning, Study and comparison of knowledge representation structures, Knowledge Representation and Inference, Natural Language

**Quantifying Uncertainty:** Acting under Uncertainty, Basic Probability Notation, Inference Using Full Joint Distributions, Bayes' Rule and Its Use, Representing Knowledge in an Uncertain Domain, Other Approaches to Uncertain Reasoning, Rule-based methods for uncertain reasoning, Representing vagueness: Fuzzy sets and fuzzy logic, Study of fuzzy logic and Decision trees, Implementation aspects of Decision trees

**Learning from Examples:** Forms of Learning, Supervised Learning, Learning Decision Trees, The decision tree representation, Expressiveness of decision trees, Inducing decision trees from examples

**Guidelines for project work:** Project/ Seminars/ Talks/presentations/ research work/ term papers based on the above topics.

**SUGGESTED READINGS**
3. Artificial Intelligence, Elain Rich and Kevin Knight, 1991, TMH.

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<tbody>
<tr>
<td>ISD26</td>
<td>Cloud Computing</td>
<td>3L-1T-0P</td>
<td>Computer Networking</td>
</tr>
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</table>

**COURSE OUTCOMES**
1. Understand the concept of cloud computing, its quality issues, services, applications, benefits and limitations.
2. Understand the underlying technologies that drive a cloud computing environment.
3. To keep abreast of the trends in cloud technology and available cloud environments such as GoogleApps, Microsoft Azure and Amazon Web Services.

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COURSE CONTENT

Introduction: Concept of a cloud, Purpose, characteristics, challenges and developments in cloud computing, Virtualization, On-demand Cloud Computing, Current cloud Technologies and Environments, Benefits and limitations.

Virtualization: Characteristics of virtualization, Types of virtualization, Hypervisors and some case studies.

Cloud architectures: Software as a Service, Platform as a Service, Infrastructure as a Service, Storage as a Service, Applications as a Service, other services

Types of cloud architectures: Public, Private, Hybrid, Design issues with cloud: scalability, fault tolerance, security, trust, privacy.

Data in the cloud: GFS, HDFS, Big Tables.

Concurrent computing: Thread programming, MPI programming, Parallel Computing with Map Reduce and extensions.

Case studies and emerging trends: Related to issues in migration to cloud, Cloud computing economics etc.

SUGGESTED READINGS


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<tbody>
<tr>
<td>ISD27</td>
<td>Big Data and Analytics</td>
<td>3L-1T-OP</td>
<td>Computer Networking, Database Management Systems</td>
</tr>
</tbody>
</table>

COURSE OUTCOMES

1. Gain a conceptual understanding of big data analytics concepts, algorithms, data management tools and statistical analysis.
2. Acquire tools to manage various aspects of big data such as Hadoop, HDFS, Map-Reduce based HBase, Cassandra, Pig, Hive etc.
3. Build applications based on big data.

COURSE CONTENT

Introduction to Big Data: Databases and their evolution, convergence of key trends, unstructured data, industry examples of big data, web analytics, big data and...
marketing, fraud and big data, risk and big data, credit risk management, big data and algorithmic trading, big data and healthcare, big data in medicine, advertising and big data, big data technologies, introduction to Hadoop, open source technologies, cloud and big data mobile business intelligence, Crowd sourcing analytics, inter and trans firewall analytics.

**NoSql Data Management:** Introduction to NoSQL, Types of NoSQL, aggregate data models, aggregates, key-value, document data models, relationships, graph databases, schema less databases, materialized views. Overview of MongoDB. MapReduce, partitioning and combining, composing map-reduce calculations, MapReduce examples such as matrix multiplication.

**Hadoop:** Introduction to Hadoop, Data format, analyzing data with Hadoop, scaling out, Hadoop streaming, Hadoop pipes, Hadoop distributed file system (HDFS), HDFS concepts, data flow, Hadoop I/O, data integrity, compression, serialization, Avro file-based data structures, Map Reduce workflows, unit tests with MRUnit, test data and local tests – anatomy of Map Reduce job run, classic Map-reduce, YARN, failures in classic Map-reduce and YARN, job scheduling, shuffle and sort, task execution, MapReduce types, input formats, output formats.


