REGULATIONS AND SYLLABUS
of
Master of Technology
in
Computer Science and Technology
(w.e.f. 2019-20 admitted batch)

A University Committed to Excellence
M.Tech. in Computer Science and Technology  
(CST) REGULATIONS  
(w.e.f. 2019-20 admitted batch)

1. ADMISSION

Admission into M.Tech. in Computer Science and Technology (CST) program of GITAM (Deemed to be University) is governed by GITAM admission regulations.

2. ELIGIBILITY CRITERIA

A pass in B.E./B.Tech./AMIE in any branch of Engineering or its equivalent or MCA/MSc.

Admissions into M.Tech. will be based on the following:

(i) Score obtained in GAT (PG), if conducted.
(ii) Performance in Qualifying Examination /Interview.
(iii) Candidates with valid GATE score shall be exempted from appearing or GAT(PG).

The actual weight age to be given to the above items will be decided by the authorities at the time of admissions.

3. CHOICE BASED CREDIT SYSTEM

Choice Based Credit System (CBCS) was introduced with effect from 2015-16 admitted batch and revised with effect from academic year 2019-20 in order to promote:

• Student centered Learning
• Activity based learning
• Students to learn courses of their choice
• Cafeteria approach

Learning objectives and outcomes are outlined for each course to enable a student to know what he/she will be able to do at the end of the program.

4. STRUCTURE OF THE PROGRAM

The Program Consists of

i) Core Courses (compulsory) which give exposure to a student in core subjects related area.
ii) Program Electives.
iii) Open Electives
iv) Mandatory and Audit Courses

Each course is assigned a certain number of credits depending upon the number of contact hours (lectures/tutorials/practical) per week.

In general, credits are assigned to the courses based on the following contact hours per week per semester.

• One credit for each Lecture / Tutorial hour per week.
• One credit for two hours of Practicals per week.

The curriculum of the four semesters M.Tech. program is designed to have a total of 68 credits for the award of M.Tech. degree
5. **MEDIUM OF INSTRUCTION**

   The medium of instruction (including examinations and project reports) shall be English.

6. **REGISTRATION**

   Every student has to register for the courses in each semester at the time specified in the academic calendar.

7. **ATTENDANCE REQUIREMENTS**

   A student whose attendance is less than 75% in all the courses put together in any semester will not be permitted to attend the semester-end examination and he/she will not be allowed to register for subsequent semester of study. He/she has to repeat the semester along with his/her juniors.

   However, the Vice-Chancellor on the recommendation of the Principal / Director of the Institute/School may condone the shortage of attendance to the students whose attendance is between 65% and 74% on genuine grounds and on payment of prescribed fee.

8. **EVALUATION**

   The assessment of the student’s performance in a theory course shall be based on two components: Continuous Evaluation (40 marks) and semester-end examination (60 marks).

   A student has to secure a minimum of 40% in any theory course in the two components (ref. 8.1) put together to be declared to have passed the course, subject to the condition that the student must have secured a minimum of 24 marks out of 60 marks (i.e. 40%) in the theory component at the semester-end examination.

   Practical/ Project Work/ Viva voce/ Seminar etc. course are completely assessed under Continuous Evaluation for a maximum of 100 marks, and a student has to obtain a minimum of 40% to secure Pass Grade. Details of Assessment Procedure are furnished below in Table 1.

   Audit courses are assessed through continuous evaluation for satisfactory or not satisfactory only. No credits will be assigned.

