# Contents

<table>
<thead>
<tr>
<th>Sl.No</th>
<th>Title</th>
<th>Page No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>About the Revised Syllabus</td>
<td>2</td>
</tr>
<tr>
<td>2.</td>
<td>DOEACC Society</td>
<td>2</td>
</tr>
<tr>
<td>3.</td>
<td>DOEACC Scheme</td>
<td>2</td>
</tr>
<tr>
<td>4.</td>
<td>DOEACC 'C' Level Course</td>
<td>3</td>
</tr>
<tr>
<td>5.</td>
<td>Practical</td>
<td>4</td>
</tr>
<tr>
<td>6.</td>
<td>Dissertation</td>
<td>5</td>
</tr>
<tr>
<td>7.</td>
<td>Credit Scheme for DOEACC 'C' Level Course</td>
<td>8</td>
</tr>
<tr>
<td>8.</td>
<td>Examination Pattern</td>
<td>10</td>
</tr>
<tr>
<td>9.</td>
<td>Hardware Requirement for 'C' Level Course</td>
<td>11</td>
</tr>
<tr>
<td>10.</td>
<td>Software Requirement for 'C' Level Course</td>
<td>12</td>
</tr>
<tr>
<td>11.</td>
<td>Parity table between Revision III (w.e.f Jan. 2003) and Revision IV (w.e.f July 2011)</td>
<td>13</td>
</tr>
<tr>
<td>12.</td>
<td>Detailed Syllabus</td>
<td></td>
</tr>
</tbody>
</table>

## Bridge Course

<table>
<thead>
<tr>
<th>C0-R4.B1</th>
<th>Elements of Mathematical Sciences</th>
<th>14</th>
</tr>
</thead>
<tbody>
<tr>
<td>C0-R4.B2</td>
<td>Operating System</td>
<td>20</td>
</tr>
<tr>
<td>C0-R4.B3</td>
<td>Data Structure through JAVA</td>
<td>28</td>
</tr>
<tr>
<td>C0-R4.B4</td>
<td>Computer System Architecture</td>
<td>34</td>
</tr>
</tbody>
</table>

### Semester I

| C1-R4 | Advanced Computer Graphics | 39 |
| C2-R4 | Advanced Computer Networks  | 44 |
| C3-R4 | Mathematical Methods for Computing | 49 |
| C4-R4 | Advanced Algorithms         | 56 |
| C5-R4 | Data Warehousing and Data Mining | 61 |
| Lab I  | Graphics and Visualisation   | 66 |
| Lab II | Data Network and Management  | 67 |

### Semester II

| C6-R4 | Multimedia Systems           | 69 |
| C7-R4 | Digital Image Processing and Computer Vision | 74 |
| C8-R4 | Information Security         | 79 |
| C9-R4 | Soft Computing               | 84 |
| C10-R4| Software Systems             | 89 |
| Lab III | Image Processing and Computer Vision | 94 |
|       | Multimedia Systems           | 96 |
| Lab IV | Information Security         | 97 |
|       | Soft Computing               | 98 |

### Any two from the following to be chosen

| CE1.1-R4 | Digital Signal Processing | 99 |
| CE1.2-R4 | Machine Learning          | 106|
| CE1.3-R4 | Cyber Forensic & Law      | 111|
| CE1.4-R4 | Project Management        | 115|
| CE1.5-R4 | Mobile Computing          | 120|
1. **ABOUT THE REVISED SYLLABUS**

The third revised version of DOEACC syllabus came into effect in July 2003 examinations. Since then many advancements have taken place in the field of Information Technology. Consequently it has become necessary to revise the syllabus.

This document presents the fourth revised version of DOEACC C level syllabus which becomes effective for teaching w.e.f. July 2011. This ‘C’ Level syllabus is designed to facilitate students in the development of concept based approach for problem solving using IT as a tool. The self learning approach is built into the syllabus, thereby training the candidates to update themselves on the changing technologies in their area of work. The ‘C’ Level syllabus has been designed to produce Consultants, System Specialists, Trainers, R&D Scientists , Managers equipped with latest knowledge and skills.

2. **DOEACC SOCIETY**

DOEACC Society is an Autonomous Scientific Society of the Department of Information Technology, Ministry of Communications & Information Technology, Govt. of India. The Society is registered under the Societies Registration Act, 1860. DOEACC Society is the only professional examination body in India, which accredits institutes / organizations for conducting particular course, specializing in the non-formal sector of IT education.

DOEACC is envisioned to be a premier knowledge institution pursuing human resource development activities in areas of Information Technology, Electronics and Communication Technology (IECT).

The office of the Society is situated at Electronics Niketan, 6, CGO Complex, New Delhi. The Society has its fifteen Centers at 23 locations namely Agartala, Aizawl, Aurangabad, Calicut (with Southern Regional Office at Pudukkottai), Chennai, Gorakhpur(with Eastern Regional Office at Patna), Imphal, Kohima/Chuchuyimlang, Itanagar, Gangtok, Kolkata, Srinagar/Jammu, Shillong, Tezpur/Guwahati, Chandigarh (Branches – New Delhi, Shimla, Lucknow). One more DOEACC Centre is being set up at Ajmer. These Centres provide quality education & training programmes in Information, Electronic Design and related technologies/areas on long term and short term basis.

3. **DOEACC SCHEME**

DOEACC scheme on IT is a joint Scheme of the Department of information Technology (erstwhile Department of Electronics), Ministry of Communications & Information Technology, Govt. of India and All India Council for Technical Education (AICTE).

**Objective of the Scheme**

The objective of the Scheme is to generate qualified manpower in the area of Information Technology (IT) at the national level, by utilizing the facilities and infrastructure available with the institutions/organizations in the non-formal sector.

The Society is managed and administered by a Governing Council which consists of eminent academicians and professionals from IT industry. Minister of State for Communications & Information Technology, Govt. of India, is the Chairman, Governing Council of the Society. The Executive Director is the Chief Executive Officer of the
Society and manages day to day affairs of the Society. Manifold functions of the DOEACC Scheme are:

a) Accreditation
b) Registration and
c) Examination

4. DOEACC ‘C’ LEVEL COURSE

Objective of the ‘C’ Level Course

The objective of ‘C’ Level is to develop Project Managers/Consultants/System Specialists/R&D Scientists/Faculty who will be equipped with the knowledge and skills desired to perform the duties of the positions referred above. In order to develop the capabilities, ‘C’ Level course has been designed to give the students a sound background in latest Technologies, Tools and Techniques in Computer Science and Engineering.

The career options available to DOEACC ‘C’ level qualifiers are:

- Project Manager
- IT Consultant
- Training faculty
- R & D Scientist
- System Specialist

Employment eligibility as Faculty in Engineering Colleges for C level holders:

1. Any Engineering graduate with C level may be eligible to become a faculty in Computer Science & Engineering/IT Department of Engineering college & universities. The student may also be allowed to pursue research in any University/IIT/NIT

2. Other C level candidates without Engineering background with GATE percentile may also be eligible to become faculty in Computer Science & Engineering/IT Department of Engineering college & universities. The student may also be allowed to pursue research in any University/IIT/NIT

DOEACC ‘C’ Level Course consists of 12 theory modules (10 compulsory modules and 2 elective module), four Practical and two Projects (out of which one will be a comprehensive project). The minimum duration of the course is two years. The structure of ‘C’ Level syllabus is indicated below:

DOEACC ‘C’ LEVEL COURSE STRUCTURE

The structure of the ‘C’ Level course is:

<table>
<thead>
<tr>
<th>Module</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>*Bridge Course</td>
<td></td>
</tr>
<tr>
<td>C0-R4.B1</td>
<td>Elements of Mathematical Sciences</td>
</tr>
<tr>
<td>C0-R4.B2</td>
<td>Operating System</td>
</tr>
<tr>
<td>C0-R4.B3</td>
<td>Data Structure through JAVA</td>
</tr>
<tr>
<td>C0-R4.B4</td>
<td>Computer System Architecture</td>
</tr>
</tbody>
</table>
Semester I

C1-R4  Advanced Computer Graphics
C2-R4  Advanced Computer Networks
C3-R4  Mathematical Methods for computing
C4-R4  Advanced Algorithms
C5-R4  Data Warehousing and Data Mining
Lab I   Graphics and Visualisation
Lab II  Data Network and Management

Semester II

C6-R4  Multimedia Systems
C7-R4  Digital Image Processing and Computer Vision
C8-R4  Information Security
C9-R4  Soft Computing
C10-R4 Software Systems

Lab III Image Processing and Computer Vision
     + Multimedia Systems
Lab IV Information Security
     + Soft Computing

Semester III  Any two from the following to be chosen

CE1.1-R4 Digital Signal Processing
CE1.2-R4 Machine Learning
CE1.3-R4 Cyber Forensic & Law
CE1.4-R4 Project Management
CE1.5-R4 Mobile Computing

C11-R4 Dissertation-I

Semester IV

C12-R4 Dissertation -II

** Bridge course C0-R4.B1 to C0-R4.B4 will be exempted for the students who have successfully qualified the DOEACC ‘B’ level course or its equivalent course recognized by AICTE/MHRD/UGC on case to case basis.

5. PRACTICAL

All ‘O’, ‘A’, ‘B’ and ‘C’ Level Candidates under the revised syllabi (Revision 4) shall have to qualify the Practical Examination, in addition to qualifying the theory examinations as well as the Dissertation Work.
Practical assignments have been worked out for each theory paper. At ‘C’ Level, there are four Practical Examinations. The Practical I - Graphics & Visualisation will be based on the syllabi of C1-R4 Advanced Computer Graphics and C3-R4 Mathematical Methods for computing and Practical II - Data Network & Management will be based on the syllabi of C2-R4 Advanced Computer Networks and C5-R4 Data Warehousing and Data Mining. Similarly, Practical III – Image Processing and Computer Vision + Multimedia Systems will be based on the syllabi of C6-R4 Multimedia Systems and C7-R4 Digital Image Processing and Computer Vision and Practical IV – Information Security + Soft Computing will be based on the syllabi of C8-R4 Information Security and C9-R4 Soft Computing of the ‘C’ Level course.

6. **DISSERTATION**

DOEACC curriculum has Dissertation as an important component of ‘C’ Level course. There are two Dissertations at ‘C’ Level. The Dissertation is carried out by the student under guidance and support from faculty and management of the respective institute/organization.

It is felt that such a Dissertation provides an opportunity to the student to apply his/her knowledge and skills to real life problems (including oral and written communication skills), and as such the Dissertation should be given utmost importance and priority both by the students as well as institution faculty/management in respect of its identification, planning and implementation.

**Objective of the Dissertation**

The aim of the Dissertation is to give the students an integrated experience in solving a real life problem by applying knowledge and skills gained on completion of theory papers in a course at a given Level. It provides an occasion for students to develop written and communication skills, Dissertation also helps the students to realize the importance of resource and time management, ownership of task towards deliverables, innovation and efficiency in task management apart from presentation skills. It also provides a good opportunity for students to build, enhance and sustain high levels of professional conduct and performance and evolves a problem solver frame of mind in student. It is also felt that taking up the Dissertation by a student prepares him for a job in industry and elsewhere.

6.1 **C Level First Dissertation (Dissertation – I)**

Every candidate should do a Dissertation individually and no grouping is allowed. The Dissertation will be carried out under the guidance of the institute, if he/she is through the institute conducting an accredited course. The direct candidate will do the Dissertation in an organization where he/she is working. In that case, he/she will carry out the Dissertation under the guidance of experts/professional from his organization.

**Who could be a Supervisor/Guide**

A Supervisor/Guide should be a person with DOEACC ‘C’ Level/ M.Tech equivalent/higher qualification and adequate experience (minimum 3 years) in the area in which the student has chosen the Dissertation. In the case of a candidate from an accredited institute, the institute concerned will render all help including the nomination of the Supervisor. All help including the nomination of the supervisor/guide will be rendered by the institute concerned. In the case of a direct candidate, the candidate
should ensure that the facilities are available in the organization (where the Dissertation is taken up) and also the same are extended to them.

Dissertation work part-1 will be a part of main Dissertation. Dissertation report submission and presentation will be mandatory.

**Time of Submission of First ‘C’ Level Dissertation**

‘C’ Level student can submit the Dissertation-I only after clearing 10 papers from the first two semesters and appearing both elective papers in semester III.

**Some important notes while preparing the Dissertation proposal**

The following suggested guidelines may be followed in preparing the Final Dissertation Report:

Good quality white executive bond paper A4 size should be used for typing and duplication. Care should be taken to avoid smudging while duplicating the copies.

**Page Specification:** (Written paper and source code)
Left margin 3.0 cms  
Right margin 3.0 cms  
Top margin 2.7 cms  
Bottom margin 2.7 cms  

Page numbers – All text pages as well as Program source code listing should be numbered at the bottom center of the pages.

**Submission of Dissertation Report to DOEACC**

The student will submit his/her Dissertation report in the prescribed format along with requisite fee. The Dissertation Report should include:

- One hard copy of the Project Report.
- Soft copy of Project on Floppy / CD
- The Project Report may be about 50 pages (excluding coding).

**Credits**

This Dissertation would be approximately 330 man-hours and carries a total of 100 marks (80% for the Dissertation evaluation and 20% for the viva-voce). The marks and a certificate of conducting Dissertation – I of only the passed candidates should be submitted in the prescribed format by the Head of the Institute running the accredited course of the organization of which the candidate is an employee.

Proforma of the mini Project Completion Certificate is given below;

**Proforma of the Dissertation Completion Certificate**

This is to certify that the Dissertation work done of seminar (-------------Title) attended at _____________________________ by Mr.Ms._____________________________ (DOEACC Registration No.__________________) in partial fulfillment of DOEACC ‘C’ Level Examination has been found satisfactory and the total marks obtained by the candidate is _______________________.

This report has not been submitted for any other examination and does not form part of any other course undergone by the candidate.

Signature: ________________________
Name: ___________________________
(By head of the institution with)
6.2 C Level Second Dissertation

At this academic level, the Dissertation is of great significance in the testing of a candidate’s virtuosity in Information Technology and judges his or her ability to independently take charge of Dissertation/System development.

All ‘C’ Level candidates are required to get the synopsis of the Dissertation and the brief bi-data of the supervisor/Guide approved from the Society. The synopsis should clearly mention the scope of the Dissertation. The Dissertation is to be taken up only after obtaining the approval of the Society.

Topic of the Dissertation

Should enable bringing out the topics learnt and should be related to applications in the Industry/field in real life.

Methodology

Candidate should undertake a Dissertation work involving use of software engineering methodologies, tools and techniques.

Format

Candidate should see the format in the Student Project Guide at DOEACC website.

Credit

Dissertation would be of approximately 450 man-hours and so credited by the Supervisor/Guide and will be presented in the form in conformance with the format given in the Student Guide. The Dissertation will also include a viva/voce examination. Dissertation carries a total of 300 marks. 80% of the marks are earmarked for the Dissertation evaluation and 20% for the viva-voce.

To qualify for a pass, a candidate must obtain at least 50% in each of Dissertation evaluation and viva-voce. Exact location of the viva-voce will be intimated by the examiner designated.

Time for submission

‘C’ Level student can submit the Dissertation only after clearing all the papers of third semester.

Fees:

A fee as applicable at the time of submission (available at DOEACC website www.doeacc.edu.in) of Dissertation-II should be remitted to DOEACC Society by a demand draft in favour of DOEACC payable at New Delhi along with the Dissertation report.
Authenticity

Should be an original work, of real life value and not copied from existing material from any source and a certificate to the effect will be provided with the Dissertation duly countersigned by the supervisor/Guide.

7. CREDIT SCHEME FOR DOEACC ‘C’ LEVEL COURSE

Introduction

A credit system based on the AICTE norms has been introduced for indicating the efforts required to pass a specific level of course under the DOEACC Scheme. Award of credit to a student will facilitate measurement/comparison of study hours including Theory Lectures, Tutorials and Practical Assignments put in a given module/paper/subject under the Scheme with similar course in IT in India and abroad. This will also facilitate other Universities/Apex Accrediting bodies to consider academic and professional equivalence of DOEACC courses. This will also help students/organizations to transfer credits from DOEACC to other academic bodies and vice-versa for ensuring continuing education.

Following table gives the no. of hours of Lectures/Tutorials and Practical per week to be attended and the credits earned by the student:-

<table>
<thead>
<tr>
<th>Module</th>
<th>Title</th>
<th>No. of Hrs. per week</th>
<th>No. of Credits+</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>L</strong></td>
<td><strong>T/P</strong></td>
<td></td>
</tr>
<tr>
<td>Bridge Course</td>
<td>(Being bridge course no credit is allotted for this Course)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C0-R4.B1</td>
<td>Elements of Mathematical Sciences</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>C0-R4.B2</td>
<td>Operating System</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>C0-R4.B3</td>
<td>Data Structure through JAVA</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>C0-R4.B4</td>
<td>Computer System Architecture</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Semester I</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C1-R4</td>
<td>Advanced Computer Graphics</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>C2-R4</td>
<td>Advanced Computer Networks</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>C3-R4</td>
<td>Mathematical Methods for computing</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>C4-R4</td>
<td>Advanced Algorithms</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>C5-R4</td>
<td>Data Warehousing and Data Mining</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Lab I</td>
<td>Graphics and Visualisation</td>
<td>6</td>
<td>3</td>
</tr>
<tr>
<td>---------------</td>
<td>---------------------------</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>Lab II</td>
<td>Data Network and Management</td>
<td>6</td>
<td>3</td>
</tr>
</tbody>
</table>

**Semester II**

<table>
<thead>
<tr>
<th>C6-R4</th>
<th>Multimedia Systems</th>
<th>3</th>
<th>3</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>C7-R4</td>
<td>Digital Image Processing and Computer Vision</td>
<td>3</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>C8-R4</td>
<td>Information Security</td>
<td>3</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>C9-R4</td>
<td>Soft Computing</td>
<td>3</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>C10-R4</td>
<td>Software Systems</td>
<td>3</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>Lab III</td>
<td>Image Processing &amp; Computer Vision + Multimedia Systems</td>
<td>6</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Lab IV</td>
<td>Information Security + Soft Computing</td>
<td>6</td>
<td>3</td>
<td></td>
</tr>
</tbody>
</table>

**Semester III**

Any two from the following to be chosen (credit 8)

<table>
<thead>
<tr>
<th>CE1.1-R4</th>
<th>Digital Signal Processing</th>
<th>3</th>
<th>3</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>CE1.2-R4</td>
<td>Machine Learning</td>
<td>3</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>CE1.3-R4</td>
<td>Cyber Forensic &amp; Law</td>
<td>3</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>CE1.4-R4</td>
<td>Project Management</td>
<td>3</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>CE1.5-R4</td>
<td>Mobile Computing</td>
<td>3</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>C11-R4</td>
<td>Dissertation Part -I</td>
<td>22</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Semester IV**

| C12-R4        | Dissertation Part -II    | 30|    | |

Total Credit 124

**Notes**

1. One hour of lecture is equated to one credit and two hours of tutorial/practicals are similarly equated to a credit, every week for a semester consisting of 20 weeks.
2. Total No. of credits earned in a module is calculated using AICTE Formula (as applicable to Under Graduate Courses in IT namely $C = L + \frac{T+P}{2}$ where L, T and P indicate no. of hours per week for Lectures, Tutorials and Practical.

3. The credit scheme was implemented from July, 2003 examinations.

4. Fractions in credits have been rounded to nearest integer.

8. EXAMINATION PATTERN

The theory examination for each module under the fourth revised syllabus would be for duration of three hours and the total marks for each subject would be 100. Four Practical examinations of three hours duration and 100 marks each have been introduced. The first examination with the revised syllabus will be held in January 2012, for which teaching will commence in July, 2011.

Dates for the various activities connected with examinations will be announced on DOEACC website, well in advance of the examinations.

8.1 Pass percentage

To qualify for a pass in a module, a candidate must have obtained at least 50% in each theory and practical examination each. The marks will be translated into grades, while communicating results to the candidates. The gradation structure is as below:-

<table>
<thead>
<tr>
<th>Pass percentage</th>
<th>Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>Failed (&lt;50)</td>
<td>F</td>
</tr>
<tr>
<td>50%-54%</td>
<td>D</td>
</tr>
<tr>
<td>55%-64%</td>
<td>C</td>
</tr>
<tr>
<td>65%-74%</td>
<td>B</td>
</tr>
<tr>
<td>75%-84%</td>
<td>A</td>
</tr>
<tr>
<td>85% and over</td>
<td>S</td>
</tr>
</tbody>
</table>

8.2 Registration

Registration is a pre-requisite for appearing in DOEACC examinations. A candidate can register at only one Level at a time to appear for the examination. Registration is only for candidates and not for institutes. Registration forms are available from the DOEACC Society free of cost and also can be downloaded from the website. The eligibility criteria for registration at ‘C’ Level is as follows:

8.2.1 Eligibility

**For students appearing through an institute:** Level 'B' / B.Tech / BE / MCA / M.Sc / Master’s Degree in Mathematics / Statistics / Operation Research / MBA (or equivalent) with B.Sc / BA (Mathematics / Statistics). GATE (Computer), followed in each case by an accredited 'C' level course.