**Guidelines for practical work:** Exercises on Hadoop, MapReduce, HDFS, MongoDB, R.

**SUGGESTED READINGS**

2. Big-Data Black Book, DT Editorial Services, Wiley India.
3. Massive Online Open Courses (MOOCS): Big Data University, Udacity and
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<tr>
<td>ISD28</td>
<td>Advances in Compiler Technology</td>
<td>3L-1T-0P</td>
<td>Compilers</td>
</tr>
</tbody>
</table>

**COURSE OUTCOMES**
1. To gain an insight of the wide range of advanced compilation techniques available, with emphasis on parallelism.
2. To gain a detailed knowledge of different types of code optimization techniques.
3. To acquire skills necessary to design a nontrivial programming language and implement a production quality compiler for the same.

**COURSE CONTENT**

**Advanced runtime management techniques:** dynamic memory allocation, garbage collection.

**Code optimization techniques:** dataflow analysis, loop optimization, region-based analysis, interprocedural analysis, peephole optimization.

**Instruction-level parallelism:** basic-block scheduling, global code scheduling, software pipelining.

**Optimizing for parallelism and locality:** affine indexes, data dependence analysis, synchronization issues, locality optimizations.

**Compilation techniques for generating energy-conserving code:** techniques for embedded systems and high-performance computers.
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SUGGESTED READINGS

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Course Contents of Open Electives

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<tbody>
<tr>
<td>EO001</td>
<td>Technical Communication</td>
<td>3L-1T-0P</td>
<td>None</td>
</tr>
</tbody>
</table>

COURSE OUTCOMES
1. The course will improve writing and documentation skills of students with emphasis on the importance of effective communication with focus on choice of words, formation of proper sentence structures and writing styles.
2. This will enhance the student’s capability to prepare technical documents and correspondence.
3. The course will equip the student with good communications skills for placements, preparing SOPs and CVs.
4. The course will sensitize the students towards research ethics, copyright and plagiarism.

COURSE CONTENT

Communication: Definition, Meaning, Importance & Process of Communication, objectives, types, C's of communication, Barriers to communication, Human & Non-human communication, distinctive features of human languages

Business Correspondence: definition, meaning and importance of business communication, business letters- purchase, enquiry, quotation, order, follow-up, acceptance-refusal

Paragraph Writing: Kinds, coherence & cohesion

Thesis Writing: Selection of topic and its development

Report Writing: Writing reports, Manuals,

Official Communication: Notices, Memos, Agendas, Minutes, Interviews, Speeches, Presentations,

Research: Ethics, methodologies, copyright, plagiarism

SUGGESTED READINGS
1. Advanced English Grammar: Martin Hewing
2. Technical Communication: Meenakshi Raman & Sangeeta Sharma

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COURSE OUTCOMES
1. Demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response.
2. Critically evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
3. Develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
4. Critically understand the strengths and weaknesses of disaster management approaches, planning and programming in different countries, particularly their home country or the countries they work in.

COURSE CONTENT
Disaster Prone Areas in India: Study of Seismic Zones; Areas Prone to Floods and Droughts, Landslides and Avalanches; Areas Prone to Cyclonic and Coastal Hazards with Special Reference to Tsunami; Post-Disaster Diseases and Epidemics
Disaster Preparedness and Management: Preparedness: Monitoring of Phenomena Triggering a Disaster or Hazard; Evaluation of Risk: Application of Remote Sensing, Data from Meteorological and Other Agencies, Media Reports: Governmental and Community Preparedness.
Disaster Mitigation: Meaning, Concept and Strategies of Disaster Mitigation, Emerging Trends in Mitigation. Structural Mitigation and Non-Structural Mitigation, Programs of Disaster Mitigation in India.