   **Table 1: Assessment Procedure**

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Component of Assessment</th>
<th>Marks Allotted</th>
<th>Type of Assessment</th>
<th>Scheme of Evaluation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Theory Courses</td>
<td>40</td>
<td>Continuous Evaluation</td>
<td>i) Thirty (30) marks for mid Semester examinations. Three mid examinations shall be conducted for 15 marks each; performance in best two shall be taken into consideration.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>60</td>
<td>Semester-end Examination</td>
<td>ii) Ten (10) marks for Quizzes, Assignments and Presentations. Sixty (60) marks for Semester-end examinations</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>100</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| 2 | Practical Courses | 100 | Continuous Evaluation | i) Fifty (50) marks for regularity and performance, records and oral presentations in the laboratory. Weightage for each component shall be announced at the beginning of the semester.  
ii) Ten (10) marks for casestudies.  
iii) Forty (40) marks for two tests of 20 marks each (one at the mid-term and the other towards the end of the semester) conducted by the concerned labteacher. |
| 3 | Technical Seminar (II Semester) | 100 | Continuous Evaluation | Through five periodic seminars of 20 marks each |
| 4 | Project Work (III Semester) | 100 | Continuous Evaluation | i) Forty (40) marks for periodic assessment on originality, innovation, sincerity and progress of the work, assessed by the project supervisor.  
ii) Thirty (30) marks for mid-term evaluation for defending the project, before a panel of examiners.  
iii) Thirty (30) marks for final report presentation and viva-voce, by a panel of examiners*. |
| 5 | Project Work (IV Semester) | 50 | Continuous Evaluation | i) Twenty (20) marks for periodic assessment on originality innovation, sincerity and progress of the work, assessed by the project supervisor.  
ii) Fifteen (15) marks for mid-term evaluation for defending the project, before a panel of examiners*.  
iii) Fifteen (15) marks for interim report presentation and viva-voce. |
| Total | 100 | Semester-end Examination | Fifty (50) marks for final project report and viva-voce examination assessed by external examiners. |
Audit courses are assessed for PASS or FAIL only. No credits will be assigned to these courses. If a student secures a minimum of 40 out of 100 marks during continuous evaluation, he/she will be declared PASS, else FAIL. PASS grade is necessary to be eligible to get the degree.

*Panel of Examiners shall be appointed by the concerned Head of the Department

9. PROVISION FOR ANSWER BOOK VERIFICATION AND CHALLENGE EVALUATION

If a student is not satisfied with his/her grade, the student can apply for answer book verification on payment of prescribed fee for each course with in one week after announcement of results.

After verification, if a student is not satisfied with revaluation marks/grade, he/she can apply for challenge valuation within one week after announcement of answer book verification result or two weeks after the announcement of results, which will be valued by two examiners i.e., one Internal and one External examiner in the presence of the student on payment of prescribed fee. The challenge valuation fee will be returned, if the student is successful in the appeal by securing a better grade.

10. SUPPLEMENTARY AND SPECIAL EXAMINATIONS

The odd semester supplementary examinations will be conducted after conducting regular even semester examinations during April/May.

The even semester supplementary examinations will be conducted after conducting regular odd semester examinations during October/November.

A student who has secured ‘F’ Grade in Project work shall have to improve his/her work and reappear for viva-voce after satisfactory completion of work approved by panel of examiners.

A student who has completed period of study and has “F” grade in final semester courses is eligible to appear for special examination.

11. MASSIVE OPEN ONLINE COURSES (MOOCs)

Greater flexibility to choose variety of courses is provided through Massive Open Online Courses (MOOCs) during the period of study. Students without any backlog courses up to first semester are permitted to register for MOOCs in second semester up to a maximum of 6 credits from program elective/open elective/audit courses. However the Departmental Committee (DC) of the respective campuses has to approve the courses under MOOCs. The grade equivalency will be decided by the respective Board of Studies (BoS).
12. GRADING SYSTEM

Based on the student performance during a given semester, a final letter grade will be awarded at the end of the semester in each course. The letter grades and the corresponding grade points are as given in Table 2.