**For students-at-large (Direct Applicants)** Level 'B' / B.Tech / BE / MCA / M.Sc / Master’s Degree in Mathematics / Statistics / Operation Research / MBA (or equivalent) with B.Sc / BA (Mathematics / Statistics). GATE (Computer) followed in each case by one and half year relevant experience.*

* Relevant experience connotes job experience in IT, including teaching in a recognized
Registration is open throughout the year, however cut off dates are specified for submitting registration applications for each examinations for the convenience of processing and allotting Registration Numbers.

<table>
<thead>
<tr>
<th>Level</th>
<th>Cut off Dates</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>January Exams</td>
</tr>
<tr>
<td>C Level</td>
<td>Preceding 31st July</td>
</tr>
</tbody>
</table>

Accredited Institutes are allowed to submit the Registration Application Form of their candidates one month beyond the cut off dates.

### 8.3 Re-registration

Candidates who are not able to clear the level within the validity period of initial registration, are allowed to re-register for once, at the same level for another full term, i.e. 6 years to clear the left over papers by submitting filled in Registration application and full Registration fee within one year of the expiry of the validity period of existing ‘C’ Level Registration.

### 8.4 PRACTICAL EXAMINATION SCHEME

- **No of Practical Examination**: Four
- **Duration of each Examination**: Three hour duration including viva-voce
- **Max. marks in each Examination**: 100=80 (Practical) + 20 (Viva)

**Grading**: Students will be awarded grades in practical examinations based on the marks scored by them in the practical and viva voce. Every candidate has to pass in both Theory and Practical examinations.

**Date(s)**: Date(s) will be announced on the DOEACC website.

The examinations will be conducted by the Society in reputed institutions for all candidates. The institutes are obliged to facilitate the conduct of Practical examinations and arrange infrastructure, faculty for the conduct of practical examination. The institutes are not allowed to charge any fee from the candidates, for the practical examination.

### 9. HARDWARE REQUIREMENT FOR ‘C’ LEVEL COURSE

#### a. Computer configuration recommended

- **Processor**: 1 GHz or higher
- **RAM**: 1 GB or higher
- **HDD**: 250 GB or higher
- **Monitor**: SVGA
- **Mouse**: Windows compatible
- **Keyboard**: Standard
- **NIC**: Standard
Optical Drive : Standard
Speaker, Mic, Webcam : Standard

b. Printer

Laser printer / Inkjet Printer : Standard
Dot matrix printer : Standard
OHP / LCD Projector : Standard
MODEM, DIAL UP/DSL : Standard
SCANNER : Standard

b. Networking Requirement

NIC : Standard
RJ-45 Connector : Standard
Punching Tool : Standard
Crimping Tool : Standard
UTP/STP/Coaxial Fibre Optic Cables & their connectors : Standard
8/16 port Hub/Switches : Standard
Wi-Fi Router : Standard

c. Networking Requirement

NIC : Standard
RJ-45 Connector : Standard
Punching Tool : Standard
Crimping Tool : Standard
UTP/STP/Coaxial Fibre Optic Cables & their connectors : Standard
8/16 port Hub/Switches : Standard
Wi-Fi Router : Standard

10. SOFTWARE REQUIREMENT FOR ‘C’ LEVEL COURSE

Operating system : Linux / Windows / 2000/xp/vista

NOS : Linux / Unix / Windows NT/Novell Netware


Antivirus Software : Standard

Compilers : C & C++ Compiler, Java MPI, PVM, SMIL Interpreter and OpenMP
<table>
<thead>
<tr>
<th>Code</th>
<th>Revision IV</th>
<th>Code</th>
<th>Revision III</th>
</tr>
</thead>
<tbody>
<tr>
<td>C2-R4</td>
<td>Advanced Computer Networks</td>
<td>C7-R3</td>
<td>Advanced Computer Networks</td>
</tr>
<tr>
<td>C3-R4</td>
<td>Mathematical Methods for Computing</td>
<td>No equivalence</td>
<td></td>
</tr>
<tr>
<td>C4-R4</td>
<td>Advanced Algorithms</td>
<td>C4-R3</td>
<td>Algorithm Analysis &amp; Design</td>
</tr>
<tr>
<td>C5-R4</td>
<td>Data Warehousing and Data Mining</td>
<td>CE3-R3</td>
<td>Data Warehousing &amp; Mining</td>
</tr>
<tr>
<td>C6-R4</td>
<td>Multimedia Systems</td>
<td>C11-R3</td>
<td>Multimedia Technology &amp; Virtual reality</td>
</tr>
<tr>
<td>C7-R4</td>
<td>Digital Image Processing and Computer Vision</td>
<td>CE5-R3</td>
<td>Image Processing &amp; Computer Vision</td>
</tr>
<tr>
<td>C8-R4</td>
<td>Information Security</td>
<td>CE4-R3</td>
<td>Network Security &amp; Cryptography</td>
</tr>
<tr>
<td>C9-R4</td>
<td>Soft Computing</td>
<td>C14-R3</td>
<td>AI &amp; Neural Networks</td>
</tr>
<tr>
<td>C10-R4</td>
<td>Software Systems</td>
<td>No equivalence</td>
<td></td>
</tr>
<tr>
<td>CE1.1-R4</td>
<td>Digital Signal Processing</td>
<td>No equivalence</td>
<td></td>
</tr>
<tr>
<td>CE1.2-R4</td>
<td>Machine Learning</td>
<td>No equivalence</td>
<td></td>
</tr>
<tr>
<td>CE1.3-R4</td>
<td>Cyber Forensic &amp; Law</td>
<td>No equivalence</td>
<td></td>
</tr>
<tr>
<td>CE1.4-R4</td>
<td>Project Management</td>
<td>C9-R3</td>
<td>Advanced Software Project Management</td>
</tr>
<tr>
<td>CE1.5-R4</td>
<td>Mobile Computing</td>
<td>CE2-R3</td>
<td>Mobile Computing</td>
</tr>
</tbody>
</table>

1. The above table shows the equivalence between the modules of new syllabus (Revision IV) and the old (Revision III) syllabus.
2. Candidates would not be allowed to appear in the equivalent papers of the Revision IV (new syllabi), if they have already passed the relevant papers in earlier revision.
3. Candidates would have to pass a total of 12 papers, 4 practicals and 2 Dissertations in order to qualify ‘C’ Level in Revision IV syllabus.
4. Candidates would not be allowed to appear for more than two elective papers as per the Revision IV. Candidates who have passed/cleared certain papers, and such papers have either become elective or have no equivalence in Revision IV and the candidate has already passed/cleared the required number of elective papers, the candidate must replace the papers with equal number of introduced compulsory papers in Revision IV i.e papers which have no equivalence in earlier Revisions.
Objective of the Course

Mathematics is the language of all sciences, specifically of Computer Science. A minimum standard of mathematical knowledge and maturity is to be assumed from students who desire to pursue a C Level programme in Computer Science. The present course is designed to bridge the gap between the mathematical knowledge that the students have and knowledge that would be required to understand the curriculum at the C level. Mathematical software need to be utilized for the solution of mathematical problems on computers. After completion of the course, the students should have sufficient knowledge to appreciate, understand and solve problems in topics like signal and image processing; data compression; mobile and wireless communications; computer graphics, vision and multimedia etc.

Outline of Course

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Topic</th>
<th>Minimum number of hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Linear Algebra: Matrices, Vectors, Determinants</td>
<td>12</td>
</tr>
<tr>
<td>2.</td>
<td>Calculus: Differential &amp; Integral Calculus</td>
<td>12</td>
</tr>
<tr>
<td>3.</td>
<td>Analytical Geometry</td>
<td>06</td>
</tr>
<tr>
<td>4.</td>
<td>Infinite Series</td>
<td>06</td>
</tr>
<tr>
<td>5.</td>
<td>Probability Theory and Distributions</td>
<td>12</td>
</tr>
<tr>
<td>6.</td>
<td>Statistics</td>
<td>12</td>
</tr>
</tbody>
</table>

Lectures = 60
Practical/Tutorials = 60
Total = 120

Detailed Syllabus

1. **Linear Algebra: Matrices, Vectors, Determinants** 12 Hrs.
   Basic concepts, Matrix addition, Scalar multiplication, Matrix multiplication, Linear systems of equations-Gauss elimination, Rank of a matrix, Vectors, Dot product, Cross product, Linear independence, Solutions of linear systems: Existence, Uniqueness, Determinants-Cramer’s rule, Inverse of a matrix, Gauss Jordan elimination, Eigen values, Eigen vector, Some application of Eigen value problems.

2. **Calculus: Differential and Integral Calculus** 12 Hrs.
   Binomial Theorem, Trigonometric functions $e^x$ log $x$ and their graphs, Real numbers and real line, Functions.
   Limit and Continuity: L’Hospital rule, Continuity, Tangent lines, Differentiation rules, Implicit differentiation, Mean value Theorem, Extreme values, Asymptotes.
   Integration: Indefinite integrals, Integration by parts, Partial Fractions, Integration by substitution, Definite Integrals, Fundamentals theorem of calculus(statement only), Properties of integrals, area, Evaluation of definite integrals.

3. **Analytical Geometry** 06 Hrs.
   Equation of a line and circle, Parameterized curves, Polar coordinates: Conic sections and Quadratic equations, Classifying conics.
4. Infinite Series
Limit of sequences and series, Theorem for calculating limits, Infinite series, Integral test, Ratio test, Comparison test, Alternate series, Taylor and Mclaurin series.

5. Probability Theory and Distributions
Rules of probability, Conditional probability, Independent events, Bayes Theorem, Continuous and Discrete random variables, Expected value of a random variable, Moment and moment generating functions, Product moment, Covariance, Probability Distributions – Bernoulli, Binomial, Poisson, Geometric, Uniform, Exponential, Normal and Bivariate normal distribution.

6. Statistics
Introduction, Random sampling, Estimation of parameters, Confidence intervals, Testing of hypothesis, Goodness of Fit, Chi-square test, Regression analysis.
RECOMMENDED BOOKS (*)

MAIN READING


SUPPLEMENTARY READING


(*) Latest edition of the books need to be procured.
1. Answer question 1 and any FOUR questions from 2 to 7.
2. Parts of the same question should be answered together and in the same sequence.

TOTAL TIME: 3 HOURS
TOTAL MARKS: 100

1. 
   a) Five persons in a group of 20 are graduate. If 3 persons are picked out of 20 at random,
      i. Compute the probability that all are graduate.
      ii. Find the probability of at least one being graduate.
   b) Let X be normal with mean 5 and variance 4. Find c corresponding \( P(X \geq C) + 95\% \).
   c) Consider a Bernoulli random variate that has probability mass function
      \( P_X(k) = p^k (1-p)^{1-k} \), where \( P[X=1] = p \) and \( P[X=0] = 1-p \). We make \( n \) independent observations \( X_1, X_2, \ldots, X_n \) of random variable \( X \). Obtain the maximum likelihood estimate of the parameter \( p \).
   d) Evaluate \( \int_{-1}^{2} (x + x^2) \, dx \).
   e) Examine the convergence of following series
      \[ \frac{1}{2} + \frac{1}{2.2^2} + \frac{1}{3.2^2} + \frac{1}{4.2^2} + \ldots \]
   f) \( A = \begin{pmatrix} 1 & 2 \\ 3 & 4 \end{pmatrix} \) and \( B = \begin{pmatrix} 5 & 6 \\ 7 & 8 \end{pmatrix} \). Find \( C = A^T B^T \) and its determinant.
   g) Find \( \frac{dy}{dx} \), if \( x^y y^x = k \), where \( k \) is constant.

2. 
   a) Solve the following system of equations using Cramer’s rule:
      \[ \begin{align*}
      2x - 5y + 7z &= 6 \\
      3x - 8y + 11z &= 11 \\
      x - 3y + 4z &= 3
      \end{align*} \]
   b) Find the asymptotes of the curve
      \[ y^3 + x^2 y + 2xy^2 - y + 1 = 0 \]
   c) For what values of \( p \) are \( A = pi - 2j + k \) and \( B = 2pi + pj - 4k \) perpendicular?

3. 
   a) Obtain the equation of two lines of regression for the following data. Also find the estimate of \( X \) for \( Y = 70 \).

<table>
<thead>
<tr>
<th>X</th>
<th>65</th>
<th>66</th>
<th>67</th>
<th>68</th>
<th>69</th>
<th>70</th>
<th>72</th>
</tr>
</thead>
<tbody>
<tr>
<td>Y</td>
<td>67</td>
<td>68</td>
<td>65</td>
<td>68</td>
<td>72</td>
<td>72</td>
<td>69</td>
</tr>
</tbody>
</table>
b) In a random sample of 400 students of the university teaching departments, it was found that 300 students failed in examinations. In another random sample of 500 students of affiliated colleges, the number of failures in the same examinations was found to be 300. Find out whether the proportion of failures in the university teaching departments is significantly greater than the proportion of failures in the university teaching departments and affiliated colleges take together.

c) A survey of 800 families with four children each revealed the following distribution:

<table>
<thead>
<tr>
<th>No. of boys</th>
<th>0</th>
<th>1</th>
<th>3</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of girls</td>
<td>4</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>No. of families</td>
<td>32</td>
<td>178</td>
<td>290</td>
<td>236</td>
<td>64</td>
</tr>
</tbody>
</table>

Is this result consistent with the hypothesis that male and female births are equally probable? Use $\chi^2_{4}(0.05) = 9.488$

4. (a) If $\omega$ is cube root of unity, then find the value of the determinant.

$$
\begin{vmatrix}
1+\omega & \omega^2 & -\omega \\
1+\omega^2 & \omega & -\omega^2 \\
\omega+\omega^2 & \omega^2 & -\omega^2
\end{vmatrix}
$$

(b) Evaluate: $\int_{0}^{\pi} x \sin^2 x \cos^4 x \, dx$

(b) Show the system of equation $x-3y-8z=10; 3x+y-4z=0$ and $2x+5y+6z=13$ is consistent and find the solution.

c) Evaluate $\int_{0}^{6} \frac{1}{1+x} \, dx$ by using Simpson’s 1/3 rule and compare the result with its exact value

$$\int_{0}^{6} \frac{1}{1+x} \, dx$$

5. (a) Find $\frac{dy}{dx}$ if

$$y = \frac{(x+2)^3(3x+5)^4 \sin x}{(2x+2)^2}$$

(b) Evaluate

$$\int_{-\pi/2}^{\pi/2} \sin^2 x \cos^2 x (\sin x + \cos x) \, dx$$

(c) Find the area of the region

$$\{ (x, y) : x^2 \leq y \leq |x| \}$$

6. (a) Use the mean value theorem to prove that $|\tan x| > x$ for all $x \in (0, \pi/2)$
b) Show that the line $5x+3y+\lambda x=2\lambda y-6$ always passes from a fixed point. Determine the coordinates of the point.
c) Find the sum of the following series as $n \to \infty$.

$$
\frac{n}{n^2+1^2} + \frac{n}{n^2+2^2} + \frac{n}{n^2+3^2} + \ldots + \frac{n}{n^2+n^2}
$$

(4+5+9 = 18)

7.  

a) The time in minutes, it takes to reboot a certain system is a continuous random variable with density

$$
f(x) = \begin{cases} 
  c(10-x)^2 & 0 \leq x \leq 10 \\
  0 & \text{otherwise}
\end{cases}
$$

i. Compute C.

ii. Obtain the probability that it takes between 1 and 2 minutes to reboot.

b) A program consists of two modules. The numbers of errors $X$ in the first module and the number of errors $Y$ in the second module have joint distribution:

$$(0,0) \quad (0,1) \quad (1,0) \quad 0.20$$

$$(1,1) \quad (1, 2) \quad (1,3) \quad 0.10$$

$$(0, 2) \quad (0,3) \quad 0.05$$

Find

i. The marginal distribution of $X$ and $Y$.

ii. The probability of number errors in the first module.

iii. The probability distribution of the total number of errors in the program.

iv. If the errors in the two modules occur independently?

(9+9 = 18)
C0-R4.B2: OPERATING SYSTEM

Objective of the Course

This course is covering all the fundamental operating systems concepts such as processes, interprocess communication, input/output, virtual memory, file systems and security. The students are expected to learn these principles through UNIX/LINUX/Windows/2000/XP/NT/Vista like operating systems.

The course outline is about the concepts, structure and mechanism of operating systems. Its purpose is to present, as clearly and completely as possible, the nature and characteristics of modern day operating systems. It examines the operating systems that run in multiprocessing environments and covers distributed computing in the context of open system interconnection(OSI) standards and protocols.

Outline of Course

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Topic</th>
<th>Minimum number of hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Overview</td>
<td>08</td>
</tr>
<tr>
<td>2.</td>
<td>Process management</td>
<td>10</td>
</tr>
<tr>
<td>3.</td>
<td>Storage Management</td>
<td>10</td>
</tr>
<tr>
<td>4.</td>
<td>I/O Systems</td>
<td>08</td>
</tr>
<tr>
<td>5.</td>
<td>Distributed Systems</td>
<td>10</td>
</tr>
<tr>
<td>6.</td>
<td>Protection &amp; Security</td>
<td>08</td>
</tr>
<tr>
<td>7.</td>
<td>Case Studies</td>
<td>06</td>
</tr>
</tbody>
</table>

Lectures = 60  
Practical/Tutorials = 60  
Total = 120

Detailed Syllabus

1. Overview  
   08 Hrs.

   Services: User Interface Services, Graphics and Multimedia Services, Messaging and Collaboration, Network basics, Web Services


2. Process Management  
   10 Hrs.

   CPU Scheduling: Scheduling Criteria, Scheduling Algorithms, Multiple Processor Scheduling, Real Time Scheduling, Algorithms Evaluation, Thread Scheduling, System Jobs.

Deadlocks: Deadlock Characterization, Methods for Handling Deadlocks, Deadlock Prevention, Deadlock Avoidance, Deadlock Deletion, Recovery from Deadlock, Combined approach to Deadlock Handling.

3. Storage Management  
Memory management: Logical versus Physical Address Space Swapping, Contiguous Allocation, paging, Segmentation, Segmentation with paging.

Virtual memory: Demand Paging, Performance of Demand paging, Page Replacement Algorithms, Thrashing, Demand Segmentation.


4. I/O Systems  

Secondary Storage Structure: Disk Structure, Disk Scheduling, Disk management, Swap-Space management, Disk Reliability, Stable Storage Implementation.


5. Distributed Systems  


Distributed Coordination: Event Ordering, Mutual Exclusion, Atomicity, Concurrency Control, Deadlock Handling, Election Algorithms, Reaching Agreement.

6. Protection & Security  


7. Case Studies 06 Hrs.
RECOMMENDED BOOKS

MAIN READING


SUPPLEMENTARY READING


Note: For all modules explanation must carry case study of either UNIX family or Windows family or both and the last module then can be covered with features of the case study studied throughout.

(*) Latest edition of the books need to be procured.
C0-R4.B2: OPERATING SYSTEM

Model Question Paper

NOTE:
1. Answer question 1 and any FOUR questions from 2 to 7.
2. Parts of the same question should be answered together and in the same sequence.

TOTAL TIME: 3 HOURS  TOTAL MARKS: 100

1. (a) How can one distinguish between Processes, Threads and Jobs ?
(b) What is a software interrupt?
(c) What is a virtual memory space? How is it different from a physical memory space?
(d) Distinguish between Partitions, Volumes and Multi-Partition Volumes..
(e) What does Process Virtualization do? What security threat does it address ?
(f) Briefly discuss one of the ways of implementing memory protection using special hardware support.
(g) Differentiate between Symmetric and Asymmetric multiprocessing.

(7 x 4)

2. (a) Describe in brief, the different attributes associated with any file in a typical computer system along with the relevance/usefulness of each of these attributes.
(b) What is Hypervisor? Define the two types of Hypervisor. Give Examples of each type.
(c) How does Bitlocker ensure OS integrity and encrypt files in the hard drive.

(6+8+4)

3. Assume that a producer is producing non zero integers £ 1000 and putting them in a circular buffer of size 100, while the consumer is consuming the non zero integers contained in that circular buffer at its own speed. Using counting and binary semaphores, write the outline of the producer process and the consumer process.