SUGGESTED READINGS
"This M. Tech. course has been passed in FOT meeting held on 24th February 2016."
SCHEME OF COURSES – M.TECH. (INFORMATION SYSTEMS)

2. Sahni, Pardeep Et.Al. (Eds.), Disaster Mitigation Experiences And Reflections. Prentice Hall Of India, New Delhi, 2002.

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<tbody>
<tr>
<td>EO003</td>
<td>Basics of Financial Management</td>
<td>3L-1T-0P</td>
<td>None</td>
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</tbody>
</table>

COURSE OUTCOMES
1. Understanding of theoretical framework for considering corporate finance problems and issues and to apply these concepts in practice.
2. Learn the art of organizing the financial transactions effectively and with integrity.
3. To have the ability and confidence to tackle common financial problems in practice.

COURSE CONTENT

Long term investment decisions: The Capital Budgeting Process, Cash Flow Estimation, Payback Period Method, Accounting Rate of Return, Net Present Value (NPV), Net Terminal Value, Internal Rate of Return (IRR), Profitability Index.


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SCHEME OF COURSES – M.TECH. (INFORMATION SYSTEMS)

SUGGESTED READINGS
2. Srivastava, Rajiv, and Anil Mishra, Financial Management, Oxford University Press

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<tr>
<td>EO004</td>
<td>Basics of Human Resource Management</td>
<td>3L-1T-0P</td>
<td>None</td>
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</tbody>
</table>

COURSE OUTCOMES
1. To have an understanding of Human Resource Management (HRM) functions within organizations
2. To design and implement effective HRM policies and practices.

COURSE CONTENT
Challenges of HR: the changing profile of the workforce - knowledge workers, employment opportunities in BPOs, IT and service industries, Flexi options, Workforce diversitycauses, paradox, resolution of diversity by management.
Recruitment: factors affecting, sources, policy, evaluation, Selection procedure, tests, interviews, Placement and Induction.

SUGGESTED READINGS

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<tbody>
<tr>
<td>EO005</td>
<td>Project Management</td>
<td>3L-1T-0P</td>
<td>None</td>
</tr>
</tbody>
</table>

COURSE OUTCOMES
1. Gain knowledge of the fundamentals of project management
2. Able to plan a manageable project schedule and execute.

COURSE CONTENT

Project Preparation: Technical feasibility, estimation of costs, demand analysis and commercial viability, risk analysis, collaboration arrangements; financial planning; Estimation of fund requirements, sources of funds. Loan syndication for the projects. Tax considerations in project preparation and the legal aspects.

Project appraisal: Business criterion of growth, liquidity and profitability, social cost benefit analysis in public and private sectors, investment criterion and choice of techniques. Estimation of shadow prices and social discount rate.


SUGGESTED READINGS

"This M. Tech. course has been passed in FOT meeting held on 24th February 2016."
## Scheme of Courses – M.Tech. (Information Systems)

### COURSE OUTCOMES
1. Gain in-depth knowledge of the Corporate laws and process related to integrate these aspects of management studies in decision making within an organization.
2. Analyze and interpret management information and make decisions based on the information available.
3. Understand and apply the theoretical aspects of accounting methods used for collecting, recording and reporting financial information.
4. Explain and appraise the taxation laws which govern corporations and individuals.

### COURSE CONTENT

**Introduction:** Administration of Company Law, characteristics of a company; common seal; lifting of corporate veil; types of companies including private and public company, government company, foreign company, one-person company, small company, associate company, dormant company, producer company; association not for profit; illegal association; formation of company, promoters and their legal position, pre incorporation contract and provisional contracts; on-line registration of a company.