Table 2: Grades and Grade Points

<table>
<thead>
<tr>
<th>Sl.No.</th>
<th>Grade</th>
<th>Grade Points</th>
<th>Absolute Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>O (outstanding)</td>
<td>10</td>
<td>90 and above</td>
</tr>
<tr>
<td>2</td>
<td>A+ (Excellent)</td>
<td>9</td>
<td>80 to 89</td>
</tr>
<tr>
<td>3</td>
<td>A (Very Good)</td>
<td>8</td>
<td>70 to 79</td>
</tr>
<tr>
<td>4</td>
<td>B+ (Good)</td>
<td>7</td>
<td>60 to 69</td>
</tr>
<tr>
<td>5</td>
<td>B (Above Average)</td>
<td>6</td>
<td>50 to 59</td>
</tr>
<tr>
<td>6</td>
<td>C (Average)</td>
<td>5</td>
<td>45 to 49</td>
</tr>
<tr>
<td>7</td>
<td>P (Pass)</td>
<td>4</td>
<td>40 to 44</td>
</tr>
<tr>
<td>8</td>
<td>F (Fail)</td>
<td>0</td>
<td>Less than 40</td>
</tr>
<tr>
<td>9</td>
<td>Ab (Absent)</td>
<td>0</td>
<td>-</td>
</tr>
</tbody>
</table>

A student who earns a minimum of 4 grade points (P grade) in a course is declared to have successfully completed the course, and is deemed to have earned the credits assigned to that course, subject to securing a GPA of 5.0 for a Pass in the semester.

13. GRADE POINT AVERAGE

A Grade Point Average (GPA) for the semester will be calculated according to the formula:

\[ \text{GPA} = \frac{\sum [C \times G]}{\sum C} \]

Where, \( C \) = number of credits for the course, 
\( G \) = grade points obtained by the student in the course.

The Cumulative Grade Point Average (CGPA), is calculated using the above formula considering the grades obtained in all the courses, in all the semesters up to that particular semester.

CGPA required for classification of class after the successful completion of the program is shown in Table 3.

Table 3: CGPA required for Award of Class

<table>
<thead>
<tr>
<th>Class</th>
<th>CGPA Required</th>
</tr>
</thead>
<tbody>
<tr>
<td>First Class with Distinction</td>
<td>≥ 8.0*</td>
</tr>
<tr>
<td>First Class</td>
<td>≥ 6.5</td>
</tr>
<tr>
<td>Second Class</td>
<td>≥ 5.5</td>
</tr>
<tr>
<td>Pass Class</td>
<td>≥ 5.0</td>
</tr>
</tbody>
</table>

* In addition to the required CGPA of 8.0 or more, the student must have necessarily passed all the courses of every semester in the first attempt.
14. **ELIGIBILITY FOR AWARD OF THE M.Tech. DEGREE**

Duration of the program: A student is ordinarily expected to complete the M.Tech. Program in four semesters of two years. However a student may complete the program in not more than four years including study period.

However the above regulation may be relaxed by the Vice-Chancellor in individual cases for cogent and sufficient reasons.

A student shall be eligible for award of the M.Tech. Degree if he/she fulfill all the following conditions.

a) Registered and successfully completed all the courses and project works.

b) Successfully acquired the minimum required credits as specified in the curriculum corresponding to the branch of his/her study within the stipulated period.

c) Has no dues to the Institute, Hostels, Libraries, NCC / NSS etc, and

d) No disciplinary action is pending against him/her.

15. **DISCRETIONARY POWER**

Not withstanding anything contained in the above sections, the Vice Chancellor may review all exceptional cases, and give his decision, which will be final and binding.
M.Tech. in Computer Science & Technology
Effective from academic year 2019-20 admitted batch

**Semester I**

<table>
<thead>
<tr>
<th>S.No</th>
<th>Course Code</th>
<th>Course Title</th>
<th>Category</th>
<th>L</th>
<th>T</th>
<th>P</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>19ECS701</td>
<td>Advanced Data Structures</td>
<td>PC</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td>19ECS703</td>
<td>Mathematical Foundations of Computer Science</td>
<td>PC</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>19ECS705</td>
<td>Advanced Algorithms</td>
<td>PC</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>19ECS7XX</td>
<td>Program Elective I</td>
<td>PE</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>5</td>
<td>19ECS7XX</td>
<td>Program Elective II</td>
<td>PE</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>6</td>
<td>19EMC741</td>
<td>Research Methodology and IPR</td>
<td>MC</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>7</td>
<td>19ECS721</td>
<td>Advanced Data Structures Laboratory</td>
<td>PC</td>
<td>0</td>
<td>0</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>8</td>
<td>19ECS727</td>
<td>Data Science and Machine Learning Laboratory</td>
<td>PC</td>
<td>0</td>
<td>0</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>9</td>
<td>19EAC7XX</td>
<td>Audit Course I</td>
<td>AC</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Total Credits: 21