(18)

4. (a) Explain the basic differences between a security/protection policy and protection mechanism as existing in any contemporary computer system.
(b) Explain the Application level filtering feature of Windows firewall .
(c) What is a password? Why is it used? Describe the various types of password validation techniques as used in any computer system.

(4+6+8)

5. Consider a hypothetical computer system having the following CPU scheduling features.
   It has gopt 3 (three) priority levels 1,2 & 3 with 1 being the highest and 3 being the lowest. It supports a multilevel preemptive scheduling policy having the features mentioned below:

<table>
<thead>
<tr>
<th>Priority level</th>
<th>Allotted Time Quantum</th>
<th>% CPU time allotted</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(in units)</td>
<td></td>
</tr>
</tbody>
</table>

(4+6+8)
Context switching time among jobs/processes having same priority = 2 units.
Context switching time from one priority level to another = 5 units.
Dispatcher execution time = 5 units (fixed)

Time Quantum allotted/job excludes the time taken by the dispatcher as well as the context switching time.
Jobs/Processes are services in a Round Robin fashion.

Before servicing the very first job, one needs to execute the dispatcher and perform a context switch i.e., no job can possess a zero waiting time.
If any job finishes well within its allotted time quantum the remaining part of that time quantum is not allotted to any other job rather a context switch takes place.

For the previously mentioned computer system having the aforesaid scheduling policy, the following job mix/processes is required to be serviced.

<table>
<thead>
<tr>
<th>Process/Job</th>
<th>Service time</th>
<th>Priority</th>
<th>Arrival time</th>
</tr>
</thead>
<tbody>
<tr>
<td>P₀</td>
<td>20</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>P₁</td>
<td>15</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>P₂</td>
<td>25</td>
<td>2</td>
<td>8</td>
</tr>
<tr>
<td>P₃</td>
<td>30</td>
<td>3</td>
<td>10</td>
</tr>
<tr>
<td>P₄</td>
<td>12</td>
<td>1</td>
<td>15</td>
</tr>
<tr>
<td>P₅</td>
<td>40</td>
<td>3</td>
<td>20</td>
</tr>
<tr>
<td>P₆</td>
<td>18</td>
<td>2</td>
<td>22</td>
</tr>
<tr>
<td>P₇</td>
<td>24</td>
<td>1</td>
<td>30</td>
</tr>
</tbody>
</table>

(a) Specify the queue status at each priority level.
(b) Specify the Gantt chart for the given job mix.
(c) From the Gantt chart compute the turnaround time as well as waiting time for each process.

(5+10+3)

6. Consider the following specifications about the physical and virtual spaces as existing in a computer system.
   - Physical space = 64K words out of which 16K is occupied by the resident operating system. Remaining portion is available to accommodate user process.
   - Physical space is divided into 2K word size frames.
   - Virtual space for user 1 = 256K words.
- Virtual space for user 2 = 512K words.
- Both the users share a common 8K word Library, which is required at all time by both the users.

(a) Specify the address layout of the following, clearly highlighting each field:
   i. Virtual address of user 1
   ii. Virtual address for user 2
   iii. Address of library
   iv. Physical Address

(b) How many Page Map Table (PMT) entries will be needed for user 1, user 2 & Library? Clearly justify your answer.

(c) Specify in detail a typical PMT entry assuming the following features of each page.

- Each page has got an associated modify bit which helps to identify whether the corresponding frame has been written into and hence needed to be written back to the virtual space during any page replacement.
- A use bit indicating whether the page has been accessed recently.
- Access permission bits signifying the following modes of access.
   i. READ
   ii. WRITE
   iii. EXECUTE

(d) Assuming that the library needs to be present at all time in memory and the system has a TLB Cache that can contain maximum 16 entries, how many user pages can be referred from TLB? Justify your answer.

\[ (8+2+5+3) \]

7.
(a) State the necessary conditions for a deadlock to occur with examples.
(b) Explain the Kernel Structure in UNIX. Discuss with examples the Directory entry attributes and Inode table Attributes in detail.
(c) Consider the following process and resource map.

- The system has got 4 (four) concurrently non-shareable and reusable resources with following unit allocation/resource.

<table>
<thead>
<tr>
<th>Resource</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>R_0</td>
<td>8</td>
</tr>
<tr>
<td>R_1</td>
<td>5</td>
</tr>
<tr>
<td>R_2</td>
<td>9</td>
</tr>
<tr>
<td>R_3</td>
<td>7</td>
</tr>
</tbody>
</table>

- There are 5 (five) processes in the system P_0………P_4 having the following maximum resource requirements.

<table>
<thead>
<tr>
<th>Process</th>
<th>R_0</th>
<th>R_1</th>
<th>R_2</th>
<th>R_3</th>
</tr>
</thead>
<tbody>
<tr>
<td>P_0</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>P_1</td>
<td>0</td>
<td>2</td>
<td>5</td>
<td>2</td>
</tr>
<tr>
<td>P_2</td>
<td>5</td>
<td>1</td>
<td>0</td>
<td>5</td>
</tr>
</tbody>
</table>
Applying banker’s algorithm, show that

i) The following is a safe Allocation State

<table>
<thead>
<tr>
<th>Process</th>
<th>R0</th>
<th>R1</th>
<th>R2</th>
<th>R3</th>
</tr>
</thead>
<tbody>
<tr>
<td>P_0</td>
<td>2</td>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>P_1</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>P_2</td>
<td>4</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>P_3</td>
<td>0</td>
<td>2</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>P_4</td>
<td>1</td>
<td>0</td>
<td>3</td>
<td>0</td>
</tr>
</tbody>
</table>

ii) The following is an unsafe Allocation State

<table>
<thead>
<tr>
<th>Process</th>
<th>R0</th>
<th>R1</th>
<th>R2</th>
<th>R3</th>
</tr>
</thead>
<tbody>
<tr>
<td>P_0</td>
<td>2</td>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>P_1</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>P_2</td>
<td>4</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>P_3</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>P_4</td>
<td>1</td>
<td>0</td>
<td>3</td>
<td>0</td>
</tr>
</tbody>
</table>

(5+5+8)
Objective of the Course

The course emphasizes programming methodology, procedural abstraction, and in-depth study of algorithms, data structures, and data abstractions. It also aims to introduce basic data types, data structures, types of data structures - Linear and Non-Linear data structure, representation of stack, queue and linked list; complexity and efficiency of various types of sorting and searching techniques; applications of data structures

At the end of the course, the student will understand:

- Data Structure.
- Analysis techniques.
- Linear data Structure like array, stack, queue and linked list.
- Non-linear data structure like tree and graphs.
- Sorting and Searching methods

Outline of Course

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Topic</th>
<th>Minimum number of hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Introduction</td>
<td>04</td>
</tr>
<tr>
<td>2.</td>
<td>Introduction to Object Oriented Programming</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>and Java</td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>Performance Analysis Techniques</td>
<td>05</td>
</tr>
<tr>
<td>4.</td>
<td>Elementary Data Structures</td>
<td>10</td>
</tr>
<tr>
<td>5.</td>
<td>Recursion</td>
<td>04</td>
</tr>
<tr>
<td>6.</td>
<td>Trees</td>
<td>04</td>
</tr>
<tr>
<td>7.</td>
<td>Graphs</td>
<td>04</td>
</tr>
<tr>
<td>8.</td>
<td>Strings</td>
<td>04</td>
</tr>
<tr>
<td>9.</td>
<td>Sorting and Searching Methods</td>
<td>10</td>
</tr>
</tbody>
</table>

Lectures = 60
Practical/Tutorials = 60
Total = 120

Detailed Syllabus

1. Introduction 04 Hrs.
Algorithms, Data Structures, Summation Formulas and properties, Sets, Relations, Functions, Graphs, Trees, Counting, Probability Concepts

2. Introduction to Object Oriented Programming and Java 15 Hrs.
Object-Oriented Design Principles, Encapsulation, Inheritance, Polymorphism, Basic goals and concepts of Java, Programming Skills, Xtreme Programming, debugging, testing, Application of OO concepts.

3. Performance Analysis Techniques 05 Hrs.
4. Elementary Data Structures 10 Hrs.
Introduction of Stack, Queue and Linked List, Application of Stacks and Queue, Representation of Queue and its types, Representation of Linked List and its types, Priority Queue, Implementing Objects, Java Code for Linked List, Stack, Queue.

5. Recursion 04 Hrs.
Characteristic of recursive Methods, Efficiency of Recursive methods, Tower of Hanoi Example, Java code for Tower of Hanoi, Eliminating Recursion, Applications of Recursion.

6. Trees 04 Hrs.
The Tree Abstract Data Type, Basic Algorithms on Trees, Types of trees and algorithms, Binary Search Tree, Red Black Tree, B-Tree, AVL Trees, Java Code for Binary Search Tree, Red Black Tree, B-Tree and AVL Tree

7. Graphs 04 Hrs.
The Graph Abstract Data Type, Data Structures for Graphs, Graph Traversal: BFS and DFS of Directed and Undirected Graph, Connected Components, Spanning Trees, Bi-connected Components and DFS. Java Code for DFS and BFS.

8. Strings 04 Hrs.
The String Abstract Data Type, Brute-Force String Pattern Matching, Regular Expression Pattern Matching, Tries.

9. Sorting and Searching Methods 10 Hrs.
Introduction to Sorting Techniques: Insertion Sort, Selection Sort, Bubble Sort, Heap Sort, Quick Sort, Merge Sort, Radix Sort, Analysis of Efficiency and Complexity of Sorting of various cases (Best, Average and Worst); implementation via Java programs.
RECOMMENDED BOOKS (*)

MAIN READING


SUPPLEMENTARY READING


(*) Latest edition of the books need to be procured.
1. Answer question 1 and any FOUR questions from 2 to 7.
2. Parts of the same question should be answered together and in the same sequence.

TOTAL TIME: 3 HOURS TOTAL MARKS: 100

1. 
a) What is data structure? Why do we need data structure? Give classification of data structure.
b) What are the applications of linked list?
c) State Whether the given statement is True or False with Justification.
   It is impossible to implement recursion without using stack-like data structure.
d) Explain how 3-dimensional array is stored in memory?
e) Explain following terms:
   (a) isolated node
   (b) Complete binary tree
   (c) weighted graph
   (d) input restricted deque
f) Discuss the factors, which affect different sorting methods.
g) Explain threaded binary tree.
(7X4)

2. 
a) Write an algorithm for conversion of general tree into binary tree & trace with the following example.

b) Explain how circular queue is advantageous as compared to simple queue? Write an algorithm to insert and delete an element in a circular queue.
c) What is algorithm analysis? Explain how it is done? Also explain Big-oh notation.
(7+8+3)

3. 
a) Perform DFS traversal of the following graph. Whenever the algorithm has a choice, assume that the node that comes earlier in the alphabet is considered first.
b) Write an algorithm for push and pop operation of stack.

c) Write a C program for following string operations:
   1. In a given text T, replace all occurrences of pattern P1 by a pattern P2, i.e. replace (T,P1,P2)
   2. In a given text T, delete all occurrences of pattern P1, i.e. (T,P)

4. a) Construct an Expression tree for following data and write the inorder, preorder and postorder of it.
   i) \(a + b - c / d * e / f - g\)

   b) What is Hashing? Explain mid-square hashing and division remainder hashing giving suitable example.

   c) Describe sequential storage allocation and linked storage allocation. Compare them and give advantages and disadvantages of each.

5. a) Explain Priority Queue.

   b) Write a recursive and non-recursive program for finding factorial of a given number. Which one is better? Why?

   c) Write a C program for linked list that performs following operations:
      (a) Insert a node at the end of the linked list.
      (b) Delete a node before specified position.
      (c) Insert a node such that linked list is in ascending order (according to information field)

6. a) Given input { 4371, 1323, 6173, 4199, 4344, 9679, 1989 } and a hash function \(h(X) = X \text{mod} 10\), show the result:
   1. Separate chaining hash table.
   2. Open addressing hash table using linear probing.
   3. Open addressing hash table using Quadratic probing.
   4. Open addressing hash table with second hash function \(h_2(x) = 7 - (x \text{mod} 7)\)

   b) Answer the following questions with reference to the given tree:

   1. Write an adjacency matrix A for the graph.
   2. Find \(A^2\) from the adjacency matrix A.
   3. What is the in degree, out degree and total degree of the v1 node?
c) Discuss the behavior of Quick Sort method depending upon initial order of data.

7. 
   a) Insert the following keys in an AVL tree and show the rotations, wherever required. A, V, L, T, R, E, I, S, O, K.
   b) Write a program for searching an element using binary search method.
   c) Write an algorithm for Radix sort method. Trace the algorithm on following data: 11, 60, 100, 20, 30, 50, 80, 75, 65, 55, 23, 32.
Objective of the Course

This course aims to introduce basic and fundamental knowledge of computer architecture, bus organization, and memory organization.

At the end of the course, the student will understand:

- Assemble the computer.
- Develop the hardwired or micro-programmed ALU and CU.

Outline of Course

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Topic</th>
<th>Minimum number of hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Introduction to Computer Arithmetic</td>
<td>08</td>
</tr>
<tr>
<td>2.</td>
<td>Register Transfer language</td>
<td>06</td>
</tr>
<tr>
<td>3.</td>
<td>Instruction Set Design</td>
<td>12</td>
</tr>
<tr>
<td>4.</td>
<td>Pipelining</td>
<td>06</td>
</tr>
<tr>
<td>5.</td>
<td>Programming the Basic Computer</td>
<td>06</td>
</tr>
<tr>
<td>6.</td>
<td>I/O Fundamentals</td>
<td>08</td>
</tr>
<tr>
<td>7.</td>
<td>Memory Organization</td>
<td>08</td>
</tr>
<tr>
<td>8.</td>
<td>Multiprocessor and Multiple Computers</td>
<td>06</td>
</tr>
</tbody>
</table>

Lectures = 60
Practical/Tutorials = 60
Total = 120

Detailed Syllabus

1. Introduction to Computer Arithmetic  08 Hrs.
Decimal Representation, Complements, Fixed point representation, Addition, Subtraction with Signed- magnitude, Signed 2’s Complement method, Booth Multiplication Algorithm, Array Multiplier, Division Algorithm, hardware Implementation, Floating Point Arithmetic operations.

2. Register Transfer Language  06 Hrs.
Register Transfer, Bus and Memory transfer, Arithmetic Micro operations, Logic Micro operations, Shift Micro operations, Arithmetic logic and shift

3. Instruction Set Design  12 Hrs.
Assembly/machine language, Von Neumann machine cycle, Microprogramming/firmware, Memory addressing, Classifying instruction set architectures, Computer Registers, General Registers Organization, Computer Instructions, Timing and control, Instruction Cycle, Memory Reference Instructions, Input-output and interrupt, Instruction Format, Addressing modes, Data transfer and manipulation, program Control, RISC and CISC.

4. Pipelining  06 Hrs.
General considerations, Comparison of pipelined and nonpipelined computers, Instruction and arithmetic pipelines – examples, Structural hazards and data dependencies, Branch delay and multicycle instructions, Superscalar computers.

5. Programming the Basic Computer  06 Hrs.
Introduction to Machine Language, Assembly language, Program loops, Programming arithmetic and logic operations, Subroutines, Input-output programming.

6. I/O Fundamentals 08 Hrs.
Typical I/O devices, Programmed I/O, Peripherals Devices, Input-Output Interface, Asynchronous Data Transfer, Modes of transfer, Priority Interrupt, DMA, I/O Processor, CPU-IOP Communication, Serial Communication, Interrupts and DMA, I/O bus operation, TRAP instruction, Role of OS.

7. Memory Organization 08 Hrs.
Memory Hierarchy, Main memory, Auxiliary Memory, Associative memory, Cache memory, Virtual Memory, Memory management hardware, Case study of PC architecture and hardware, bias and interrupts, DMA control, Different types of bus, ISA, EISA.

8. Multiprocessor and Multiple Computers 06 Hrs.
SISD, SIMD and MIMD architectures, Centralized and distributed shared memory-architectures.
RECOMMENDED BOOKS (*)

MAIN READING


SUPPLEMENTARY READING

5. Cook and White, “Computer Peripherals”, Edward Arnold

(*) Latest edition of the books need to be procured.
1. Answer question 1 and any FOUR questions from 2 to 7.
2. Parts of the same question should be answered together and in the same sequence.

NOTE:

TOTAL TIME: 3 HOURS          TOTAL MARKS: 100

1. 
   a) What are the differences between RISC and CISC architecture?
   b) An 8-bit register contains the binary value 11010101. What is the register value after each operation of arithmetic shift left, arithmetic shift right, logical shift left and circular shift right?
   c) How many AND gates and address are required for the multiplication of b4, b3, b2, b1 (Multiplicand) and a4, a3, a2, a1 (Multiplicand) using array multiplier?
   d) What are the differences between Centralized and distributed shared memory architecture?
   e) What are the differences between serial communication and parallel communication?
   f) Define following terms
      1) Micro-Operation
      2) Three State Gate
      3) Effective Address
      4) Instruction Code
   g) What are the different types of Memory available? Write down advantages and disadvantages of all types of Memory.

(7x4)

2. 
   a) What are essential features of associative memory? Explain how a memory address is mapped into cache memory address using set associative mapped cache. The main memory is 64K words. The cache has words with block size of 128 words.
   b) Hazard refers to the possibility of erroneous computation when a CPU tries to simultaneously execute multiple instructions. Give solution to solve data hazard in pipeline processor.
   c) Explain following Architecture and give example of each.
      1) SISD
      2) SIMD
      3) MIMD

(6+6+6)

3. 
   a) What is subroutine? How stack is useful in execution of the subroutine?
   b) DMA is used to transfer data between memory and I/O Device with interrupting CPU. Draw logical circuit diagram of DMA controller and explain working of it.
   c) Write an assembly program to multiply two unsigned positive numbers, each with 16 significant bits to produce unsigned double precision product.

(3+10+5)

4. 
   a) List and explain different types of addressing modes used to design general purpose computer.
   b) Write an assembly program to subtract two double precision numbers.
5.
a) Write a short note on Interrupt.
b) Explain Instruction pipelining with suitable example.
c) Write the basic computer instruction format. Describe memory reference instructions; register reference instructions and Input-Output Instructions.

6.
a) Wire algorithm of Booth multiplication. Show step by step multiplication process of
   Multiplier: 15
   Multiplicand: 10
b) Design the combinational circuit for common bus system for four bit register using multiplexer.

7.
a) Draw hardwired implementation for signed magnitude addition and subtraction.
b) An instruction cycle is the sequence of actions that the central processing unit (CPU) performs to execute each machine code instruction in a program. Explain phases of execution of instruction.
c) By taking suitable example, write different ways of presenting floating numbers.
Objective of the Course

Computer Graphics is becoming increasingly important for data visualization, video games, animated movies, image based rendering, flight simulators, CAD-CAM, reconstruction of 3D medical data from 2D slices, Terrain visualization in Geographical Information Systems, and a host of other simulation situations.

Outline of Course

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Topic</th>
<th>Minimum number of hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Basic Background</td>
<td>07</td>
</tr>
<tr>
<td>2.</td>
<td>3D Viewing</td>
<td>07</td>
</tr>
<tr>
<td>3.</td>
<td>Representing Curves and Surfaces</td>
<td>10</td>
</tr>
<tr>
<td>4.</td>
<td>Solid Modeling</td>
<td>06</td>
</tr>
<tr>
<td>5.</td>
<td>Visible Surface Determination</td>
<td>10</td>
</tr>
<tr>
<td>6.</td>
<td>Illumination models &amp; Rendering</td>
<td>09</td>
</tr>
<tr>
<td>7.</td>
<td>Color Models</td>
<td>06</td>
</tr>
<tr>
<td>8.</td>
<td>Introduction to Animation</td>
<td>05</td>
</tr>
</tbody>
</table>

Lectures = 60
Practical/Tutorials = 60
Total = 120

Detailed Syllabus

1. Basic Background 07 Hrs.
Two Dimensional Geometric Transformations.
Clipping: Point clipping, Line clipping, Polygon clipping, Text clipping, Logical Classification of input devices, Different input modes, Interactive picture-construction techniques, Three Dimensional Geometric Transformations.

2 3D Viewing 07 Hrs.
Viewing pipeline, Viewing coordinates, Parallel and Perspective Projections, View volumes and Projection transformations, Clipping.

3. Representing Curves and Surfaces 10 Hrs.
Polygon Meshes: Representing polygon Meshes, Consistency of polygon-mesh representations, Plane equations.
Parametric Cubic Curves: Hermite curves, Bezier curves, Uniform nonrational B-splines, Subdividing Curves, Drawing curves, Comparison of the cubic curves, Parametric Bicubic surfaces.

4. Solid Modeling 06 Hrs.
Representation of Solids, Primitive Instancing, Sweep representations, Boundary representations, Spatial-partitioning representations, Constructive solid geometry methods, Octrees, Binary, Space Partitioning trees.