**Documents:** Memorandum of association and its alteration, articles of association and its alteration, doctrine of constructive notice and indoor management, prospectus, shelf prospectus and red herring prospectus, misstatement in a prospectus; GDR; book building; issue, allotment and forfeiture of shares, calls on shares; public offer and private placement; issue of sweat capital; employee stock options; issue of bonus shares; transmission of shares, buyback and provisions regarding buyback; share certificate; D-Mat system; membership of a company.

**Management and Meetings:** Classification of directors, additional, alternate and adhoc director; women directors, independent director, small shareholders’ director; director identity number (DIN); appointment, who can appoint a director, disqualifications, removal of directors; legal position, powers and duties; key managerial personnel, managing director, manager; meetings of shareholders and board; types of meeting, convening and conduct of meetings, requisites of a valid meeting; postal ballot, meeting through video conferencing, e-voting; committees of board of directors – audit committee, nomination and remuneration committee, stakeholders relationship committee, corporate social responsibility committee; prohibition of insider trading.

### Table

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<tbody>
<tr>
<td>EO006</td>
<td>Basics of Corporate Law</td>
<td>3L-1T-0P</td>
<td>None</td>
</tr>
</tbody>
</table>
SUGGESTED READINGS

1. Hicks, Andrew & Goo S.H., Cases and Material on Company Law, Oxford University Press

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<tr>
<td>EO007</td>
<td>BIOLOGICAL COMPUTING</td>
<td>3L-1T-0P</td>
<td>None</td>
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</tbody>
</table>

COURSE OUTCOMES

1. Understand computing in context of biological systems
2. Understand computing languages needed to solve biological problems
3. Acquire computational skills for analysis of biological processes through grid computing
4. Gain knowledge of different biological databases and their usage
5. Gain innovative insight into DNA computing

COURSE CONTENT

Introduction: Orientation, Introduction to Bioinformatics, UNIX, Python, R language
DNA Analysis, RNA Analysis, Protein Analysis, DNA computing
Grid computing, Biogrid, Biological databases, Internet Resources
Multiple Sequence Alignment and Phylogeny
Introduction to Genomics

SUGGESTED READINGS

"This M. Tech. course has been passed in FOT meeting held on 24th February 2016."
SCHEME OF COURSES – M.TECH. (INFORMATION SYSTEMS)

1. Computations in cells & tissues, 1st Edition by H. Bolouri, R. Paton; Published by Springer

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<td>EO008</td>
<td>Basic of Social Science</td>
<td>3L-1T-0P</td>
<td>None</td>
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</table>

COURSE OUTCOMES
1. Have an understanding of how Sociology is concerned with society and the relationships among individuals within a society.

COURSE CONTENT

Introduction: The Development of Sociology in the 19th Century

Sociology as Science: Science, scientific method and critique, Major theoretical strands of research methodology, Positivism and its critique, Fact value and objectivity, Non-positivist methodologies.


Politics and Society: Sociological theories of power, Power elite, bureaucracy, pressure groups, and political parties, Nation, state, citizenship, democracy, civil society, ideology, Protest, agitation, social movements, collective action, revolution.

Sociological Thinkers: Karl Marx- Historical materialism, mode of production, alienation, class struggle, Emile Durkheim- Division of labour, social fact, suicide, religion and society, Max Weber- Social action, ideal types, authority, bureaucracy, protestant ethic and the spirit of capitalism, Talcott Parsons- Social system, pattern variables, Robert K. Merton- Latent and manifest functions, conformity and deviance, reference groups, Mead - Self and identity.

SUGGESTED READINGS

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SCHEME OF COURSES – M.TECH. (INFORMATION SYSTEMS)

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<tr>
<td>EO009</td>
<td>ENTREPRENEURSHIP</td>
<td>3L-1T-0P</td>
<td>None</td>
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</table>

COURSE OUTCOMES
1. Develop entrepreneurial skills by giving an overview of who the entrepreneurs are and what competences are needed to become an entrepreneur.