**Semester II**

<table>
<thead>
<tr>
<th>S.No</th>
<th>Course Code</th>
<th>Course Title</th>
<th>Category</th>
<th>L</th>
<th>T</th>
<th>P</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>19ECS702</td>
<td>Soft Computing</td>
<td>PC</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td>19ECS7XX</td>
<td>Program Elective III</td>
<td>PE</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>19ECS7XX</td>
<td>Program Elective IV</td>
<td>PE</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>19ECS7XX</td>
<td>Program Elective V</td>
<td>PE</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>5</td>
<td>19EOE7XX</td>
<td>Open Elective</td>
<td>OE</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>6</td>
<td>19ECS722</td>
<td>Soft Computing Laboratory</td>
<td>PC</td>
<td>0</td>
<td>0</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>7</td>
<td>19ECS724</td>
<td>Digital Forensics Laboratory</td>
<td>PC</td>
<td>0</td>
<td>0</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>8</td>
<td>19ECS792</td>
<td>Technical Seminar</td>
<td>PC</td>
<td>0</td>
<td>0</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>9</td>
<td>19EAC7XX</td>
<td>Audit Course I</td>
<td>AC</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Total Credits: 21

**Semester III**

<table>
<thead>
<tr>
<th>S.No</th>
<th>Course Code</th>
<th>Course Title</th>
<th>Category</th>
<th>L</th>
<th>T</th>
<th>P</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>19ECS891</td>
<td>Project Work I</td>
<td>PW</td>
<td>0</td>
<td>0</td>
<td>26</td>
<td>13</td>
</tr>
</tbody>
</table>

Total Credits: 13

**Semester IV**

<table>
<thead>
<tr>
<th>S.No</th>
<th>Course Code</th>
<th>Course Title</th>
<th>Category</th>
<th>L</th>
<th>T</th>
<th>P</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>19ECS892</td>
<td>Project Work II</td>
<td>PW</td>
<td>0</td>
<td>0</td>
<td>26</td>
<td>13</td>
</tr>
</tbody>
</table>

Total Credits: 13

**Number of Credits**

<table>
<thead>
<tr>
<th>Semester</th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Credits</td>
<td>21</td>
<td>21</td>
<td>13</td>
<td>13</td>
<td>68</td>
</tr>
</tbody>
</table>
### Programme Elective I

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Course Code</th>
<th>Course Title</th>
<th>Category</th>
<th>L</th>
<th>T</th>
<th>P</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>19ECS741</td>
<td>Machine Learning</td>
<td>PE</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td>19ECS743</td>
<td>Wireless Sensor Networks</td>
<td>PE</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>19ECS745</td>
<td>Distributed Systems</td>
<td>PE</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
</tbody>
</table>

### Programme Elective II

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Course Code</th>
<th>Course Title</th>
<th>Category</th>
<th>L</th>
<th>T</th>
<th>P</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>19ECS747</td>
<td>Data Science</td>
<td>PE</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td>19ECS749</td>
<td>Introduction to Intelligent Systems</td>
<td>PE</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>19ECS751</td>
<td>Data Preparation and Analysis</td>
<td>PE</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
</tbody>
</table>

### Programme Elective III

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Course Code</th>
<th>Course Title</th>
<th>Category</th>
<th>L</th>
<th>T</th>
<th>P</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>19ECS742</td>
<td>Advanced Wireless and Mobile Networks</td>
<td>PE</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td>19ECS744</td>
<td>Secure Software Design and Enterprise Computing</td>
<td>PE</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>19ECS746</td>
<td>Computer Vision</td>
<td>PE</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
</tbody>
</table>

### Programme Elective IV

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Course Code</th>
<th>Course Title</th>
<th>Category</th>
<th>L</th>
<th>T</th>
<th>P</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>19ECS748</td>
<td>Human and Computer Interaction</td>
<td>PE</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td>19ECS750</td>
<td>GPU Computing</td>
<td>PE</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>19ECS752</td>
<td>Digital Forensics</td>
<td>PE</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
</tbody>
</table>