5. Visual Surface Determination 10 Hrs.

6. Illumination Models and Surface-Rendering Methods 09 Hrs.

7. Color Models 06 Hrs.
Properties of light, Intuitive color concepts, RGB color model, YIQ color model, CMY color model, HSV color model, Conversion between HSV and RGB models, HLS color model.

8. Introduction to Animation 05 Hrs.
Introduction, Methods of controlling Animation, basic rules of Animation, Problems peculiar to animation, Raster animations, Computer-Animation languages, Key-frame systems, Motion specifications.
RECOMMENDED BOOKS

MAIN READING


SUPPLEMENTARY READING


(*) Latest edition of the books need to be procured.
1. Answer question 1 and any FOUR questions from 2 to 7.
2. Parts of the same question should be answered together and in the same sequence.

1. 
   a) Distinguish between Gouraud and Phong’s method of shading.
   b) How OpenGL can be used in implementation of graphics application
   c) Which are the applications of Computer Graphics? Explain in a brief.
   d) Explain Multimedia system and multimedia server.
   e) Explain true curve generation algorithm.
   f) Describe briefly ray tracing technique for rendering an object.
   g) What is morphing? How morphing can be implemented in computer graphics?

2. 
   a) Write down the properties of Bezier curve.
   b) Compare RGB, HVS, and CMY color model.
   c) Explain z-buffer algorithm for hidden-surface removal.

3. 
   a) What is parallel projection? Explain the types of parallel projection.
   b) Write a short note on 3D clipping.
   c) Derive the transformation matrix for scaling an object by a scaling factor s in a direction defined by the directional angles a, b and c.

4. 
   a) Determine the Bezier blending functions for five control points. Plot each function and label the maximum and minimum values.
   b) Why a cubic form is chosen for representing curves?
   c) Explain the painter’s algorithm for hidden surface removal. Why painter’s algorithm is a priority algorithm?

5. 
   a) Write a program to shear an object with respect to any of the three coordinate axes, using input values for the shearing parameters.
   b) What are the advantages in storing color codes in lookup table? Describe the content of color table.
   c) Determine the blending functions for uniform, periodic B-spline curves for d = 6.

6. 
   a) Modify the two-dimensional Liang-Barsky line clipping algorithm to clip three-dimensional lines against a specified regular parallelepiped.
   b) Develop a procedure, based on a back-face detection technique, for identifying all the visible faces of a convex polyhedron that has different-colored surfaces. Assume that the object is defined in a right-handed viewing system with the xy-plane as the viewing surface.
   c) Design a storyboard layout and accompanying key frames for an animation of a single
7.

a) Describe in brief the following viewing parameters. What role do they play in 3D viewing process?
   1. Video reference point
   2. Line of sight
   3. Clipping planes

b) Explain the following terms in brief:
   1. Specular reflection
   2. Diffused reflection
   3. Point-Source Illumination

c) Compare Bezier and B-spline functions for generating curves and discuss the properties of each.
C2-R4: ADVANCED COMPUTER NETWORKS

Objective of the Course

The course aims to impart knowledge about advanced techniques used in analysis, modeling, design and operation of modern computer networks. Internet has grown phenomenally over past several decades and has posed new challenges in view of new service demands. The course addresses the issues concerning the above.

The course builds on the basics covered in the introductory course on computer/data networks and provides in-depth understanding of topics of seminal and current interests. It allowed students to build sufficient expertise to design local and wide area network protocols and acquire skills to conduct R & D in computer networks.

Outline of Course

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Topic</th>
<th>Minimum number of hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Networking Concepts</td>
<td>06</td>
</tr>
<tr>
<td>2.</td>
<td>Performance Models</td>
<td>10</td>
</tr>
<tr>
<td>3.</td>
<td>Multiple Access Networks</td>
<td>06</td>
</tr>
<tr>
<td>4.</td>
<td>Cell Relay and Asynchronous Transfer Mode</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>(ATM)</td>
<td></td>
</tr>
<tr>
<td>5.</td>
<td>IP Networks</td>
<td>07</td>
</tr>
<tr>
<td>6.</td>
<td>Multicast and Internetworking</td>
<td>07</td>
</tr>
<tr>
<td>7.</td>
<td>End-to-End Protocols</td>
<td>07</td>
</tr>
<tr>
<td>8.</td>
<td>Multimedia Networking</td>
<td>07</td>
</tr>
</tbody>
</table>

Lectures = 60
Practical/Tutorials = 60
Total = 120

Detailed Syllabus

1. Networking Concepts 06 Hrs.

2. Performance Models 10 Hrs.
Queueing Systems-M/M/S/K’ Queues, Burke’s Theorem, M/G/1 Queues, Delay in synchronous and asynchronous time-division multiplexing.

Network of Queues: Jackson’s Theorem, Closed Queuing Networks.

3. Multiple Access Networks 06 Hrs.

5. IP Networks 07 Hrs.

6. Multicast and Internetworking 07 Hrs.
The Multicast Backbone (MBONE), Link State Multicast, Distance Vector Multicast, Reverse Path Broadcast, Reverse Path Multicast (RPM), Protocol Independent Multicast (PIM), Multiprotocol Label switching (MPLS)-Destination Based Forwarding, Explicit Routing, Virtual Private Networks (VPNs) and Tunnels.

7. End-to-End Protocols 07 Hrs.

8. Multimedia Networking 07 Hrs.
Requirements on Internet. Streaming Audio and Video – Access through Web Server, Real-Time Streaming Protocol (RTSP). Voice over IP (VoIP) and Internet Phone-Packet Loss, End-to-End Delay, Delay Jitter, Fixed and Adaptive Play-out, RTP, RTCP and SIP protocols
RECOMMENDED BOOKS

MAIN READING


SUPPLEMENTARY READING


(*) Latest edition of the books need to be procured.
1. Answer question 1 and any FOUR questions from 2 to 7.
   Parts of the same question should be answered together and in the same sequence.

TOTAL TIME: 3 HOURS  TOTAL MARKS: 100

1. a) Give the differences between TDMA and CDMA.
   b) What are issues of Packet-Delay in Voice over IP?
   c) What are the Limitations of Traditional Fixed Capacity Networks?
   d) Explain concepts of Cards and Decks in designing of programs in WAP.
   e) What are the applications of wireless subscriber loop?
   f) How EDGE technology is emerged from GSM?
   g) What are the applications of Mobile IP?

   (7 X 4)

2. a) Wireless Application Protocol is an open international standard for application-layer network communications in a wireless-communication environment. What are the protocol elements of WAP?
    b) What are the technical features of GSM?
    c) In Mobile IP, when any mobile host moves from one region to another region deregistration and registration process occurs. Explain the registration process and role played by each entity in Mobile IP.

   (6+6+6)

3. a) Write a short note on: Various Configuration models of Voice over IP.
    b) Remote procedure call (RPC) is an Inter-process communication technology that allows a computer program to cause a subroutine or procedure to execute in another computer. Explain mechanism of RPC.

   (10+8)

4. a) What are IPv4 and TCP performance issues? And also write Limitations of current generation TCP and IPv4.
    b) What are the features of IPv6 as compared to IPv4?
    c) Explain Following Terms:
       1) In band Congestion Method
       2) Congestion Control
       3) Flow Control
       4) Throughput

   (5+5+8)

5. a) Describe various Types of AALS.
    b) What are the radio propagation issues to implement Mobile IP?
    c) Explain functions of following entities
       1) Home Agent
       2) Foreign Agent
       3) Mobile Agent

   (5+4+9)
6.  
   a) How multicasting differs from unicasting and broadcasting?  
   b) IPv6 is a new version of IP which is designed to be an evolutionary step from IPv4. What are the changes required in ICMP and DNS to support IPv6 protocol.  
   c) MPLS makes it easy to create "virtual links" between distant nodes. How virtual links are made and maintained in MPLS?  

7.  
   a) What are the two types of ATM cell format and explain functions of each field of cell format.  
   b) What are the challenges of MBONE routing?  
   c) Why there is need for Mobile IP? What are the design issues for developing Mobile IP concept?
C3-R4: MATHEMATICAL METHODS FOR COMPUTING

Objective of the Course

The aim of the course is to provide grounding in analytical frameworks and tools which are becoming increasingly important and useful in research and development in the area of computer science. Probabilistic approaches and optimization methods are required to analyze problems in almost all areas, viz Mobile/wireless network, analysis of algorithms, AI, Image processing, Machine learning, communication network etc. Thus, knowledge of these techniques has become necessary for design and analysis of computational models of these systems. The first part of course provides a comprehensive foundation of the theory of probability and information theory and stochastic processes. The second part deals with optimization methods for solving various real life problems. This course will thus equip students with analytical approaches required to pursue research in emerging areas of computer science.

Outline of Course

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Topic</th>
<th>Minimum number of hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Probability and Information Theory</td>
<td>12</td>
</tr>
<tr>
<td>2.</td>
<td>Stochastic Processes</td>
<td>12</td>
</tr>
<tr>
<td>3.</td>
<td>Queueing Theory and Performance Evaluation</td>
<td>12</td>
</tr>
<tr>
<td>4.</td>
<td>Optimization</td>
<td>14</td>
</tr>
<tr>
<td>5.</td>
<td>Laplace and Fourier Transforms</td>
<td>10</td>
</tr>
</tbody>
</table>

Lectures = 60
Practical/Tutorials = 60
Total = 120

Detailed Syllabus

1. Probability and Information theory 12 Hrs.

2. Stochastic Processes 12 Hrs.

   The M/M/1 Queueing System, State dependent M/M/1 Queueing System, M/M/1/N : Finite buffer case, M/M/∞ Queueing system: Infinite number of servers, The M/G/1 Queueing system, Network of Queues, Open networks and Closed networks.
4. Optimization  
Modeling with linear programming, Simplex Method, Dual Problem, Integer Linear programming [Branch and bound algorithm], Deterministic dynamic programming [forward and backward recursions], Introduction to nonlinear programming Karush-Kuhn-Tucker (KKT) condition.

5. Laplace and Fourier Transforms  
RECOMMENDED BOOKS

MAIN READING


SUPPLEMENTARY READING


(*) Latest edition of the books need to be procured.
1. Answer question 1 and any FOUR questions from 2 to 7.
2. Parts of the same question should be answered together and in the same sequence.

TOTAL TIME: 3 HOURS
TOTAL MARKS: 100

1. a) An infinite sequence of independent trials is to be performed. Each trial results in a success with probability $p$ and a failure with probability $1-p$. What is the probability that
   i. At least one success occurs in the first $n$ trials;
   ii. Exactly $k$ success occur in the first $n$ trials;
   iii. All trials result in success.

b) The joint density function of $X$ and $Y$ is given by
   
   $f(x, y) = \begin{cases} 
   2e^{-x}e^{-2y} & 0 < x < \infty, 0 < y < \infty \\
   0 & \text{otherwise}
   \end{cases}$

Compute
   (i) $P(X<Y)$  
   (ii) $P(X<a)$

c) For an M/M/1/N queuing system, calculate the blocking probability when $N=5$ and $\lambda/\mu=1$

d) The transition probability matrix of a four-state Markov Chain is
   
   $P = \begin{bmatrix}
   0.7 & 0 & 0.3 & 0 \\
   0.5 & 0 & 0.5 & 0 \\
   0 & 0.4 & 0 & 0.6 \\
   0 & 0.2 & 0 & 0.8
   \end{bmatrix}$

Obtain two-step transition probability matrix.

e) Consider the following optimization probability
   
   maximize $x_2 - x_1$
   subject to $3x_1 = x_2 - 5$
   $|x_2| \leq 2$
   $x_1 \leq 0$

Convert the problem into a standard form linear programming problem.

f) Show that the relative error in Hit or Miss Monte Carlo methods is $O(n^{-1/2})$

g) If $X$ can taken on any of $n$ possible values with respective probabilities $P_1, P_2, P_n$; prove that the entropy $H(X)$ is maximized when $p_i=1/n$, $i=1,2,3,\ldots,n$. What is $H(X)$ equal to in this case?

(7x4)

2.
a) In the open queuing network, the routing probability are shown on the diagram. Obtain throughputs $\varphi_1$ and $\varphi_2$. Calculate the joint probability distribution of numbers in the queuing system.

![Diagram of queuing network with rates $\lambda$, $\mu_1$, and $\mu_2$ and routing probabilities 3/4, 1/4, and 1/2.]

b) Is the following table realizable for a finite buffer state-independent M/M/1 system? Why or why not?

<table>
<thead>
<tr>
<th>n</th>
<th>P(n)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0.4</td>
</tr>
<tr>
<td>1</td>
<td>0.3</td>
</tr>
<tr>
<td>2</td>
<td>0.2</td>
</tr>
<tr>
<td>3</td>
<td>0.1</td>
</tr>
<tr>
<td>≥4</td>
<td>0.0</td>
</tr>
</tbody>
</table>


(9+9)

3.

a) Two experiments, X and Y, are given. The sample space with regard to X consists of $x_1$, $x_2$, and $x_3$, that of Y consists of $y_1$, $y_2$ and $y_3$. Then joint probabilities $r(x_i, y_j) = r_{ij}$ are given in the following matrix $R$:

- $P \{ X_1 = 1 | X_0 = 2 \}$
- $P \{ X_2 = 2 | X_1 = 1 \}$
- $P \{ X_2 = 2, X_1 = 1 | X_0 = 2 \}$
- $P \{ X_3 = 1, X_2 = 2, X_1 = 1 | X_0 = 2 \}$

i. How much information do you receive if someone tells you the outcome resulting from X and Y?
ii. How much information do you receive if someone tells you the outcome of Y?
iii. How much information do you receive if someone tells you the outcome of X, while you already knew outcome of Y?

b) Verify that the relationship

$$H(P_1, P_2, P_3, \ldots, P_N) = H(P_1 + P_2, P_3, \ldots, P_N) + \left( \frac{P_1}{P_1 + P_2} \right) H\left( \frac{P_2}{P_1 + P_2}, \frac{P_2}{P_1 + P_2} \right)$$

Is satisfied by the entropy function for a random variable with three possible outcomes, $H(P_1, P_2, P_3)$.

c) Is the following code uniquely decipherable?

- $x_1$ 010  $x_3$ 0110  $x_5$ 0011  $x_7$ 11110
- $x_2$ 0001  $x_4$ 1100  $x_6$ 00110  $x_8$ 101011

If not, construct an ambiguous sequence.

(6+6+6)

4.

C Level R4  53
a) Consider the process \( X(t) = A \cos \omega t + B \sin \omega t \)
where \( A \) and \( B \) are uncorrelated random variables each with mean 0 and variance 1 and \( \omega \) is a positive constant. Is the process a covariance stationary?

b) Let \( \{X_n, n \geq 0\} \) be a Markov chain with three states 0, 1, 2 and with transition matrix
\[
\begin{pmatrix}
3/4 & 1/4 & 0 \\
1/4 & 1/2 & 1/4 \\
0 & 3/4 & 1/4
\end{pmatrix}
\]
and the initial distribution \( P(X_0=i) = 1/3, i=0,1,2. \)
Obtain
\[
P\{X_1 = 1 | X_0 = 2\}, \ P\{X_2 = 2 | X_1 = 1\}, \ P\{X_2 = 2, X_1 = 1 | X_0 = 2\}
\]
\[
P\{X_2 = 2, X_1 = 1, X_0 = 2\}, \ P\{X_3 = 1, X_2 = 2, X_1 = 1, X_0 = 2\}
\]

5.

a) Find the Fourier transform of
\[
f(x) = \begin{cases} 
k & \text{if } 0 < x < a \\
0 & \text{otherwise}
\end{cases}
\]
b) Solve the integral equation
\[
y(t) = t + \int_0^t y(\tau) \sin(t - \tau) \, d\tau
\]

6.

a) Let \( X \) be uniformly distributed an (0.1). Show that \( Y = -\lambda^{-1} \ln(1-x) \) has an exponential distribution with parameter \( \lambda > 0. \)

b) The joint density of \( X \) and \( Y \) is given by
\[
f(x, y) = \begin{cases} 
e^{-(-x+y)} & \text{if } 0 < x < \infty, \ 0 < y < \infty \\
0 & \text{otherwise}
\end{cases}
\]
Find the density of the random variable \( X/Y. \)

c) Present a method to simulate a random variable having distribution function
\[
f(x, y) = \begin{cases} 
0 & x \leq -3 \\
\frac{1}{2} + \frac{x}{6} & -3 < x < 0 \\
\frac{1}{2} + \frac{x^2}{32} & 0 < x \leq 4 \\
1 & x > 4
\end{cases}
\]

7.

a) Consider the problem:
Minimize $z = x_1^2 + x_2^2 + x_3^2$

subject to

$4x_1 + 2x_2 + 2x_3 - 14 = 0$

b) Consider the following minimization problem:

Minimize $f(x) = x_1^2 + x_2^2 + x_3^2$

subject to

$g_1(X) = 2x_1 + x_2 - 5 \leq 0$
$g_2(X) = x_1 + x_3 - 2 \leq 0$
$g_3(X) = 1 - x_1 \leq 0$
$g_4(X) = 2 - x_2 \leq 0$
$g_5(X) = -x_3 \leq 0$

Obtain Kuhn-Tucker Conditions.
Objective of the Course

This course aims to introduce theoretical analysis of various types of algorithms, Design of efficient algorithms for a variety of problems, with mathematical proof of correctness and analysis of time and space requirements, Create data structure and algorithms to solve the problem, Prove algorithm’s work and examine the properties of algorithms like simplicity, running time, space, to check the efficiency as a function of its input size, how long does it take? Space efficiency as a function of its input size, to review mathematical background, to check how parallel algorithms work, to study various techniques like dynamic, randomization etc, to prove algorithm’s correctness, to determine its resource usage, topics include lower bounds for sorting and medians, analysis of advanced data structures, graph algorithms (strongly connected components, shortest paths, minimum spanning trees, maximum flows and bipartite matching), and NP-Completeness.

At the end of the course the student will understand
- The methods of analyzing various types of algorithms.
- Efficiency of algorithms as a function of its input size in terms of both time and memory.
- Properties of algorithms
- Effective and efficient exploration of advanced data structures to be used in algorithms.

Outline of Course

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Topic</th>
<th>Minimum number of hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Introduction</td>
<td>06</td>
</tr>
<tr>
<td>2.</td>
<td>Greedy Algorithms</td>
<td>06</td>
</tr>
<tr>
<td>3.</td>
<td>Divide &amp; Conquer Algorithms</td>
<td>06</td>
</tr>
<tr>
<td>4.</td>
<td>Dynamic Programming Algorithms</td>
<td>06</td>
</tr>
<tr>
<td>5.</td>
<td>Amortized Analysis</td>
<td>04</td>
</tr>
<tr>
<td>6.</td>
<td>Graph Algorithms</td>
<td>08</td>
</tr>
<tr>
<td>7.</td>
<td>String Matching</td>
<td>06</td>
</tr>
<tr>
<td>8.</td>
<td>Sorting</td>
<td>06</td>
</tr>
<tr>
<td>9.</td>
<td>Computational Complexity</td>
<td>06</td>
</tr>
<tr>
<td>10.</td>
<td>Approximate Algorithms</td>
<td>06</td>
</tr>
</tbody>
</table>

Lectures = 60
Practical/Tutorials = 60
Total = 120

Detailed Syllabus

1. Introduction 06 Hrs.
Mathematics for Algorithmic, Sets, Functions and Relations, Vectors and Matrices, Linear Inequalities and Linear Equations, Review of basic concepts; Worst case and average case analysis: big oh; small oh, omega and theta notations, Solving recurrence equations.

2. Greedy Algorithms 06 Hrs.
Knapsack Problem, 0-I Knapsack, Fractional Knapsack, Activity Selection Problem, Huffman’s Codes, Minimum Spanning Tree, Kruskal’s Algorithm, Prim’s Algorithm, Dijkstra’s Algorithm.
3. Divide & Conquer Algorithms 06 Hrs.
Multiplying large integers, Binary Search, Finding Median, Quick Sort and Matrix Multiplication.

4. Dynamic Programming Algorithms 06 Hrs.
Making Change, Principle of optimality, Knapsack Problem, Shortest Path, Matrix Chain Multiplication, Activity Selection Problem DP Solution.

5. Amortized Analysis 04 Hrs.
Aggregate Method, Accounting Method, Potential Method, Dynamic Table.

6. Graph Algorithms 08 Hrs.
Breadth First Search (BFS), Depth First Search (DFS), Branch and Bound, Topological Sort, Strongly Connected Components, Euler Tour, Generic Minimum Spanning Tree, Bellman-Ford Algorithm, Matching, Incremental Design, Closest pair problem.