COURSE CONTENT
Introduction: Concept and Definitions, Entrepreneur v/s Intrapreneur; Role of entrepreneurship in economic development; Entrepreneurship process; Factors impacting emergence of entrepreneurship; Managerial versus entrepreneurial Decision Making; Entrepreneur v/s Investors; Entrepreneurial attributes and characteristics; Entrepreneurs versus inventors; Entrepreneurial Culture; Women Entrepreneurs; Social Entrepreneurship; Classification and Types of Entrepreneurs; EDP Programmes; Entrepreneurial Training; Traits/Qualities of an Entrepreneurs.

Creating Entrepreneurial Venture: Generating Business idea- Sources of Innovation, methods of generating ideas, Creativity and Entrepreneurship; Challenges in managing innovation; Business planning process; Drawing business plan; Business plan failures; Entrepreneurial leadership- components of entrepreneurial leadership; Entrepreneurial Challenges; Legal issues – forming business entity, considerations and Criteria, requirements for formation of a Private/Public Limited Company, Intellectual Property Protection- Patents Trademarks and Copyrights – importance for startups, Legal Acts Governing Business in India.

Functional plans: Marketing plan– for the new venture, environmental analysis, steps in preparing marketing plan, marketing mix, contingency planning; Organizational plan – designing organization structure and Systems; Financial plan – pro forma income statements, pro forma cash budget, funds Flow and Cash flow statements; Pro forma balance sheet; Break Even Analysis; Ratio Analysis.

Entrepreneurial Finance: Debt or equity financing, Sources of Finance- Commercial banks, private placements, venture capital, financial institutions supporting entrepreneurs; Lease Financing; Funding opportunities for Startups in India.

Enterprise Management: Managing growth and sustenance- growth norms; Factors for growth; Time management, Negotiations, Joint ventures, Mergers & acquisitions.

SUGGESTED READINGS
1. Kumar, Arya, Entrepreneurship: Creating and Leading an Entrepreneurial Organization, Pearson, India.
2. Hisrich., Peters, Entrepreneurship: Starting, Developing and Managing a New Enterprise, Irwin
5. Hisrich, Robert D., Michael Peters and Dean Shephered, Entrepreneurship, Tata McGraw Hill, New Delhi

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<td>EO010</td>
<td>Social Work</td>
<td>3L-1T-OP</td>
<td>None</td>
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</table>

COURSE OUTCOMES
1. Learn about various methods of social work, community organization, social welfare administration, Problems pertaining to Marriage, Family and caste etc.

COURSE CONTENT


Community organization: Meaning, Objective, Principles, Approaches, Roles of Community Organization Worker.

Social Action: Meaning, Scope, approaches (Sarvodaya, Antyodaya etc.) and Strategies.

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**Work in India Problem pertaining to Marriage, Family and caste:** Dowry- child Marriage, Divorce, Families with working couples, Disorganised Families, Families with Emigrant Heads of the Households, Gender Inequality, Authoritarian Family structure, Major Changes in Caste systems and problem of casteism. Problems Pertaining of Weaker Sections. Problems of Children, Women Aged. Handicapped and Backward Classes (SCs, STs, and other Backward Classes).


**Problems of Social Structure:** Poverty, Unemployment, Bonded Labour, Child Labour.


**SUGGESTED READINGS**
1. Rajni Bedi, Social Work: An Introductory Text Book
3. Nitesh Dhawan, Social work perspective Philosophy and Methods

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<tr>
<td>EO011</td>
<td>Intellectual Property and Patenting</td>
<td>3L-1T-0P</td>
<td>None</td>
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</tbody>
</table>

**COURSE OUTCOMES**
1. Gain in-depth knowledge of the laws and process related to Trademarks, Copyrights and other forms of IPs with focus on Patents, the Indian and International Patent filing procedure, drafting patent application and conducting prior art searches.

**COURSE CONTENT**

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Introduction: Historical and philosophical background of patents and other intellectual property, Patent System: the Constitution, Congress, Patent Office (PTO), and courts; Analyzing and understanding judicial opinions.