### Programme Elective V

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Course Code</th>
<th>Course Title</th>
<th>Category</th>
<th>L</th>
<th>T</th>
<th>P</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>19ECS754</td>
<td>Mobile Applications and Services</td>
<td>PE</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td>19ECS756</td>
<td>Compilers for High Performance Computing</td>
<td>PE</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>19ECS758</td>
<td>Optimization Techniques</td>
<td>PE</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
</tbody>
</table>
### Audit Course I and II

<table>
<thead>
<tr>
<th>S. No</th>
<th>Course Code</th>
<th>Course Name</th>
<th>Category</th>
<th>L</th>
<th>T</th>
<th>P</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>19EAC741</td>
<td>English for Research Paper Writing</td>
<td>AC</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>19EAC742</td>
<td>Disaster Management</td>
<td>AC</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>3</td>
<td>19EAC744</td>
<td>Value Education</td>
<td>AC</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>4</td>
<td>19EAC745</td>
<td>Constitution of India</td>
<td>AC</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>5</td>
<td>19EAC746</td>
<td>Pedagogy Studies</td>
<td>AC</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>6</td>
<td>19EAC747</td>
<td>Pedagogy Studies</td>
<td>AC</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>7</td>
<td>19EAC748</td>
<td>Personality Development through life</td>
<td>AC</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>8</td>
<td>19EAC750</td>
<td>Stress Management by Yoga</td>
<td>AC</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

### Open Electives

<table>
<thead>
<tr>
<th>S. No</th>
<th>Course Code</th>
<th>Course Name</th>
<th>Category</th>
<th>L</th>
<th>T</th>
<th>P</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>19EOE742</td>
<td>Business Analytics</td>
<td>OE</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td>19EOE746</td>
<td>Operations Research</td>
<td>OE</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>19EOE748</td>
<td>Cost Management of Engineering Projects</td>
<td>OE</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
</tbody>
</table>
This course provides an overall idea of how to design, implement, and perform various operations like search, insert, delete, etc., on the complex data structures. As a part of string matching techniques and text data compression algorithms were also considered.

**Course Objectives:**
- Learn to choose appropriate data structures, understand the ADT/libraries, and use it to design algorithms for a specific problem.
- Understand the necessary mathematical abstraction to solve problems.
- Familiarize with advanced paradigms and data structure used to solve algorithmic problems.
- Analyze efficiency and proof of correctness of various algorithms.

**Unit I**
9L
Dictionaries: Definition, Dictionary Abstract Data Type, Implementation of Dictionaries.

**Learning Outcomes**
After completion of this unit, the student will be able to
- define adt, understand hashing (L1)
- design and implement a hash function with the above collision resolution techniques (L6)

**Unit II**
9L
Skip Lists: Need for Randomizing Data Structures and Algorithms, Search and Update Operations on Skip Lists, Probabilistic Analysis of Skip Lists, Deterministic Skip Lists

**Learning Outcomes**
After completion of this unit, the student will be able to
- create and perform operations like insert, delete and search operations on skipped lists (L6)
- differentiate between singly linked list/doubly linked list and skip list with respect to space complexity and time complexity to perform search, insert and delete operations. (L2)

**Unit III**
9L

**Learning Outcomes**
After completion of this unit, the student will be able to
- organize data in a hierarchy form/non linear way (L4)
- perform search, insert and delete operations in the above data structures. (L4)

**Unit IV**
9L

**Learning Outcomes**
After completion of this unit, the student will be able to
- perform various string handling and string matching algorithms mainly considering similarity and identity in account. (L6)
- understand various text data compression techniques (L2)
Unit V  
Computational Geometry: One Dimensional Range Searching, Two Dimensional Range Searching, constructing a Priority Search Tree, Searching a Priority Search Tree, Priority Range Trees, Quad trees, k-D Trees.