7. String Matching 06 Hrs.
Naïve String Matching, Knuth-Morris-Pratt Algorithm, Boyer-Moore Algorithm, Applications in Bioinformatics.

8. Sorting 06 Hrs.
Bubble Sort, Insertion Sort, Selection Sort, Shell Sort, faster Methods-Tree, Heap Sort, Merge Sort, Quick Sort, Linear-Timer Sorting-Counting (Enumeration) Sort, Radix Sort, Bucket Sort.

9. Computational Complexity 06 Hrs.
Information-Theoretic Argument, Adversary Argument, P and NP, NP-Completeness and Reduction, Primality tests, Quadratic residues, Applications to cryptography, Lower bound theory, Information theoretic bounds, Adversary arguments and NP completeness.

10. Approximate Algorithms 06 Hrs.
RECOMMENDED BOOKS (*)

MAIN READING


SUPPLEMENTARY READING


(*) Latest edition of the books need to be procured.
C4-R4: ADVANCED ALGORITHMS

Model Question Paper

NOTE:

1. Answer question 1 and any FOUR questions from 2 to 7.
2. Parts of the same question should be answered together and in the same sequence.

TOTAL TIME: 3 HOURS
TOTAL MARKS: 100

1. 
   a) Define Time Complexity of an algorithm. What is the time-complexity of tractable problem?
   b) What is the main advantage of backtracking? How do we achieve this?
   c) Is a recursive algorithm less efficient compared to an iterative one? Why or why not?
   d) Give an example where the choice of data structure has a bearing on the performance of the algorithm.
   e) What are the possible causes if a program hangs up, aborts, terminates without proper output, and produces the garbage? What is your action?
   f) Give the worst-case no. of moves required to solve Tower of Hanoi problem using recursion for given n rings and three rods.
   g) Give the worst-case Time complexity of finding if there exist a cycle in the directed graph of n nodes and edges.

   (7x4)

2. 
   a) Design an efficient algorithm to decide whether a given undirected graph G(V,E) contains a cycle of length L.
   b) What do you mean by backtracking? How it differs from Branch & Bound?
   c) What is amortized analysis? Give the usefulness of it. Give the various types of it using examples.
   d) What is the major difference between dynamic programming and greedy strategies?

   (6+4+4+4)

3. 
   a) Is dynamic programming a Top-Down or a Bottom-Up technique? Why? Explain with an example.
   b) Develop an algorithm and a recursive function to calculate the GCD of two integers a and b.
   c) Can we say that Divide and Conquer strategy is inherently recursive? Why?

   (6+8+4)

4. 
   a) Give the Kruskal’s algorithm for Minimum Spanning Tree and compare it with Prim’s algorithm.
   b) Is there any NP hard problem, which is also NP? If yes give example. If no why?
   c) Write the nondeterministic algorithm to solve knapsack problem.
   d) Give an algorithm to find the longest monotonically increasing subsequence of a sequence of n number? Give the worst case Time complexity.

   (5+5+4+4)

5. 
   a) If a problem can be split using Divide and Conquer strategy in almost equal portions at each stage, then it is a good candidate for recursive implementation, but if it cannot be
so divided in equal portions, then it is better to be implemented iteratively. Can we have a general statement like this? Explain with example.

b) Explain how N-Queen problem can be solved using backtracking.
c) Construct the recurrence for finding the nth Fibonacci number and solve it.
d) What are the issues that govern or influence the choice of either adjacency matrix or an adjacency list for storage of graphs?

6.
a) There is a method known for calculating n! with time complexity of n log₂ n. Can we use that method for solving Traveling Salesman Problem with the same time-complexity instead of n! Explain.
b) Given a finite set of distinct coin types, say 50, 20, 10, 5, 2, 1 pcs, and an integer amount C. Each type is available in unlimited quantity. Write an algorithm to find the exact change with minimum no. of coins. What strategy will you use?
c) Write down the parenthesized equation and number of multiplications required to get Z so that multiplication in this way cost least number of multiplication.
   A = 9×7; B = 7×10; C = 10×6; D = 6×15; E = 15×9

7.
a) Give names of all sorting algorithms you know of which use the Divide and Conquer strategy? Can you name any sorting algorithm that uses Greedy Strategy?
b) Differentiate between Greedy, Dynamic Programming and Divide and Conquer Problem.
c) What do you mean by polynomial time complexity and logarithmic complexity? Which one is higher?
Objective of the Course

Data warehousing and data mining are the essential components of decision support systems for the modern day industry and business. These techniques enable the knowledge worker (analysis, manager, executive) to make better and faster decisions. The objective of this course is to introduce the student to various Data Warehousing and Data Mining concepts and Techniques. A database perspective has to be used throughout the course to introduce principles, algorithm, architecture, design and implementation of data mining and data warehousing techniques.

Outline of Course

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Topic</th>
<th>Minimum number of hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Introduction and Background</td>
<td>03</td>
</tr>
<tr>
<td>2.</td>
<td>Data Preprocessing</td>
<td>08</td>
</tr>
<tr>
<td>3.</td>
<td>Data Warehousing and OLAP Technology</td>
<td>08</td>
</tr>
<tr>
<td>4.</td>
<td>Data Cube computation and Data Generalization</td>
<td>08</td>
</tr>
<tr>
<td>5.</td>
<td>Mining frequent patterns, associations and correlations</td>
<td>08</td>
</tr>
<tr>
<td>6.</td>
<td>Classifications and Predictions</td>
<td>08</td>
</tr>
<tr>
<td>7.</td>
<td>Cluster Analysis</td>
<td>08</td>
</tr>
<tr>
<td>8.</td>
<td>Mining streams Time series and sequence data</td>
<td>06</td>
</tr>
<tr>
<td>9.</td>
<td>Applications of Data Warehousing and Data Mining</td>
<td>03</td>
</tr>
</tbody>
</table>

Lectures = 60  
Practical/Tutorials = 60  
Total = 120

Detailed Syllabus

1. Introduction and Background  03 Hrs.
An introduction to multidisciplinary filed of data mining. Discussion on the evolutionary path of database technology that has led to the need for data warehousing and data mining, different kind of data on which data mining applied, classification of data mining system, Major issues in Data miming. Stress on important of its application potential.

2. Data Pre-processing  08 Hrs.
Why preprocess the data?, descriptive data summarization, .Data cleaning, data integration and transformation, data reduction, and data discretization and concept hierarchy generation.

3. Data warehousing and OLAP Technology  08 Hrs.
Data warehouse, multi dimensional model, Data Warehouse Architecture and implementation, OLAP overview and OLAP operators, Data cube constructions.

4. Data Cube Computation and Data Generalization  08 Hrs.
Efficient methods for data cube computation – A road map for materialization of different kinds of cube, multi way array aggregation for full cube computation, Computing iceberg queries from
apex cuboids, star cubing, pre-computing shell fragments for fast high dimensional OLAP and computing cubes with complex iceberg conditions

Data Generalization and Summarization based characterization: Attribute Oriented Induction (AOI) – Efficient implementation of AOI, Analytical Characterization, Mining class comparison: Discriminating between Different classes, Mining Descriptive Measures in Large database.

5. Mining frequent Patterns, Associations and Correlations 08 Hrs.
Basic concepts and a road map for Association rule mining, efficient and scalable frequent itemset mining methods, mining various kinds of association rules, from association mining to correlation analysis, constraint based association rule mining.

6. Classification and Predictions 08 Hrs.

7. Cluster Analysis 08 Hrs.
Types of data in cluster analysis, Partition based Clustering, Hierarchical Clustering, Density based Clustering, Grid based Clustering, Model based Clustering, Discussion on scalability of clustering algorithm, Outlier analysis, Parallel approaches to clustering and outlier analysis

8. Mining Stream, Time Series and Sequence Data 06 Hrs.
Mining data streams, mining time-series data, mining sequence patterns in transactional databases and mining sequence patterns in biological data

9. Application of Data Warehousing and Data Mining 03 Hrs.
Exploration of web sites on data warehousing and data mining application including bibliography databases, Corporate Houses and Research labs.
Use of data mining packages and data warehousing packages, e.g. SAS, IBM, excel miner tools.
RECOMMENDED BOOKS (*)

MAIN READING

1. Jiawei Han and Micheline Kamber, “Data Mining Concepts and Techniques”, second edition, 2006.
2. Margaret Dunham, “Data Mining: Introductory and Advanced Topics”, Prentice Hall India

SUPPLEMENTARY READING

2. S.M. Weiss and N Indurkhya, “Predictive Data Mining”, Morgan Kaufmann Publishers

(*) Latest edition of the books need to be procured.
1. Elaborate the major operating components, which are regularly monitored in data warehouse environment. What are the major features that differentiate OLTP from OLAP?

b) What are cuboids? Use example to illustrate its use in data warehouse implementation. Briefly explain drill-up and drill-down Analysis.

c) From the architecture point of view what are the three data warehouse models?

d) Briefly describe any two methods to generate concept hierarchy.

e) Explain the difference between Star schema and Fact constellation schema in terms of their usage.

f) Give the significance and relationship between the terms - Associative Rule, support, and confidence in data mining.

g) For what purpose Data Cube Aggregation and Dimensionality Reduction strategies are used.

(7x4)

2. Define data cleaning. Explain the basic methods for data cleaning.

b) What is a data cube? The weather bureau has about 10,000 probes which are scattered throughout various land and sea locations across the country to collect data such as air pressure and temperature at each hour. All the data have to be stored at a central office of the bureau. Give a 4-D view clearly mentioning the dimensions of the data collected at the central office.

c) Define a data warehouse elaborating its key features. How do the organizations benefit from it?

d) What is a data cube measure? List the categories of measures based on the kind of aggregate functions used in computing a data cube.

(6+4+4+4)

3. For a company x, min_sup=10%, min_conf is 75%, while for another company y min_sup is 20% & min_conf is 60%, for which of the two companies, the rule a => b is more strong? Why?

b) Outline major ideas of naive Bayesian classification.

c) Briefly explain the criteria to compare any two classification methods.

(10+4+4)

4. What should be the similarity measure in cluster analysis? Why is scaling important for clustering?

a) Briefly describe the three problems with naturally evolving architecture.

b) Can a quantitative characterization rule and a quantitative discriminant rule be expressed together in the form of the rule? Justify.

d) Define k-itemset. Explain the join and prune steps and the terminating condition of Apriori algorithm.
5. List out requirement of clustering in data mining.
   a) Briefly describe each type of CH with example.
   c) Explain the algorithm for inducing a decision tree from training samples. Why is tree pruning useful in decision tree induction?
   d) Where Attribute Relevance Analysis is used? How does the information gain calculation works? How entropy based method is related to it? Explain in detail.

6. a) Consider the following data.
    
    | A   | B  | ~B |
    |-----|----|----|
    | 200 | 45 |    |
    | 50  | 150|    |

    Find correlation between A and B.
   b) Give an example of how specific clustering method may be integrated with the other concepts in data mining.
   c) Differentiate: precision & sensitivity.

7. a) Differentiate between supervised & unsupervised learning. How can the accuracy of the classifiers be increased?
   b) Write down the steps of AOI. Write down two common approaches to control generalization process.
   c) What is MLP? How does MLP work? What are the parameters required to set for this?
LAB I: GRAPHICS AND VISUALISATION

Sample Practical List

1. Display/Draw bar Chart to indicate the population of the different states of India.

2. Display/Draw the following face unfilled and filled, using line drawing and circle drawing functions.

3. Display/Draw the following picture unfilled and filled, using line drawing and circle drawing functions.

4. To create Bezier curves using four control points. The program should run for ten different sets of control points.

5. To clip a polygon using Sutherland-Hodgeman Algorithm.

6. To perform one point perspective projection of a cube, with origin as one of the corner points, onto the Z=0 plane with centre of projection on +ve Z axis.

7. To generate Coon’s Bicubic Surface.

8. To implement Z-Buffer algorithm for handling visible surface problem.

9. To map any set of RGB values into corresponding HSV values and conversely.

Note: These are suggested Assignments. Teachers may use these assignments as reference guide. Teachers are encouraged to innovate keeping in view with the current technologies.
LAB II: DATA NETWORK AND MANAGEMENT

Sample Practical List

1. Create a computer for studying M/M/K queues using the following steps.
   (a) Write a program to simulate poisson arrivals.
   (b) Write a program to generate packets with their lengths distributed exponentially.
   (c) Write a program for computing total average queue length, waiting delay and total average delay for traffic intensities in the range of 0.1 to 0.9 using 1, 2 and 3 servers. Display the characteristics in all the above cases.

2. Write a program to simulate.
   (a) Simplex stop-and-wait protocol at data link layer when the channel is error-free.
   (b) Repeat (a) when the channel is error prone (choose an appropriate probability of error in transmission of a bit).
   (c) Repeat (a) when the channel is a satellite link (delay of the order of 250 ms).
   (d) Modify the program to implement 3-bit and 7-bit sliding window protocols for ©, and compare results with (c).

3. Simulate continuous-state leaky bucket algorithm for ATM traffic. Vary the input traffic rate nominally (say +(-) 10%) to create traffic bursts and then check conformance and obtain sustainable cell rate.

4. Simulate pure and slotted Aloha protocols for per packet time load ranging from 0 to 5. Simulation should show load-throughput and delay-throughput characteristics. Use poisson distributed input and geometrically distributed retransmission probability.

5. Take an 8-port hub and connect 8 computers. Input standard Ethernet traffic and measure the throughput for a large range of input load.

6. Simulate standard IEEE 802.5 token ring protocol showing all the events. It should display throughput, delay and priority operations.

7. Simulate the following scenario.
   Create a mesh network of six or more nodes which are not fully connected. The link capacities (cost) should be variable. Then implement shortest cost routing for each node pair. Now input the traffic using poisson arrivals with exponentially distributed service time. Output of the simulator should show delay per link and overall average delay per packet for varying input traffic and varying per packet service time.

8. Implement subnet masking on an emulated IP network by using the IP addressing scheme. Also implement IP packet fragmentation and show its effect on the network performance.
9. Study the operation of interconnecting devices viz. repeater, hub, router and gateway.

10. Write a program to simulate a transport protocol. It should include the following events.
    (a) Opening and closing of transport connections including 3-way handshake.
    (b) Dynamic buffer management using credit mechanism.
    (c) Should be able to demonstrate deadlock condition.

11. Using slow start algorithm in TCP write a program to show its congestion avoidance behaviour. Vary RTT over wide range and use Jacobson’s algorithm to improve the performance.

12. Capture a voice segment and then carry out data compression. Input the compressed data in a simulator for voice over IP (VOIP). The VOIP simulator should be created to generate small packets from voice segments, varying queuing and transmission delays for each packet in the IP network (total delay in the range of 120-200 ms) and up to 5% random packet loss. At the receiver, reassemble IP packets and apply decompression and play out the voice segment. Compare it with the original voice segment. Also study the effect of receiver buffer depth.

Note: These are suggested Assignments. Teachers may use these assignments as reference guide. Teachers are encouraged to innovate keeping in view with the current technologies.
C6-R4: MULTIMEDIA SYSTEMS

Objective of the Course

Multimedia systems are concerned with the capture, storage and presentation of information in a variety of forms, including text, image, video and sounds. Such systems are becoming widespread in modern computing due to the rapid emergence of cheap multimedia technology. The aim of this course is to enable students appreciate the capabilities and limitations of this technology and the implication for future applications. The course will give students concise and consistent view on multimedia theory and practice with the emphasis on the applications in the virtual environment.

The learning outcomes expected out of this course are:
- To develop understanding of the fundamental principles of speech, image and video capture, compression and decompression
- To demonstrate an understanding of the methods involved in the design of multimedia systems and their applications
- To develop an understanding about features of virtual reality systems
- To demonstrate an understanding of the future directions of multimedia systems development

Outline of Course

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Topic</th>
<th>Minimum number of hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Introduction</td>
<td>08</td>
</tr>
<tr>
<td>2.</td>
<td>Compression of Multimedia data</td>
<td>12</td>
</tr>
<tr>
<td>3.</td>
<td>Multimedia Systems</td>
<td>08</td>
</tr>
<tr>
<td>4.</td>
<td>Delivery of Multimedia Data</td>
<td>08</td>
</tr>
<tr>
<td>5.</td>
<td>Multimedia Information Management</td>
<td>08</td>
</tr>
<tr>
<td>6.</td>
<td>Multimedia Programming Tagging (SMIL)</td>
<td>02</td>
</tr>
<tr>
<td>7.</td>
<td>Introduction to MIDI (Musical Instrument Digital Interface)</td>
<td>02</td>
</tr>
<tr>
<td>8.</td>
<td>Virtual Reality</td>
<td>12</td>
</tr>
</tbody>
</table>

Lectures = 60
Practical/Tutorials = 60
Total = 120

Detailed Syllabus

1. **Introduction** 08 Hrs.
   Concept of Temporal and Non-Temporal Data, Basic Characteristic of Non-Temporal Media; Images, Graphics, Text, Basic characteristic of Temporal Media; Video, audio and animation, Hypertext and Hypermedia, Presentation: Synchronization, Events, Scripts and Interactivity. Introduction to Authoring Systems.

2. **Compression of Multimedia Data** 12 Hrs.
Audio Compression; Introduction to Speech and Audio Compression, MP3 Compression Scheme.
Compression of Synthetic Graphic Objects

3. Multimedia Systems
General Purpose Architecture for Multimedia Support:
Introduction to Multimedia PC/ Workstation Architecture, Characteristics of MMX instruction set,
I/O System: Overview of USB port and IEEE 1394 interface,
Operating System Support for Multimedia Data:
Resource Scheduling with real-time considerations, File System, I/O Device Management

4. Delivery of Multimedia Data
Network and Transport Protocols for Multimedia Data
QoS issues, RTP and RSVP
Video-conferencing and video-conferencing standards
Overview of Voice/ Video over IP

5. Multimedia Information Management
Multimedia Database Design
Content Based Information Retrieval: Image Retrieval, Video Retrieval, Overview of MPEG-7,
Design of Video- On Demand Systems

6. Multimedia Programming Tagging (SMIL)
Introduction to SMIL, Running SMIL applications, SMIL Authoring.

7. Introduction to MIDI (Musical Instrument Digital Interface)
Components of MIDI, Hardware Aspects to MIDI, MIDI Messages, General MIDI, Digital Audio and MIDI

8. Virtual Reality
Introduction to Virtual Reality and Virtual Reality Systems
Related Technologies: Tele-operation and Augmented Reality Systems
Interface to the Virtual World- Input: Head and hand trackers, data globes, haptic input devices
Interface to the virtual world- Output: Stereo display, head-mounted displays, auto-stereoscopic displays, holographic displays, haptic and force feedback
VRML Programming; Modeling objects and virtual environments
Domain Dependent applications: Medical, Visualization, Entertainment etc.
RECOMMENDED BOOKS (*)

MAIN READING

1. Ralf Steinmetz and Liara Nahrstedt, “Multimedia: Computing, Communications & Applications”, Pearson Education

SUPPLEMENTARY READING


(*) Latest edition of the books need to be procured.
C6-R4: MULTIMEDIA SYSTEMS

Model Question Paper

NOTE:

1. Answer question 1 and any FOUR questions from 2 to 7.
2. Parts of the same question should be answered together and in the same sequence.

TOTAL TIME: 3 HOURS  TOTAL MARKS: 100

1. a) Mention four approaches to providing Quality of Services in high-speed network for multimedia.
   b) Explain time-domain sampled representation of sound.
   c) Explain how speech recognition can be implemented in computer application?
   d) Explain JPEG-DCT encoding and quantization.
   e) Write a short note on Real Time RPC.
   f) Which are the advantages of compression?
   g) Write down the advantages of Multimedia system in computer applications.

   (7x4)

2. a) Describe the role of multimedia standards.
   b) Which are the challenges for developing multimedia system?
   c) Describe multimedia authoring system.

   (3+8+7)

3. a) Explain HDTV standard.
   b) Explain Media Stream Protocol.
   c) Explain video compression techniques.

   (6+5+7)

4. a) Which are the limitations in workstation operating system for multimedia application? Describe all.
   b) Write a short note on Virtual Device.
   c) What is the need to measure performance of video? Which are the various parameters of display can be used for measuring performance?

   (7+3+8)

5. a) Describe the structure of the encoder for MPEG layers 1 and 2.
   b) Write a short note on Color balance error.
   c) Explain different modes of interchange in architecture of multimedia computer system.

   (8+3+7)

6. a) Write a short note on multimedia tool kit.
   b) Explain the following terms:
      1. Aspect ratio
      2. Vertical Retrace
      3. Resolution
      4. Sync
   c) Describe the architecture of MPEG.

   (5+8+5)
7.
   a) Write down the characteristic of Multimedia System Services.
   b) Explain how MIDI files are created and their roles are in multimedia system.
   c) Describe the data modeling for hypermedia information.