Comparative overview of patents, copyrights, trade secrets, and trademarks: Legal fundamentals of patent protection for useful inventions, Design and plant patents, Legal fundamentals of copyright protection, Similarity and access, Expression vs. ideas and information, merger, Fair use of copyrighted works (e.g., for classroom use), Contributory copyright infringement, Critical differences between patent and copyright protection, Copyright infringement distinguished from plagiarism, Legal fundamentals of trade-secret protection, Legal fundamentals of trademark protection.

Requirements and limitations of patentability: New and useful: (A) The legal requirement of novelty (B) First to invent vs. first inventor to file, The legal requirement of non-obviousness.

The process of applying for a patent ("patent prosecution"): Anatomy of a patent application, Adequate disclosure, The art of drafting patent claims, Patent searching: (A) Purposes and techniques, Actions for patent infringement, Interpretation of claims, Doctrine of equivalents, Product testing as a possibly infringing use, Doctrine of exhaustion.

SUGGESTED READINGS

Course No. | Title of the Course | Course Structure | Pre-Requisite
--- | --- | --- | ---
EO012 | Supply Chain Management and Logistics | 3L-1T-0P | None

COURSE OUTCOMES
1. Have acquaintance with the concepts and tools of supply chain management and logistics as relevant for a business firm.

COURSE CONTENT
Introduction: Concept of supply chain management (SCM) and trade logistics; Scope of logistics; Logistic activities – an Overview; Contribution of logistics at macro and micro levels; SCM and trade logistics; Business view of SCM; Concept, span and process of integrated SCM; Demand management – methods of forecasting; Supply
SCHEME OF COURSES – M.TECH. (INFORMATION SYSTEMS)

chain metrics (KPIs), performance measurement and continuous improvement; Product development Process and SCM; Strategic role of purchasing in the supply chain and total customer satisfaction; Types of purchases; Purchasing cycle.

Managing Relationship: Role of Relationship marketing in SCM; Managing relationships with suppliers and customers; Captive buyers and suppliers; Strategic partnerships; Supplier-retailer collaboration and alliances.

Focus Areas of Logistics and Supply Chain management: Transportation-Importance of effective transportation system; Service choices and their characteristics; inter-modal services; Transport cost characteristics and rate fixation; In-company management vs. out-sourcing; World sea borne trade; International shipping- characteristics and structure; Liner and tramp operations; Liner freighting; Chartering-Types, principles and practices; Development in sea transportation-Unitization, containerisation, inter and multimodal transport; CFC and ICD. Air transport: Set up for air transport and freight rates; Carriage of Goods by sea -Role and types of cargo intermediaries. Warehousing and inventory management: Reasons for warehousing; Warehousing evaluation and requirements; Warehousing location strategies; Inventory management principles and approaches; Inventory categories - EOQ, LT, ICC

IT Enabling Logistics and Supply Chain: Technology in logistics – EDI, bar Coding, RFID etc., data warehousing, electronic payment transfers; Business management systems; TRADITIONAL ERP, SPECIAL ERP, MR, DRP, PDM, EIP, CPFR, WMS, TMS; Re-engineering the supply chain- Future directions.


SUGGESTED READINGS
1. Christopher, M., Logistics and Supply Chain Management, Prentice Hall.
2. Handfield and Nicholas, Jr., Introduction to Supply Chain Management, Prentice Hall.

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<tr>
<td>EO013</td>
<td>ORGANIZATION DEVELOPMENT</td>
<td>3L-1T-0P</td>
<td>None</td>
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COURSE OUTCOMES
1. Gain understanding how Organisation Development is a growing field of Human
SCHEME OF COURSES – M.TECH. (INFORMATION SYSTEMS)

Resource Management with foundations in a number of behavioural and social sciences.

COURSE CONTENT
1. Organizational Systems and Human Behaviour - Developing a basic knowledge of how organizations and groups function as systems; introducing and discussing various theoretical approaches and issues.
2. Interpersonal and Consulting Skills - Increasing effectiveness as a change agent by providing a variety of opportunities in order to increase self-awareness, practice alternative ways of approaching personal and interpersonal problem-solving and develop basic consulting and interviewing skills.
3. Introduction to Organization Development - Introducing some basic theories, models and methods in the field of organization development, especially those relating to the role of consultant and strategies for change.
4. Intervention and Change in Organizations - Consolidating and further developing consulting skills and strategies.
5. Action Research Project - Carrying out a change activity in an organization, while also researching the effects of the process. This provides participants with an opportunity to consolidate and demonstrate skills and knowledge gained in other units of the course.

SUGGESTED READINGS
As suggested by the course instructor.

Course No. | Title of the Course | Course Structure | Pre-Requisite
--- | --- | --- | ---
EO014 | INDUSTRIAL ORGANISATION AND MANAGERIAL ECONOMICS | 3L-1T-0P | None

COURSE OUTCOMES
Students will gain an understanding of the basics of management and Industrial organisation.

COURSE CONTENT
Unit I: Principles of management, General idea, various functions, scope of engineering. Organisation structure, Types, merits and demerits.
Unit II: Plant location and layout, Factors effecting location, types of layout. Production planning and control, Sequence of planning and control of production. Scheduling, routing, despatching, Methods Study, Methods analysis, time study.
methods of rating.

Unit III: General idea of personnel management, Industrial psychology, job evaluation and monitoring. Business decision making and forward planning. Demand and demand forcasting of production analysis- prices and pricing decision-profit and capital, management. Analysis of inter-industry relation, macro-economics and business.

SUGGESTED READINGS
1. Koutsoyiannis A : Modern Microeconomics, ELBS.
2. Managerial Economics for Engineering :Prof. D.N. Kakkar
3. Managerial Economics : D.N. Dwivedi
5. Indian economy: Ruddardutt and K.P.M. Sundharam

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<td>E0015</td>
<td>GLOBAL STRATEGIES AND TECHNOLOGY</td>
<td>3L-1T-0P</td>
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</table>

COURSE OUTCOMES
1. Understand the specifics of strategy and organization of the multinational company.
2. Learn the framework for formulating successful and adaptive strategies in an increasingly complex world economy.

COURSE CONTENT
Globalization of industries, the continuing role of country factors in competition, organization of multinational enterprises, and building global networks, Analysis of competitive situations from the general management point of view, including fit between key environmental forces and the firm’s resources, and changes in these over time. Formulating and implementing strategy based on that analysis. Developing and leveraging a firm’s core competencies to gain long-term sustainable advantage.

SUGGESTED READINGS
1. Global strategy by Mike W. Peng
2. Redefining Global Strategy by pankajghemawat
3. Fundamentals of Global Strategy by Cornelis A. de Kluwer

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SCHEME OF COURSES – M.TECH. (INFORMATION SYSTEMS)

Course No. | Title of the Course | Course Structure | Pre-Requisite
--- | --- | --- | ---
EO016 | ENGINEERING SYSTEM ANALYSIS AND DESIGN | 3L-1T-0P | None

COURSE OUTCOMES
1. The students will learn about system definitions and role of system analyst. They will learn about system modeling and design. They will be exposed to System Implementation and Maintenance issues.

COURSE CONTENT
**Unit 1.** System definition and concepts: Characteristics and types of system, Manual and automated systems
Real-life Business sub-systems: Production, Marketing, Personal, Material, finance
Systems models types of models: Systems environment and boundaries, Real-time and distributed systems, Basic principles of successful systems

**Unit 2.** Systems analyst: Role and need of systems analyst, Qualifications and responsibilities, Systems Analyst, agent of change.
Various phases of systems development life cycle: Analysis, Design, Development, Implementation, Maintenance

**Unit 3.** Systems Design and modeling: Process modeling, Logical and physical design, Design representation, Systems flowcharts and structured charts, Data flow diagrams, Common diagramming conventions and guidelines using DFD and ERD diagrams.
Data Modeling and systems analysis, designing the internals: Program and Process design, Designing Distributed Systems

**Unit 4.** User Interfaces – Relational Analysis – Database design – program design– structure chart – HIPO – SSADM – Alternate Life cycles – Prototypes.