(6+6+6)
C7-R4: DIGITAL IMAGE PROCESSING & COMPUTER VISION

Objective of the Course

This course presents the theory and practice of digital image processing with Mathematical and focuses on the Digital Image Processing package. The features and capabilities of the package are demonstrated, and numerous examples and practical hands-on exercises are included. The material is presented as a sequence of eight one-hour lectures. Each lecture covers a major image processing topic, typically consisting of a discussion of the basic theoretical concepts and including examples that illustrate relevant, practical imaging problems. The lectures are followed by exercise sessions to help attendees understand the material and to provide a focused and practical learning experience.

Outline of Course

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Topic</th>
<th>Minimum number of hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Introduction to Image Processing &amp; Computer Vision</td>
<td>07</td>
</tr>
<tr>
<td>2.</td>
<td>Image Formation</td>
<td>05</td>
</tr>
<tr>
<td>3.</td>
<td>Image Enhancement &amp; Restoration</td>
<td>10</td>
</tr>
<tr>
<td>4.</td>
<td>Color Image Processing</td>
<td>05</td>
</tr>
<tr>
<td>5.</td>
<td>Wavelets and Multi resolution processing</td>
<td>06</td>
</tr>
<tr>
<td>6.</td>
<td>Image Compression</td>
<td>05</td>
</tr>
<tr>
<td>7.</td>
<td>Edge and Boundary Detection</td>
<td>04</td>
</tr>
<tr>
<td>8.</td>
<td>Morphological Image Processing</td>
<td>06</td>
</tr>
<tr>
<td>9.</td>
<td>Motion Estimation, Detection &amp; Tracking</td>
<td>06</td>
</tr>
<tr>
<td>10.</td>
<td>Shape Representation and Reconstruction</td>
<td>06</td>
</tr>
</tbody>
</table>

Lectures = 60  
Practical/Tutorials = 60  
Total = 120

Detailed Syllabus

1. Introduction to Image Processing & Computer Vision 07 Hrs.
   Fundamentals, Purpose, Application, Image processing system components, image sensing & Acquisition, sampling & Quantization. Neighbors of a pixel adjacency connectivity, regions & boundaries, Distance Measures, stereo vision.

2. Image Formation 05 Hrs.
   Monocular imaging system, Orthographic & Perspective Projection, Camera model and Camera calibration, stereo and multi view geometry, Binocular imaging systems.

3. Image Enhancement & Restoration 10 Hrs.
4. Colour Image Processing 05 Hrs.
Colour models, pseudocolour, image processing, colour transformation, segmentation.

5. Wavelets and Multi resolution Processing 06 Hrs.
Image pyramids, subband coding, Harr transform, multi resolution expansions, discrete and continuous wavelet transforms

6. Image Compression 05 Hrs.
Fundamentals, Basic compression methods – Huffman, Arithmetic, LZW, run length coding schemes, Error free & Lossy compression, Standards: JPEG, JBIG

7. Edge and Boundary Detection 04 Hrs.
Edge detection, boundary detection, edge detection performance, boundary detection performance.

8. Morphological Image Processing 06 Hrs.
Erosion and dilation, opening and closing, boundary extraction, hole filling.

9. Motion Estimation, Detection & Tracking 06 Hrs.
Regularization theory, optical computation, Motion estimation, Structure from motion.

10. Shape Representation & Reconstruction 06 Hrs.
Deformable curves and surfaces, Snakes and active contours, Level set representations, Fourier and wavelet descriptors, Medial representations, Multiresolution analysis.
RECOMMENDED BOOKS (*)

MAIN READING


SUPPLEMENTARY READING


(*) Latest edition of the books need to be procured.
C LEVEL R4  77

C7-R4: DIGITAL IMAGE PROCESSING AND COMPUTER VISION

Model Question Paper

NOTE:

1. Answer question 1 and any FOUR questions from 2 to 7.
2. Parts of the same question should be answered together and in the same sequence.

TOTAL TIME: 3 HOURS TOTAL MARKS: 100

1.
   a) Define Image Segmentation. Explain any one method of image segmentation.
   b) Describe HIT-or-MISS Transformation.
   c) What is meant by a band limited function?
   d) Explain edge detection using laplacian operator.
   e) Define luminance (intensity) and contrast.
   f) Write down the steps to inverse the image using Discrete Fourier Transform.
   g) Explain Image Enhancement by Arithmetic and Logic Operation. (7x4)

2.
   a) Prove the following properties of Fourier transform of 2-D sequences.
      1. Separability
      2. Spatial correlation
      3. Shifting
   b) Give the general orthogonal series expansion of an N×N image. Identify the image transform from the expansion. When the transformation is called unitary?
   c) Find the impulse response of the reconstruction filter and find the expression of the signal reconstructed from the samples. (6+6+6)

3.
   b) Briefly Explain Application of Fuzzy Logic in Pattern Analysis.
   c) Describe Spatial resolution & Gray level-Resolution. Also show how image content are affected with change of both. (6+6+6)

4.
   a) Explain Un-sharp Masking & High Boost Filtering.
   b) Compare RGB, CMYK and HIS color models.
   c) Define point spread function and region of support. When is a system said to be FIR or IIR? (6+6+6)

5.
   a) Impulse response of an imaging system is given as
      \[ h(x,y) = 2 \sin^2[p(x-x_0)] / [p(x-x_0)]^2 \sin^2[p(y-y_0)] / [p(y-y_0)]^2. \] Find its frequency response, OTF and MTF.
   b) Calculate \( D_4 \) distance, \( D_9 \) distance and \( D_m \) distance for pixels in square. Find the connected component for each if possible & give minimum path length. Set \( V=\{3\} \)
6. 
a) Explain the basic transformations: translation, scaling, rotation, concatenation and inverse transformation.
b) Using perspective transformation and assuming the world coordinate system is aligned with the camera coordinate system, derive expression for x, y, z.

7. 
a) Explain median filtering. How does the size of the window affect the filtered output?
b) Show that DFT of two dimensional circular convolution of two arrays is the product of their DFTs.
c) Explain in detail the elements of Digital Image Processing systems.
C8-R4: INFORMATION SECURITY

Objective of the Course

This course aims to introduce students to some of the basic ideas of number theory, and to apply some basic techniques of number theory to cryptography. The module will introduce and illustrate different methods of proof in the context of elementary number theory. To familiarizes the students with the principles of symmetric cryptography, and methods of cryptanalysis, with particular emphasis on the design and deployment of computer-based block ciphers. To equip the student with a background in elementary number theory, and to cover some basic methods of public key cryptography.

The learning outcomes expected out of this course are:

- Understand the basics of modular arithmetic
- State and prove Fermat's little Theorem & its generalisation using Euler's function & use them to implement the RSA cipher.
- Understand proofs of some theorems in the Number Theory.
- Implement and break simple substitution ciphers and the Vigenere cipher
- Provide historical background to cryptography
- Understand strength and weaknesses of different encryption algorithms.
- Various attacks on encryption schemes
- Hash Functions
- Public-key Cryptography
- Integrity and Digital Signature

Outline of Course

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Topic</th>
<th>Minimum number of hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Introduction to cryptography</td>
<td>06</td>
</tr>
<tr>
<td>2.</td>
<td>Mathematics of Cryptography</td>
<td>04</td>
</tr>
<tr>
<td>3.</td>
<td>Introduction to Number Theory</td>
<td>06</td>
</tr>
<tr>
<td>4.</td>
<td>Conventional Encryption</td>
<td>08</td>
</tr>
<tr>
<td>5.</td>
<td>Pseudo-random Number Generators (PRNGs)</td>
<td>08</td>
</tr>
<tr>
<td>6.</td>
<td>Hash Functions and MAC</td>
<td>10</td>
</tr>
<tr>
<td>7.</td>
<td>Key Establishment and Public-key Cryptography</td>
<td>10</td>
</tr>
<tr>
<td>8.</td>
<td>Integrity and Digital Signature</td>
<td>08</td>
</tr>
</tbody>
</table>

Lectures = 60
Practical/Tutorials = 60
Total = 120

Detailed Syllabus

1. Introduction to Cryptography 06 Hrs.
Terminology, Security Aspects, Attack Models, Classical Cryptography, Shift Cipher, Substitution Cipher, Vigenere Cipher, Basic Cryptanalysis

2. Mathematics of Cryptography 04 Hrs.
Groups, Rings, and Fields, Integer Arithmetic, Modular Arithmetic, The Euclidean Algorithm, Finite Fields of The Form GF(p), Polynomial Arithmetic, Finite Fields Of the Form GF(2^n), Linear Congruence

3. **Introduction to Number Theory** 06 Hrs.

4. **Conventional Encryption** 08 Hrs.
Attacks on Encryption Schemes, Perfect Security, Cipher Machines, Modes of Operation (ECB, CBC, CFB, OFB), Multiple Encryption, DES, Triple-DES, AES, RC4 Stream Cipher, Attacks on DES.

5. **Pseudo-random Number Generators (PRNGs)** 08 Hrs.
Random and Pseudorandom Numbers, Next-bit Test, Removing Biases, ANSI X9.17 Generator Blum-Blum-Shub Generator, Statistical Tests.

6. **Hash Functions and MAC** 10 Hrs.

7. **Key Establishment and Public-key Cryptography** 10 Hrs.

8. **Integrity and Digital Signature** 08 Hrs.
Message Integrity, Digital Signature, Authentication Protocol, Digital Signature Standards, Attacks on Digital Signature, Variation and Applications
RECOMMENDED BOOKS (*)

MAIN READING


(*) Latest edition of the books need to be procured.
C8-R4: INFORMATION SECURITY

Model Question Paper

NOTE:

1. Answer question 1 and any FOUR questions from 2 to 7.
2. Parts of the same question should be answered together and in the same sequence.

TOTAL TIME: 3 HOURS TOTAL MARKS: 100

1. a) How many keys are required for two people to communicate via a cipher? Explain with an example.
    b) How does the Discrete algorithm work and computes the power of integers for the module 19?
    c) What requirements must a public-key cryptosystem fulfill to be a secure algorithm?
    d) What are the two different uses of public key cryptography related to key distribution?
    e) What is the difference between direct and arbitrared digital signature?
    f) Explain the principal of public key cryptography and show how it differs from conventional and classical technique.
    g) What type of information might be derived from a traffic analysis attack?

(7X4)

2. a) What are the requirements for secure use of conventional encryption? Explain the model of conventional cryptosystem.
    b) When a combination of symmetric key encryption and an error control code is used for message authentication, in what order must the two functions be performed? Justify with an example.
    c) What are the three tests used in evaluating a random number generator?

(6+9+3)

3. a) Which parameters and design choices determine the actual algorithm of a Fiestel Cipher?
    b) What is differential cryptanalysis attack? How is it different from linear cryptanalysis attack?
    c) What is the difference between statistical randomness and unpredictability?

(9+4+5)

4. a) If a bit error occurs in the transmission of a cipher text character in 8 bit CFB mode, how far does error propagate?
    b) Explain Modular arithmetic and show the Arithmetic operations of Modular operations.
    c) Using Extended Euclid’s algorithm, find multiplicative inverse of 550 mod 1769

(7+7+4)

5. a) What is the difference between an unconditionally secure cipher and a computationally secure cipher?
    b) In public key system using RSA, you intercept the ciphertext C=10 sent to a user whose public key is e=5, n=35. What is the plaintext M?
    c) Identify the attacks in context of communication across the network and show how basic usages of MD for dealing with any one of attack.

(3+8+7)
6.  
   a) What is the need of Digital Signatures? / Discuss the requirements of digital Signature. What are problem associated with Direct Digital Signature? 
   b) Justify the requirement of Authentication and explain the Message Authentication using one of the Authentication techniques with example. 
   c) What are the two basic functions used in encryption algorithm? 

7.  
   a) List out types of Attach on Encrypted messages also explain how the Average Time required Exhaustive Key search affected by key size. 
   b) What is purpose Chinese Reminder algorithm and where in security algorithm it is used 
   c) Explain how Secrecy and authentication can be achieved using Public-key Cryptosystem
C9-R4: SOFT COMPUTING

Objective of the Course

Soft computing uses soft computational techniques in machine learning and artificial intelligence to study and model complex phenomena where classical hard computing techniques have not yielded complete solutions. The purpose of this course is to introduce to the students the general topics and techniques of soft computing and learning. It will focus on some of the classic soft computing topics, such as fuzzy logic, neural networks and their hybridizations, some concepts of optimization and regression.

At the end of the course the student will understand:

- Fundamentals of soft computing
- Neural network concept.
- Fuzzy logic
- Hybridization of neural network and fuzzy logic
- Fundamentals of Optimization and regression

Outline of Course

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Topic</th>
<th>Minimum number of hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Introduction to Soft Computing</td>
<td>06</td>
</tr>
<tr>
<td>2.</td>
<td>Introduction to Genetic Algorithm</td>
<td>06</td>
</tr>
<tr>
<td>3.</td>
<td>Genetic Modeling</td>
<td>08</td>
</tr>
<tr>
<td>4.</td>
<td>Regression and Optimization</td>
<td>08</td>
</tr>
<tr>
<td>5.</td>
<td>Neuro-Fuzzy Modeling</td>
<td>08</td>
</tr>
<tr>
<td>6.</td>
<td>Advances Neuro-Fuzzy Modeling</td>
<td>08</td>
</tr>
<tr>
<td>7.</td>
<td>Neuro-Fuzzy Control</td>
<td>08</td>
</tr>
<tr>
<td>8.</td>
<td>Other Hybrid System</td>
<td>08</td>
</tr>
<tr>
<td></td>
<td>Lectures</td>
<td>= 60</td>
</tr>
<tr>
<td></td>
<td>Practical/Tutorials</td>
<td>= 60</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>= 120</td>
</tr>
</tbody>
</table>

Detailed Syllabus

1. **Introduction to Soft Computing**  
   06 Hrs.  

2. **Introduction to Genetic Algorithm**  
   06 Hrs.  
   Introduction to Genetic Algorithms - Definition of GA - Description of Terminology/Vocabulary of GA - Importance and Goal of Traditional Optimization Methods - Classification of Search Techniques - Introduction to Hill climbing - Simulated annealing – Decision Tree - Difference between Genetic Algorithms and Traditional Methods - Simple Genetic Algorithm Examples

3. **Genetic Modeling**  
   08 Hrs.  
4. Regression and Optimization  08 Hrs.

5. Neuro-Fuzzy Modeling  08 Hrs.

6. Advanced Neuro-Fuzzy Modeling  08 Hrs.

7. Neuro-Fuzzy Control  08 Hrs.
Introduction, Feedback control Systems, Neuro-Fuzzy Control, Expert Control, Inverse Learning, Specialized Learning, Back-propagation through Time and Real Time Recurrent Learning, Reinforcement Learning Control, Introduction to Fuzzy Filtered Neural Network

8. Other Hybrid System  08 Hrs.
RECOMMENDED BOOKS (*)

MAIN READING

2. Akerker and Sajja, MS and Jones and Bartlett, MA, USA, “Knowledge-Based Systems”, 2009
3. Ian Cloete and Jacek Zurada, “Knowledge Based Neuro-Computing” University Press, Massachusetts Institute of Technology, USA, 2002

SUPPLEMENTARY READING


(*) Latest edition of the books need to be procured.
1. a) How many keys are required for two people to communicate via a cipher? Explain with an example.
   b) How the Discrete algorithm works and computes the power of integers for the module 19.
   c) What requirements must a public-key cryptosystem fulfill to be a secure algorithm?
   d) What are the two different uses of public key cryptography related to key distribution?
   e) What is the difference between direct and arbitrated digital signature.
   f) Explain the principle of public key cryptography and show how it differs from conventional and classical technique.
   g) What type of information might be derived from a traffic analysis attack?

   (7x4)

2. a) What are the requirements for secure use of conventional encryption? Explain the model of conventional cryptosystem.
   b) When a combination of symmetric key encryption and an error control code is used for message authentication, in what order must the two functions be performed? Justify with an example.
   c) What are the three tests used in evaluating a random number generator?

   (6+9+3)

3. a) Which parameters and design choices determine the actual algorithm of a Fiestel Cipher?
   b) What is differential cryptanalysis attack? How is it different from linear cryptanalysis attack?
   c) What is the difference between statistical randomness and unpredictability?

   (9+4+5)

4. a) If a bit error occurs in the transmission of a cipher text character in 8 bit CFB mode, how far does error propagate?
   b) Explain Modular arithmetic and show the Arithmetic operations of Modular operations.
   c) Using Extended Euclid’s algorithm, find multiplicative inverse of 550 mod 1769

   (7+7+4)

5. a) What is the difference between an unconditionally secure cipher and a computationally secure cipher?
   b) In public key system using RSA, you intercept the ciphertext C=10 sent to a user whose public key is e=5, n=35. What is the plaintext M?
   c) Identify the attacks in context of communication across the network and show how basic usages of MD for dealing with any one of attack.

   (3+8+7)
6. 
   a) What is the need of Digital Signatures? / Discuss the requirements of digital Signature. What are problem associated with Direct Digital Signature?
   b) Justify the requirement of Authentication and explain the Message Authentication using one of the Authentication techniques with example.
   c) What are the two basic functions used in encryption algorithm?

7. 
   a) List out types of Attach on Encrypted messages also explain how the Average Time required Exhaustive Key search affected by key size.
   b) What is purpose Chinese Reminder algorithm and where in security algorithm it is used
   c) Explain how Secrecy and authentication can be achieved using Public-key Cryptosystem

(7+7+4)

(9+5+4)
Objective of the Course

This course aims to introduce various topics relevant to development of modern quality software system. This course is a graduate-level software engineering course. Assuming a basic knowledge of software engineering principles, we will explore advanced specification and design in UML, component-based software engineering, rapid development processes and techniques, advanced validation and verification methods, configuration management, and other advanced topics.

Graduate standing in Computer Science, and at least one undergraduate software engineering course. A basic knowledge of software engineering and UML diagramming methods will be assumed.

Outline of Course

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Topic</th>
<th>Minimum number of hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Basic of Software Engineering and Study of Different Life cycle Models</td>
<td>06</td>
</tr>
<tr>
<td>2.</td>
<td>Requirements &amp; Specification</td>
<td>06</td>
</tr>
<tr>
<td>3.</td>
<td>Design Concept and Methods</td>
<td>08</td>
</tr>
<tr>
<td>4.</td>
<td>Object Oriented Methodology for Analysis and Design</td>
<td>08</td>
</tr>
<tr>
<td>5.</td>
<td>Modeling with UML</td>
<td>08</td>
</tr>
<tr>
<td>6.</td>
<td>Testing Object Oriented System and Quality Assurance</td>
<td>08</td>
</tr>
<tr>
<td>7.</td>
<td>Software Architecture</td>
<td>08</td>
</tr>
<tr>
<td>8.</td>
<td>Software Agent</td>
<td>08</td>
</tr>
</tbody>
</table>

Lectures = 60
Practical/Tutorials = 60
Total = 120

Detailed Syllabus

1. Basic of Software Engineering and Study of Different Life cycle Models 06 Hrs.

2. Requirements & Specification 06 Hrs.
Problem Recognition, Evaluation And Synthesis, Modeling, Specifications And Review Techniques Requirements engineering; analysis; system model; software prototyping; formal specification; algebraic specification; model based specification

3. Design Concept and Methods 08 Hrs.
4. Object Oriented Methodology for Analysis and Design 08 Hrs.
Introduction to OO Methodology, Object model, Dynamic model, Functional Model for Software Analysis and Design. Requirement’s Analysis and Model – Actors and Use cases, Use case Narratives and Scenario, Managing Requirements.

5. Modeling with UML 08 Hrs.

6. Testing Object Oriented System and Quality Assurance 08 Hrs.
Overview of Testing activities and Techniques, Test case generation and Test suites, Managing Testing. Test case from Use case. OO Metrics, Quality models, Software reliability; software reuse; safety-critical software.

7. Software Architecture 08 Hrs.
Software Architecture in Practice: Industrial Best Practices; Role of the Architect; Evaluation; Case Studies; Cultural Aspects. Foundations of Software Architecture: Description Languages; Analysis Methods; Transformations; Assessment; Extraction/Recovery. Software connectors: Architecture description languages (ADLs), Dynamism in software architectures, Architecture-based testing and analysis, From architecture to design: overview of UML, Role of UML in software architectures.

8. Software Agent 08 Hrs.
Agent Oriented Vs. OO Software Development, Design Methods, Multi Agent System, Use of UML, Agent methodologies in Industries, Component based Software Engineering.
RECOMMENDED BOOKS (*)

MAIN READING


SUPPLEMENTARY READING

1. Ian Sommerville, “Software Engineering”, Addison Wesley

(*) Latest edition of the books need to be procured.
1. **a)** Why the Spiral life cycle model is considered to be a meta model? Also differentiate between throw away and evolutionary prototype in prototype model.