**Unit 5.** System Implementation and Maintenance: Planning considerations, Conversion methods, producers and controls, System acceptance Criteria, System evaluation and performance, Testing and validation, Systems qualify Control and assurance, Maintenance activities and issues.

SUGGESTED READINGS

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### COURSE OUTCOMES

1. General understanding of organization in biological systems
2. Conceptual knowledge of functioning in biological systems
3. Clarity about relevance of Biology to engineering graduates
4. Understanding human body or any other suitable organism as a study-model for engineering students.
5. Understanding electrical, chemical and magnetic forces, and communication networks in biosystem.

### COURSE CONTENT

The Biological system – An Introduction; Biomolecules & self assemblies; Molecular recognition; Bioenergetics; Communication network in biosystem; Mechanics in biology; Storage, preservation and propagation of biological information; Biomaterials in engineering applications; Organisms as factories for biomaterials; Engineering organisms for novel applications

### SUGGESTED READINGS

3. Applied Mathematical Models and Human Physiology By: Johnny T. Ottesen, MS Olufsen,
4. JK Larsen, Published by Society for Industrial and Applied Mathematics,
5. Advanced Biology By Michael Roberts, Michael Jonathan Reiss, Grace Monger
7. Basic Biotechnology By: Colin Ratledge, Bjorn Kristiansen (Ed.)

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<td>EO017</td>
<td>BIOLOGY FOR ENGINEERS</td>
<td>3L-1T-0P</td>
<td>None</td>
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<tr>
<td>EO018</td>
<td>ENERGY, ENVIRONMENT AND SOCIETY</td>
<td>3L-1T-0P</td>
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### COURSE OUTCOMES

1. To be able to assess the energy resources available worldwide
2. To understand the negative impact of conventional energy resource utilization on ecosystem

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3. To learn about various types of pollutions and their control strategies
4. To understand renewable energy resources and their socio-economic impact

**COURSE CONTENT**

Introduction to Environment, Energy and its impact on society
Universe, Environment and Ecosystem: Origin of earth, atmosphere, Origin of Life, Ecosystem, Biotic and abiotic components, Ecological pyramids, Food chain, Food web, Habitat and Niche, Major ecosystems, Atmosphere, Biodiversity
Pollution: Air Pollution, Water Pollution, Soil Pollution, Noise Pollution
Energy: Different sources of Energy, Renewable sources of energy, Non renewable energy, Bioenergy, Bioethanol and Biodiesel
Biofertilizers, Biopesticides and Biopolymers
Environmental Ethics and Morals

**SUGGESTED READINGS**

6. Rezaiyan. J and N. P. Cheremisinoff, Gasification Technologies, A Primer for Engineers and Scientists, Taylor and Francis, 2005

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<td>E0019</td>
<td>Public Policy And Governance</td>
<td>3L-1T-0P</td>
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</table>

**COURSE OUTCOMES**

1. Students will be introduced to Public Policy and Administrative governance. They will also learn about Administrative Governance.

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## COURSE CONTENT

**Introduction to Public Policy and Administrative Governance:** Introduction to public policy, econometrics for policy research, policy analysis, economics for public decision making.

**Public Bureaucracy in Theory and Practice:** Benefit cost analysis, public budgeting, revenue and expenditures, managing and leading public service organisations.

**Administrative Governance:** The Challenge of Policy Implementation, public and non-profit programme evaluation.

**Non-state Actors in Policy-making and Administrative Governance:** governance in twenty-first century, Social Diversity and the Question of “Difference” in Policy-making and administrative Governance.

## SUGGESTED READINGS