**b)** Why should a requirement engineer avoid making any design decision during requirement analysis?

**c)** What are functional and non-functional requirements for software? Who will specify those requirements?

**d)** What is the difference between cardinality and modality? How structure partitioning can help to make s/w more maintainable?

**e)** Describe the difference between verification and validation. Who should perform the validation tests—the software developer or the software user? Justify the answer.

**f)** Explain: Why high quality software process should lead to high quality software products.

**g)** When are verification and validation performed? Who should perform validation test (developer or user)? Justify your answer.

(7x4)

2. **a)** What are the major phases of the entire life of the s/w? Specify the percentage of efforts required on each phase. Which phase requires the maximum efforts?

**b)** Define the problem domain and establish the scope for the following system.

“Examination System for an academic institution.”

**c)** Draw the use case diagram for the following system.

“A simple invoicing system for a small business”.

(7+5+6)

3. **a)** What purpose do “walkthrough” serve? How do they accomplish this?

**b)** Develop an E-R diagram and prepare data dictionary for the following system.

“Hotel reception desk management”.

**c)** What is the content of data dictionary? Is it a part of analysis or design? Is it prepared before or after DFD and ER Diagram?

(6+4+8)

4. **a)** Explain the need for various measures and describe various metrics. How are the concepts of coupling and software portability related? Give example for the same.

**b)** Develop a set of use cases for the following system.

“Software for a general purpose personal digital assistant”.

**c)** Discuss the relationship between the concept of information hiding as an attribute of effective modularity and the concept of module independence. Why is it good idea to keep the scope of effect of a module within its scope of control?

(7+3+8)

5. **a)** Develop a state chart diagram for the following system.

“A university student record keeping system”.

(7+3+8)
b) Differentiate between object based and object oriented programming. Explain how object oriented design provide separation of interface and implementation.

c) What is the difference between a milestone and a deliverable? Give examples for the same.

(7+7+4)

6.  
a) A manager decides to use the reports of program inspections as an input to the staff appraisal process. These reports show who have made and who have discovered program errors. Is this ethical managerial behavior? Would it be ethical if the staff were informed in advance that this would happen? What difference might it make to the inspection process?

b) What is qualification to object modeling? Define the role of qualifier. Identify what type of association (e.g. one to one) etc. may be qualified. What are the advantages of qualified association?

c) Explain: the role of UML in software architecture design.

(7+7+4)

7.  
a) What are the major phases of the entire life of the software? Specify the percentage of efforts required on each phase. Which phase requires the maximum efforts?

b) Describe what is meant by data and tool integration. How structure partitioning can help to make software more maintainable? Write advantages of different structural models for architectural design of System.

c) How Quality and Reliability of software are differing? Can a software be correct and still not exhibit good quality? Can a software be correct and still not be reliable?

(6+6+6)
LAB III: IMAGE PROCESSING AND COMPUTER VISION

Sample Practical List

1. Introduction to MATLAB & Image processing Toolbox.

2. Write a m-function for following image transforms for grayscale image.
   (Input: Gray Scale Image)
   a. Inverse Transform
   b. Power-law Transform
   c. Log Transform

3. Write m-function for Histogram Equalization for grayscale image.
   (Input: Gray Scale Image)

4. Write m-function for Local Histogram Equalization.
   (Input: Gray Scale Image)

5. Write m-function for Histogram Specification for grayscale image.
   (Input: 2 Gray Scale Images)

6. Demonstrate the use of Smoothing and Sharpening using various Filters for
   Smoothing (Average(Mean) Filter, Weighted Filter, Median Filter, Gaussian
   Averaging Filter, Laplacian Filter) for Sharpening (H-V and H-V-D)
   (Input: Gray Scale Image)

7. Perform the BIT PLANE SLICING for the gray scale image. Show the effect of
   removing the each bit plane from the image.
   (Input: Gray Scale Image)

8. Demonstrate the use of Filtering in Frequency Domain. Implement the function
   for the IDEAL, GAUSSIAN, and BUTTERWORTH (both High pass and Low
   pass) filters. Also compare and analyze results.
   (Input: Gray Scale Image)

9. Demonstrate the use of different filter applied for image restoration which is
   degraded by Raleigh, Gaussian, and Salt & Pepper Noise. Implement following
   filters:
   a. Mean Filter
   b. Arithmetic Mean filter
   c. Geometric filter
   d. Harmonic Filter
   e. Contra Harmonic filter
   f. Order Statistics Filters
   g. Median filter
   h. Max & Min Filters
   i. Mid point Filter
   (Input: Gray Scale Image)

10. Demonstrate use of Prewit, Sobel, Robert, Canny edge detector for Edge
    detection.
    (Input: Gray Scale Image)
11. Implement Fourier Descriptor for shape detection and prepare CHAIN CODE for shape.
   \textbf{(Input: Binary Image with one Shape)}

12. Demonstrate use of Morphological Operations (Dilate & Erosion).
    \textbf{(Input: Binary Image with one Shape)}

13. Write a M-function for Color space Transformation. (RGB\leftrightarrow YUV\leftrightarrow CMYK)
    \textbf{(Input: Color Code)}

\textbf{Software Requirement:} MATLAB 6.0

\textbf{Note:} These are suggested Assignments. Teachers may use these assignments as reference guide. Teachers are encouraged to innovate keeping in view with the current technologies.
LAB III: MULTIMEDIA SYSTEMS

Sample Practical List

1. Write a Program to copy one Bitmap File to another using Header and Data information.

2. Implement RLE Compression Algorithm for a BMP file

3. Write a program to read Wav file header.

4. Write a program to read TIFF file header information.

5. Write a program for color space conversion (RGB-YUV-LAB).

6. Generate a Quantization Table for JPEG.

7. Implementation of 2D DCT & IDCT for 8x8 image.


10. Study of Content Based Image/Video Retrieval Techniques.

11. Study of TWAIN architecture.


Note: These are suggested Assignments. Teachers may use these assignments as reference guide. Teachers are encouraged to innovate keeping in view with the current technologies.
LAB IV: INFORMATION SECURITY

Sample Practical List

1. To implement Caesar cipher encryption-decryption.  
   *(Input: Text Based Value)*

2. To implement Monoalphabetic cipher encryption-decryption.  
   *(Input: Text Based Value and keys)*

3. To implement Playfair cipher encryption-decryption.  
   *(Input: Text Based Value and keys)*

4. To implement Polyalphabetic cipher encryption-decryption.  
   *(Input: Text Based Value and keys)*

5. To implement columnar transposition cipher encryption-decryption.  
   *(Input: Text Based Value and keys)*

6. To implement Hill cipher encryption-decryption.  
   *(Input: Text Based Value and keys)*

7. To implement Rail-Fence cipher encryption-decryption.  
   *(Input: Text Based Value and keys)*

8. To implement Diffie-Hallman key exchange algorithm.


10. To implement SHA-1 compression techniques.

11. To implement S-DES encryption techniques.

Software Requirement: C / C++

Note: These are suggested Assignments. Teachers may use these assignments as reference guide. Teachers are encouraged to innovate keeping in view with the current technologies.
LAB IV: SOFT COMPUTING

Sample Practical List


4. Study and Implementation of various Genetic Operators.

5. Study and Implementation of various Reproduction techniques of Genetic Algorithm.

6. Introduction of Neural network with advantages and disadvantages and its applications.

7. Study of different types of Learning Techniques.

8. Implement 2-2-1 Configuration Neural Network Architecture and Observe effect of Learning Rate.

9. Implement XOR Problem using Neural Network.

10. Study of Various kind of Parameter of Neural Network

Note: These are suggested Assignments. Teachers may use these assignments as reference guide. Teachers are encouraged to innovate keeping in view with the current technologies.
Objective of the Course

This subject aims to introduce theoretical analysis of various types of signal, different signal with mathematical proof of correctness, Discrete time signal, digital Fourier transform, Z-transform, frequency analysis and system, design of digital filter, DSP coprocessor and its application to review mathematical background.

At the end of the course the student will understand:
- Analysis of various types of signal.
- Mathematics for signal.
- Examine the properties of signal.

Outline of Course

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Topic</th>
<th>Minimum number of hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Discrete Time Signals &amp; System</td>
<td>05</td>
</tr>
<tr>
<td>2.</td>
<td>Z-Transform</td>
<td>04</td>
</tr>
<tr>
<td>3.</td>
<td>Applications of z-transform</td>
<td>02</td>
</tr>
<tr>
<td>4.</td>
<td>Frequency Analysis of Signals and Systems</td>
<td>05</td>
</tr>
<tr>
<td>5.</td>
<td>Discrete Fourier Transform</td>
<td>08</td>
</tr>
<tr>
<td>6.</td>
<td>Implementation of Discrete Time Systems</td>
<td>08</td>
</tr>
<tr>
<td>7.</td>
<td>Design of Digital Filters</td>
<td>08</td>
</tr>
<tr>
<td>8.</td>
<td>Introduction to DSP co-processors</td>
<td>04</td>
</tr>
<tr>
<td>9.</td>
<td>Applications</td>
<td>08</td>
</tr>
<tr>
<td>10.</td>
<td>Advance DSP concepts</td>
<td>08</td>
</tr>
</tbody>
</table>

Lectures = 60
Practical/Tutorials = 60
Total = 120

Detailed Syllabus

1. **Discrete Time Signals & System** 05 Hrs.

2. **Z-Transform** 04 Hrs.
   Definition and Properties of Z-transform, Rational Z-transforms, Inverse Z-transform, one-sided Z-transform, Analysis of LTI systems in Z-domain

3. **Application of Z-Transform** 02 Hrs.
   Time domain analysis, frequency response - graphical interpretation, application: digital audio effects

4. **Frequency Analysis of Signals and Systems** 05 Hrs.
Frequency analysis: Continuous time signals and Discrete-time signals, Properties of the Fourier transform for discrete-time signals, Frequency domain characteristics of LTI systems, LTI system as a frequency selective filter, Inverse systems and deconvolution

5. Discrete Fourier Transform 08 Hrs.
Frequency domain sampling, Properties of DFT, Linear filtering method based on DFT, Frequency analysis of signals using DFT, FFT algorithm, Applications of FFT, Goertzel algorithm, Quantisation effects in the computation of DFT

Frequency domain sampling, Properties of DFT, Linear filtering method based on DFT, Frequency analysis of signals using DFT, FFT algorithm, Applications of FFT, Goertzel algorithm, Quantisation effects in the computation of DFT

7. Design of Digital Filters 08 Hrs.

8. Introduction to DSP co-processors 04 Hrs.
TMS 320C40/50, Analog Devices

9. Applications 08 Hrs.
Image processing, Speech, Audio, Telecommunication, Graphics, image enhancement, 3-D rendering, Navigation, GPS, Correlation, machine vision, Frequency domain filtering.

10. Advance DSP concepts 08 Hrs.
Multirate signal processing, adaptive signal processing, finite word length effect
RECOMMENDED BOOKS (*)

MAIN READING

1. J.G. Proakis, “Introduction to Digital Signal Processing”, PHI

SUPPLEMENTARY READING


(*) Latest edition of the books need to be procured.
1. Answer question 1 and any FOUR questions from 2 to 7.
2. Parts of the same question should be answered together and in the same sequence.

TIME: 3 HOURS
TOTAL MARKS: 100

Time: 3 Hours
Total Marks: 100

1. Find frequency response $H(e^{jw})$ of the linear time-invariant system, whose input and output satisfy the difference equation:

   \[ y[n] - 0.5y[n-1] = x[n] + 2x[n-1] + x[n-2]. \]

b) For $X(e^{jw}) = \frac{1}{1-ae^{-jw}}$, with $-1 < a < 0$, determine and sketch the following as a function of $w$:

   (i) $\text{Re}\{X(e^{jw})\}$  
   (ii) $\text{Im}\{X(e^{jw})\}$  
   (iii) $|X(e^{jw})|$  
   (iv) $\text{angle}\{X(e^{jw})\}$

c) Consider an LTI system that is stable and for which $H(z)$-the z-transform of the impulse response is given by $H(z) = \frac{3}{1+0.33z^{-1}}$.

   (i) Find the output $y[n]$ by evaluating the discrete convolution of $x[n]$ and $h[n]$.
   (ii) Find the output $y[n]$ by computing the inverse transform of $Y(z)$.

d) Prove the following properties of Z-transform:

   (i) Multiplication by an exponential sequence
   (ii) Time Shifting

e) Explain the relationship between DTFT and Z-transform.

f) What is an IIR filter? Compare its characteristics with an FIR filter.

g) A high pass filter satisfying the following specifications is to be designed.

   \[
   |H(e^{jw})| < 0.04 \quad 0 \leq |w| \leq 0.2\pi
   \]

   \[
   0.995 < |H(e^{jw})| < 1.005 \quad 0.3\pi \leq |w| \leq \pi
   \]

   State the specifications that should be used to design the prototype continuous time filter, if the discrete time filter is designed by applying bilinear transformation with $T = 2$ ms to the prototype continuous time filter.

(7 x 4)

2. Consider the DT signal below which is only nonzero for three values of $n$:

   \[ x[n] = 4\delta[n] + 2\delta[n-1] + \delta[n-2] \]

   (i) Compute and plot the autocorrelation, $r_{xx}[\ell]$, of $x[n]$.
   (ii) $x(n)$ is pass through a DT linear system characterized by a difference equation $y(n) = 2x[n-2] + x(n-6)$, Compute and plot the cross correlation between $x(n)$ and $y(n)$.

b) Design direct form-II realization of the transfer function:

   \[ H(z) = \frac{3 + 3.6z^{-1} + 0.6z^{-2}}{1 + 0.1z^{-1} - 0.2z^{-2}}. \]

c) Consider the following system, the pole-zero plot for $H(z)$ is shown below.
(i) Determine $h(n)$, the impulse response of $H(z)$.
(ii) In the following system, Determine whether $G(z)$ can be chosen so that $y(n) = v(n)$ for any input $x(n)$.

3.
(a) For a given Linear time invariant system, determine the system function and the impulse response of the system shown below:

(b) Determine the $z$-transform and its ROC of the following sequence:
   (i) $x[n] = n^2 u[n]$
   (ii) $\cos \omega_0 n u[n]$

(c) The even part of a real sequence $x[n]$ is defined by
   
   $$x_e[n] = \frac{x[n] + x[-n]}{2}$$

   If $x[n]$ is a real finite-length sequence defined such that $x[n]=0$ for $n < 0$ and $n \geq N$. Let $X[k]$ denote the N-point DFT of $x[n]$.
   (i) Find the DFT of $x_e[n]$. Is it equal to $\text{Re}\{X[k]\}$?
   (ii) What is the inverse DFT of $\text{Re}\{X[k]\}$ in terms of $x[n]$?

4.
(a) Consider two finite-length sequences $x[n]$ and $h[n]$ for which $x[n] = 0$ outside the interval $0 \leq n \leq 49$ and $h[n] = 0$ outside the interval $0 \leq n \leq 9$.
   (i) What is the maximum possible number of nonzero values in the linear convolution of $x[n]$ and $h[n]$?
   (ii) The 50 point circular convolution of $x[n]$ and $h[n]$ is

   $$x[n] \star_{50} h[n] = 10, \quad 0 \leq n \leq 49.$$  
   The first 5 points of the linear convolution of $x[n]$ and $h[n]$ are

   $$x[n] \cdot h[n] = 5, \quad 0 \leq n \leq 4.$$
   Determine as many points as possible of the linear convolution of $x[n] \ast h[n]$. 

C Level R4 103
b) Two four-point sequences $x[n]$ and $h[n]$ are as follows:

\[
x[n] = \cos\left(\frac{\pi n}{2}\right), \quad n = 0, 1, 2, 3.
\]
\[
h[n] = 2^n, \quad n = 0, 1, 2, 3.
\]
i) Calculate the four-point DFT $X[k]$.
ii) Calculate the four-point DFT $H[k]$.
iii) Calculate $y[n] = x[n]\frac{4}{h[n]}$ by doing the circular convolution directly.
iv) Calculate $y[n]$ of part (iii) by multiplying the DFTs of $x[n]$ and $h[n]$ and performing an inverse DFT.

c) Determine the signal $x[n]$ with z-transform:

\[X(z)=\frac{3}{1-(10/3)z^{-1}+z^{-2}}\] if $X(z)$ converges on the unit circle.

5.
a) Determine the input-output relationship, the system function, and plot the pole-zero pattern for the discrete time system shown:

\[
\begin{align*}
&\text{rcos}\theta \\
&\text{rsin}\theta \\
x(n) &\quad + \quad z^{-1} \quad y(n) \\
&\quad rcos\theta \\
&\quad rsin\theta \\
&-rco\theta \\
&\quad z^{-1} \\
&\quad -rsin\theta \\
&\quad -rcos\theta
\end{align*}
\]

b) i) Determine a parallel and a cascade realization of the system

\[
H(z) = \frac{1 + z^{-1}}{(1 - z^{-1})(1 - 0.8 e^{j\pi/2} z^{-1})(1 - 0.8 e^{-j\pi/2} z^{-1})}
\]
ii) Determine the type 1 and type 2 state-space descriptions of the system in part (i).

c) Consider an FIR lattice filter with coefficients $K_1=0.65, K_2=-0.34$ and $K_3=0.8$.

i) Find its impulse response by tracing a unit impulse input through the lattice structure.
ii) Draw the equivalent direct-form structure.

6.
a) A digital low-pass filter is required to meet the following specifications:

- Passband ripple: ≤ 1 dB, Passband edge: 4 kHz, Stopband attenuation: ≥ 40 dB
- Stopband edge: 6 kHz, Sample rate: 24 kHz

The filter is to be designed by performing a bilinear transformation on an analog system function. To meet the specifications in the digital implementation what should be the order of Butterworth, Chebychev and Elliptic analog designs.

b) The impulse response of an analog filter is shown as below:
i) Let \( h(n) = h_a(nT) \), where \( T = 1 \), be the impulse response of a discrete-time filter. Determine the system function \( H(z) \) and the frequency response \( H(w) \) for this FIR filter.

ii) The FIR filter with unit sample response \( h(n) \) given above is to be approximated by a second-order IIR filter of the form

\[
G(z) = \frac{b_0 z^{-1}}{1 - a_1 z^{-1} - a_2 z^{-2}}
\]

Use the least-squares inverse design procedure to determine the coefficients \( b_0, a_1, \) and \( a_2 \).

c) Explain: Autoregressive-moving average (ARMA) model in random process.

7.

a) Explain: Short time Spectrum Analysis in Speech Processing

Or Video Compression using Wavelet transform

b) Using the in-place radix-2 decimation-in-time and radix-2 decimation-in-frequency algorithms, compute the 8-point DFT of the sequence

\[
x(n) = \begin{cases} 1, & \frac{1}{2}, \frac{1}{2}, \frac{1}{2}, 0, 0, 0, 0, 0 \end{cases}
\]

Follow exactly the corresponding signal flow graphs and keep track of all intermediate quantities by putting them on the diagrams.

c) Using the radix-4 decimation-in-time algorithm, compute the 16-point DFT of the sequence,

\[
x(n) = \cos \frac{\pi}{2} n, \quad 0 \leq n \leq 15.
\]
CE1.2-R4: MACHINE LEARNING

Objective of the Course

The intent of this course is to present a broad introduction to Machine Learning, the study of computing systems that improve their performance with experience; including discussions of each of the major approaches. The primary focus of the course will be on understanding the underlying algorithms used in various learning systems.

At the end of the course, the student will understand:
- Concept Learning and the General-to-Specific Ordering
- Decision Tree Learning
- Artificial Neural Networks
- Bayesian Learning
- Computational Learning Theory
- Evaluation of learning algorithm

Outline of Course

S. No.   Topic Minimum number of hours
1.   Introduction 04
2.   Inductive Classification 06
3.   Ensemble Learning 08
4.   Experimental Evaluation of Learning Algorithms 08
5.   Rule Learning: Propositional and First-Order 10
6.   Artificial Neural Networks 08
7.   Support Vector Machines 08
8.   Bayesian Learning 08

Lectures = 60
Practical/Tutorials = 60
Total = 120

Detailed Syllabus

1. Introduction 04 Hrs.
   Definition of learning systems. Goals and applications of machine learning. Aspects of developing a learning system: training data, concept representation, function approximation.

2. Inductive Classification 06 Hrs.

3. Ensemble Learning 08 Hrs.
   Using committees of multiple hypotheses. Bagging, boosting, and DECORATE. Active learning with ensembles
4. Experimental Evaluation of Learning Algorithms
Measuring the accuracy of learned hypotheses. Comparing learning algorithms: cross-validation, learning curves, and statistical hypothesis testing

5. Rule Learning: Propositional and First-Order

6. Artificial Neural Networks

7. Support Vector Machines
Maximum margin linear separators. Quadractic programming solution to finding maximum margin separators. Kernels for learning non-linear functions.

8. Bayesian Learning
RECOMMENDED BOOKS

MAIN READING


SUPPLEMENTARY READING


(*) Latest edition of the books need to be procured.
CE1.2-R4: MACHINE LEARNING

Model Question Paper

NOTE:

1. Answer question 1 and any FOUR questions from 2 to 7.
2. Parts of the same question should be answered together and in the same sequence.

TOTAL TIME: 3 HOURS
TOTAL MARKS: 100

1. a) Define learning system, what is goal of Machine Learning?
b) What is tree pruning? Explain with example.
c) Explain the terms: Bagging, Boosting.
d) What is Neural Network? Define various layers of Neural Network.
e) What is significance of maximum margin linear separators in support vector machine?
g) Write Naive Bayes learning algorithm.

(7X4)

2. a) What is Hopfield network? Discuss various features of it.
b) Explain Recursive induction of decision tree with example.
c) What is rough set? How it differs from fuzzy set?

(6+6+6)

3. a) What is a perception? How we can compare it with neuron? Explain how perceptions are used to solve classification problem?
b) Explain K-Nearest-neighbor algorithm with example.
c) Write a PROLOG program to find the nth element of a list and to find the union of two lists.

(8+6+4)

4. a) Given the following sentences:
   1. John likes all kinds of food.
   2. Apples are food.
   3. Chicken is food.
   4. Anything anyone eats and isn’t killed by is food.
   5. Bill eats peanuts and is still alive.
   Convert these statements into formulas in propositional logic and then clause form. Using resolutions prove that John likes peanuts.
b) What is clustering? Explain K-means partition clustering method with example.
c) Explain various types of cuts in PROLOG.

(6+8+4)

5. a) Write a short note on inverse learning.
b) Describe models of learnability. Explain concept of probably approximately correct (PAC) learning with explain.
c) How to measuring the accuracy of learned hypotheses? Compare various learning algorithms.

(4+8+6)
6. a) What is horn clause? Convert the following sentences in First order predicate logic and then horn clause.
   1. Everyone is loyal to someone.
   2. All men are mortal.
b) What is PROLOG? Explain structure of prolog program with example.
c) What is difference between predicate and propositional logic?

7. a) How the resolution is done in propositional logic?
b) Write short note on Version spaces and the candidate elimination algorithm with example.
c) Explain Certainty factor in context of Bayes' theorem
Objective of the Course

The aim of this course is to introduce students to reveal and track the legal and illegal activities on the net. Cyber Forensics has been in the popular mainstream for some time, and has matured into an Information-Technology (IT) capability that is very common among modern information security programs. The goal of cyber forensics is to support the elements of troubleshooting, monitoring, recovery, and the protection of sensitive data in the cyberspace. Moreover, in the event of a crime being committed, Cyber Forensics is also an approach for collecting, analyzing, and archiving data as evidence in a court of law. Although scalable to many IT domains, especially modern corporate architectures, Cyber Forensics can be challenging when being applied to non-traditional environments, which do not comprise of current ITs or are designed with technologies that do not provide adequate data storage or audit capabilities. In addition, further complexity is introduced if the environments are designed using proprietary solutions and protocols, thus limiting the ease of which modern forensic methods can be utilized.

At the end of the course, the student will understand:

- Understand the basics and principles of Cyber Forensics and Law
- Able to do step-by-step through the basics of investigation and introduce the tools and procedures required to legally seize and forensically evaluate a suspect machine
- Understand rules of evidence, chain of custody, standard operating procedures, and the manipulation of technology to conceal illegal activities and how cyber forensics can uncover them

Outline of Course

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Topic</th>
<th>Minimum number of hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Introduction</td>
<td>06</td>
</tr>
<tr>
<td>2.</td>
<td>Cyber Forensics Tools and Utilities</td>
<td>08</td>
</tr>
<tr>
<td>3.</td>
<td>Concealment Techniques</td>
<td>06</td>
</tr>
<tr>
<td>4.</td>
<td>Hardware: Model System Platforms</td>
<td>04</td>
</tr>
<tr>
<td>5.</td>
<td>Software: Operating Systems, Network Traffic and Applications</td>
<td>10</td>
</tr>
<tr>
<td>6.</td>
<td>Standard Operating Procedures: Digital Forensic Laboratory Accreditation Standards</td>
<td>10</td>
</tr>
<tr>
<td>7.</td>
<td>Acquiring Data, Duplicating Data, and Recovering Deleted Files</td>
<td>08</td>
</tr>
<tr>
<td>8.</td>
<td>Forensic Discovery and Analysis Using Back Track</td>
<td>05</td>
</tr>
<tr>
<td>9.</td>
<td>Privacy and Cyber Forensics</td>
<td>03</td>
</tr>
</tbody>
</table>

Lectures = 60
Practical/Tutorials = 60
Total = 120

Detailed Syllabus

1. Introduction 06 Hrs.

2. Cyber Forensics Tools and Utilities 08 Hrs.

3. Concealment Techniques 06 Hrs.
Spoliation, Secret Key Cryptography, Public Key Cryptography, Hash Function, Spoofing, Internet Protocol, Transmission Control Protocol, Hijacked Session Attacks, Polymorphism, Steganography, Reversing the Steganographic process, Counter- or Anti Forensics, Cloaking Techniques: Data hide and seek, Renaming Files, Manipulating File Systems, and Data Hiding on NTFS

4. Hardware: Model System Platforms 04 Hrs.
Introduction, Computers, Power Supply, Hard Drive, Laptops, Tablets, External Storage, Servers, I-Pods, PDAs, Digital appliances such as washing machines, microwave ovens.


Digital Forensic Laboratory accreditation Standards, Laboratory Manager Checklist, Digital Forensics Examiner Checklist, Technician or Assistant Checklist, Budget Checklist, Training and Testing Checklist, Evidence Control Checklist, Quality Assurance Checklist, Equipment Checklist, Health and Safety Checklist, Laboratory Facilities Checklist

7. Acquiring Data, Duplicating Data, and Recovering Deleted Files 08 Hrs.
Recovering Deleted Files and Deleted Partitions: Deleting Files, Recycle Bin, Data Recovery in Linux, Recovering Delete Files, Deleted File recovery Tools, Recovering Deleted Partitions, Deleted Partition Recovery Tools, Data Acquisition and Duplication.

8. Forensic Discovery and Analysis Using Backtrack 05 Hrs.
Digital Forensics, Acquiring Images, Forensic Analysis, File Carving.

9. Privacy and Cyber Forensics 03 Hrs.
Law Relating and Privacy, Common Law Privacy, Privacy: Common Law Privacy, Constitutional Law; Legal Liability for Mistakes.
RECOMMENDED BOOKS (*)

MAIN READING


SUPPLEMENTARY READING


(*) Latest edition of the books need to be procured.
1. a) Define cyber forensic. What is the importance of cyber forensics?
b) What is need of cyber forensic tools?
c) What does term steganography means? List four steganography tools.
d) How to define digital forensic examination and analysis tools using abstraction layers?
e) Explain the points related to quality assurance of digital forensic laboratory.
f) How does deleted recovery file tools work? Name some of them.
g) What is digital evidence computer forensics?

2. a) What is criminal justice in India and implications on cyber crime?
b) How internet traffic been measured? What is traffic index?
c) How to collect data from network traffic?

3. a) Distinguish between cyber crime and conventional crime.
b) How to trace an attacker using deterministic edge router marking?
c) Explain types of law enforcement computer forensic technology

4. a) Explain Prodiscover Incident Response in brief
b) How to define digital forensic examination and analysis tools using abstraction layers?
c) Explain the points related to quality assurance of digital forensic laboratory.

5. a) Difference between secret key algorithm and public key algorithm
b) How to secure your emails using SSL?
c) How does a deleted recovery partition tool work? name some of them

6. a) Explain Cloaking Techniques in detail
b) Differentiate between Block based Carving and Characteristic Based Carving.
c) What are the mode and manner of committing cyber crime?

7. a) Explain the following terms:
   1) Spoofing
   2) TCP
   3) IP
b) How does deleted recovery file tools work?
c) What is the use of computer forensics in law enforcement?
Objective of the Course

The course aims to provide an understanding management issues process during software project management. It provides holistic views of different aspect of development process necessary for the management of the project which includes various activities, resources, quality, cost and system configuration etc. This course will be supported by appropriate software package.

At the end of the course, the student will understand:

- Introduction to Software Project Management System
- Overview of Project Planning
- Project Estimation
- Project Scheduling
- Organization and Team Structure
- Risk Analysis and Management
- Resource Allocation
- Project Tracking and Configuration Management
- Project Contract Management
- Software Quality Assurance

Outline of Course

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Topic</th>
<th>Minimum number of hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Introduction to Software Project management System</td>
<td>06</td>
</tr>
<tr>
<td>2.</td>
<td>Overview of Project Planning</td>
<td>08</td>
</tr>
<tr>
<td>3.</td>
<td>Project Estimation</td>
<td>06</td>
</tr>
<tr>
<td>4.</td>
<td>Project Scheduling</td>
<td>06</td>
</tr>
<tr>
<td>5.</td>
<td>Organization and Team Structure</td>
<td>06</td>
</tr>
<tr>
<td>6.</td>
<td>Risk Analysis and Management</td>
<td>04</td>
</tr>
<tr>
<td>7.</td>
<td>Resource Allocation</td>
<td>06</td>
</tr>
<tr>
<td>8.</td>
<td>Project Tracking and Configuration management</td>
<td>06</td>
</tr>
<tr>
<td>9.</td>
<td>Project Contract management</td>
<td>06</td>
</tr>
<tr>
<td>10.</td>
<td>Software Quality assurance</td>
<td>06</td>
</tr>
</tbody>
</table>

Lectures = 60
Practical/Tutorials = 60
Total = 120

Detailed Syllabus

1. Introduction to Software Project Management System 06 Hrs.
Software Development as a project, stakeholders in software project, software product, processes, quality and cost, objectives, issues and problems relating to software projects.

2. Overview of Project Planning 08 Hrs.
Steps in project planning, defining scope and objectives, deliverables and other products, alternatives in planning,
3. Project Estimation

4. Project Scheduling
Work Breakdown structure, Activity Network: Network planning model, Activity-on-arrow network, precedence network, Forward and Backward pass, Critical Path, Stack and float, Gantt Chart, PERT Charts.

5. Organization and Team Structure
Overview of Organization structure and Team Structure, Organizational Behavior, Recruitment and Placement, Staffing, Motivation and Group Behavior. Individual and Group Decision making, Leadership and Leader style, Forms of Organizational Structure

6. Risk Analysis and Management
Risk Identification, Nature and Categories of Risk in software Development, Risk Assessment; Risk Mitigation, Monitoring and Management(RMM), RMM Plan, Risk Containment, Evaluating Scheduling Risk using PERT.

7. Resource Allocation

8. Project Tracking and Configuration Management
Measurement of Physical and Financial progress, Earned value analysis, Status reports and Milestone reports. Necessity of configuration management, Configuration Management Activity, Change control, Source code Control System (SCCS).

9. Project Contract Management
Outsourcing of products and services, Types of contract, Stages in contract placement, Terms and Condition of contract, Contract monitoring and Acceptance Testing.

10. Software Quality Assurance
Quality Control, Assurance, Movements, SQA-Software Quality Assurance Activities, Approaches To SQA, Reliability, ISO 9000 And 9001, CMM Levels, Quality Audit. (CMMI Levels may be included as CMM is replaced with CMMI)
RECOMMENDED BOOKS (*)

MAIN READING

SUPPLEMENTARY READING

(*) Latest edition of the books need to be procured.

Many research papers will be required for reading this course. In addition, the student should obtain one or more books on UML for reference. Pretty nearly any UML book will do, but the following list would constitute the author’s recommendations.

3. The Unified Software Development Process, by Ivar Jacobson et al, Addison-Wesley
4. Object-Oriented Software Engineering, Bernd Bruegge and Allen Dutoit, Pearson/Prentice Hall
5. UML Toolkit, Hans-Erik Eriksson and Magnus Penker, Wiley.
7. UML Pocket Reference, Dan Pilone, O’Reilly (or UML in a Nutshell, same publisher)
CE1.4-R4: PROJECT MANAGEMENT

Model Question Paper

NOTE:

1. Answer question 1 and any FOUR questions from 2 to 7.
2. Parts of the same question should be answered together and in the same sequence.

TOTAL TIME: 3 HOURS  TOTAL MARKS: 100

1. Give reasons of why software project is different from and harder to manage than other engineering discipline projects.
   a) Discuss how software quality can be achieved during software development.
   b) What is the relationship between software configuration management and software maintenance?
   c) Explain merits and demerits of ISO 9001 and SEI CMM certification.
   d) Why software reliability always takes precedence over efficiency.
   e) Describe the software project management best practices.

2. a) What are the four attributes which all software products should have? Explain each of them in brief. Suggest three other attributes which may be significant.
    b) Why is it important to develop the cost and schedule estimates during planning before software requirement analysis or design conducted?
    c) “Many people believe that the only way in which the order of magnitude and improvements in software quality and productivity will be achieved is through component based development”. Is this statement true? Explain.

3. a) What is the difference between a revision and a version? What do you mean by version control? Why is version control required? How can version control be achieved?
    b) Discuss the problems associated with the implementation of a successful quality assurance plan in a software development organization. Is it possible to assess quality of software before the programs are actually developed?
    c) Project managers normally use PERT charts for doing resource allocation, whereas GANTT charts are used for monitoring and controlling the progress of the project. Justify the statement.

4. a) In which units the productivity of a software development team can be measured? List three important factors that affect the production of a software development team.
    b) Can there be more than one critical path in a project schedule? Why is it important for the project manager to identify the critical paths in a project schedule?
    c) Name the risk based software development process model? What are its advantages and disadvantages? What is early risk resolution? Why 80% of risks resolution should be completed by the end of the elaboration phase in a modern software project?
5.  
   a) Explain the need for software measures. What is a Function Point? What are the advantages and disadvantages of FP based metrics. How the software size for the application can be estimated in function points? Also using FP count, how the efforts can be estimated provided various productivity means are given.
   b) What are the fundamental tasks that must be included in SQA planning?
   c) Is it true that “High quality software process should lead to high quality software products”? Justify. Can all software projects be managed with the help of evolutionary model of software development?

   (8+4+6)

6.  
   a) Which are the four primary functions, which software project managers perform? What are the attributes of a successful software project manager?
   b) What is the meaning of earned value analysis? How to perform it? What is error tracking as a project tracking and control approach?
   c) What is the software configuration? Why does one has to manage it? What are the five software configuration management tasks? Define and discuss each of them.

   (8+4+6)

7.  
   a) Many software projects are so large that a no. of software development teams must be formed. Recommend a management structure for coordinating multiple teams. What are the potential problems that can arise?
   b) What is the critical distinction between a milestones and deliverables? Explain with an example.
   c) Why is Project Management important to the software development process?
   d) Suppose an organization assessed at Level 3 of SEI CMM, what can you infer about the current quality practices at the organization? What does the organization has to do to reach SEI CMM Level 4?
   e) Is it true that a software product can always be developed faster by having a larger development team of competent software engineers? Justify your answer.

   (4+4+4+4+2)
CE1.5-R4: MOBILE COMPUTING

Objective of the Course

This course is designed for students interested in the broad area of mobile computing techniques and technologies. It exposes students to mobile computing framework, supporting communication and networking techniques and implementation issues. Broadly the material is organized as introductory concepts, communication infrastructure, networking issues, data management, programming support and security. The lecture material is supplemented by practicals and tutorials.

Outline of Course

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Topic</th>
<th>Minimum number of hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Introductory Framework</td>
<td>03</td>
</tr>
<tr>
<td>2.</td>
<td>Wide-Area Mobile Communication Access</td>
<td>07</td>
</tr>
<tr>
<td>3.</td>
<td>Local-Area Mobile Communication Access</td>
<td>07</td>
</tr>
<tr>
<td>4.</td>
<td>Mobile Network Layer</td>
<td>08</td>
</tr>
<tr>
<td>5.</td>
<td>Mobile Transport Layer</td>
<td>06</td>
</tr>
<tr>
<td>6.</td>
<td>Mobile Data bases</td>
<td>09</td>
</tr>
<tr>
<td>7.</td>
<td>Mobile Server and Management</td>
<td>06</td>
</tr>
<tr>
<td>8.</td>
<td>Mobile Operating Systems</td>
<td>04</td>
</tr>
<tr>
<td>9.</td>
<td>Programming and Language support</td>
<td>05</td>
</tr>
<tr>
<td>10.</td>
<td>Security in Mobile Computing</td>
<td>05</td>
</tr>
</tbody>
</table>

Lectures = 60
Practical/Tutorials = 60
Total = 120

Detailed Syllabus

1. Introductory Framework 03 Hrs.
   Concept of mobile computing, basic architecture, mobile devices, limitations of mobile devices.

2. Wide Area Mobile Communication Access 07 Hrs.
   GSM architecture and operations - radio interfaces, handover, security; General Packet Radio Service (GPRS); CDMA Systems - WCDMA, IMT-2000, UMTS,

3. Local Area Mobile Communication Access 07 Hrs.
   Basic MAC protocol CSMA/CA, Infrastructure and ad hoc network topologies, MACA, MACAW; use of PCF, IEEE 802.11 standards, Hiperlan; IrDA; Blue Tooth, ZigBee.

4. Mobile Network Layer 08 Hrs.
   Routing algorithms - DSR, AODV, TORA, CGSR. Mobile IP- basic concept, handover management, location management, registration, tunneling, route optimization, dynamic host configuration.

5. Mobile Transport Layer 06 Hrs.
   Limitations of TCP in mobile wireless systems, TCP fixes – Snooping, Indirect TCP; TCP variants - Fast retransmit/recovery, TCP - Reno, TCP-freeze, TCP- Transaction oriented, Explicit notification.
6. Mobile Databases 09 Hrs.
Basic concepts - Hoarding and caching, cache invalidation, client - server computing architecture, transaction models, query processing, data recovery. Data dissemination - communication asymmetry, data delivery mechanisms, broadcast disks, selective tuning and indexing; synchronization protocols.

7. Mobile Server and Management 06 Hrs.
Mobile agents, gateways, service discovery, device management, mobile file system.

8. Mobile Operating Systems 04 Hrs.
Basic concepts; requirements, Symbian OS, Palm OS.

9. Programming and Language Support 05 Hrs.
WAP architectures, WML, X HTML - MP, XML, J2ME.

10. Security in Mobile Computing 05 Hrs.
Information security, techniques and algorithms, protocols, trust, security models and frame works.
RECOMMENDED BOOKS (*)

MAIN READING


SUPPLEMENTARY READING

1. W. Stallings, "Wireless Communications and Networks", Pearson Education.

(*) Latest edition of the books need to be procured.
1. Answer question 1 and any FOUR questions from 2 to 7.
2. Parts of the same question should be answered together and in the same sequence.

TOTAL TIME: 3 HOURS
TOTAL MARKS: 100

1. a) What is handoff? Which are the types of handoff present in GSM technology? Which device does handle that handoff?
b) List the reasons to get registration denial from foreign agent.
c) How does Universal Telecommunication Systems (UMTS) provide interoperability and global roaming?
d) What is Push-data-in-air technology?
e) What are the limitations of IP addressing scheme to provide mobility?
f) List and brief security concern in Mobile Transaction.
g) What are the transactions take place in Kangaroo algorithm?

2. a) Write and explain registration request packet format in Mobile IP.
b) What are the differences between Wireless and Mobile Technology?
c) Explain GPRS network operation and available data services in GPRS.

3. a) What are the major security concerns in mobile transaction?
b) Write short note on: UMTS
c) Which are the groups of services supported by the GSM?

4. a) What are the characteristics of 3rd and 4th Generation network?
b) By taking suitable network diagram, explain steps of Destination Sequence distance Vector Algorithms
c) In satellite communication, explain LEO, GEO, and MEO.

5. a) What are the differences between FDMA, TDMA and CDMA?
b) How does WAP integrated with HTTP gateway?
c) What are the needs to have Mobile DBMS? Explain ACID properties of transaction with respect to Mobile Host.

6. a) Describe briefly History of Mobile Technology.
b) List and Explain layers of Bluetooth protocol stack.
c) What kind of tables is maintained by foreign agent during registration process of Mobile node?
7. 
a) Describe issues related Naming, Routing and Mobility management of Mobile node?
b) What are the components Cellular technologies (GSM)? Explain the functionality of each components of Cellular Technology.