Learning Outcomes
After completion of this unit, the student will be able to
• distinguish between one dimensional range search and two dimensional range search (L2)
• understand the database management query concepts in this domain (L2)

TextBook(s):

Course Outcomes:
After completion of this course, the student will be able to
• understand the implementation of symbol table using hashing techniques. (L2)
• develop and analyze algorithms for red-black trees, b-trees and splay trees. (L3)
• develop algorithms for text processing applications. (L5)
• identify suitable data structures and develop algorithms for computational geometry problems. (L4)
The purpose of this course is to provide a clear understanding of the concepts that underlying fundamental concepts and tools in mathematics with emphasis on their applications to computer science. It emphasizes mathematical definitions and proofs as well as applicable methods.

Course Objectives:
- Familiarize the student about the concepts of Probability and Probabilistic Distributions.
- Evaluate principles of Random Sampling and derive the Problems
- Enable the student to interpret wider range of visual and numerical data, and carry out basic inferential procedures
- Illustrate the knowledge of mathematical modelling
- Utilize the knowledge of computing and mathematics appropriate to the discipline.
- Be familiar with the concepts of graph theory and using them in solving computer science problems.

Unit I
Probability mass, density, and cumulative distribution functions, Parametric families of distributions, Expected value, variance, conditional expectation, Applications of the univariate and multivariate Central Limit Theorem, Probabilistic inequalities, Markov chains

Learning Outcomes
After completion of this unit, the student will be able to
- use the axioms of probability, define conditional probability. (L2)
- write axioms, and infer meaningful conclusions about the data. (L1)
- define conditional probability and understand intuitively about the conditional probability. (L1)
- identify the need for central limit theorem. (L2)
- use probabilistic inequalities such as Chernoff bound, Markov and Chebyshev's inequalities.(L2)

Unit II
Random samples, sampling distributions of estimators, Methods of Moments and Maximum Likelihood

Learning Outcomes
After completion of this unit, the student will be able to
- understand the concepts of estimation theory. (L2)
- describe the sampling distribution of a sample proportions. (L2)
- calculate probabilities of a sample proportion. (L3)

Unit III

Learning Outcomes
After completion of this unit, the student will be able to
- summarize data visually and numerically. (L4)
- learn the mathematical and probabilistic foundations of statistical inference. (L1)
- reduce the dimensionality of data. (L3)
- fit the Regression lines and analyze multivariate data. (L1)

Unit IV
Graph Theory: Isomorphism, Planar graphs, graph coloring, Hamilton circuits and Euler cycles. Permutations and Combinations with and without repetition. Specialized techniques to solve combinatorial enumeration problems
Learning Outcomes
After completion of this unit, the student will be able to
• apply the basic concepts of graph theory and note the different properties of graphs(L4).
• apply the basic concepts to solve combinatorial problems(L4)
• describe and solve some real time problems using concepts of graph theory(L2)

Unit V
10L
Computer science and engineering applications
Datamining,Networkprotocols,analysisofWebtraffic,Computersecurity,Softwareengineering,Computer architecture, operating systems, distributed systems, Bioinformatics, Machine learning.

Learning Outcomes
After completion of this unit, the student will be able to
• compare and contrast symmetric and asymmetric encryption systems and their vulnerability to attack, and explain the characteristics of hybrid systems. (L4)
• knowledge and awareness of the basic principles and concepts of biology, computer science and mathematics. (L5)
• how machine learning algorithms works - a basic introduction. (L1)
• why we want to study big data and how to prepare data for machine learning algorithms. (L1)
• acquire strong fundamental knowledge in science, mathematics, fundamentals of computer science, software engineering and multidisciplinary engineering to begin in practice as a software engineer. (L2)

Text Book(s)
4. Alan Tucker, Applied Combinatorics, Wiley

Course Outcomes:
After completing this Course, the student should be able to
• evaluate principles of random sampling and derive the problems(L4).
• understand the concepts of estimation theory (L2).
• fit the regression lines and analyse multivariate data(L3)
• compare and contrast symmetric and asymmetric encryption systems and their vulnerability to attack, and explain the characteristics of hybrid systems(L4)
The course is concentrated on the study and development of algorithms for solving practical problems efficiently, and the theoretical analysis of their behavior. It involves algorithm design techniques, methods for analyzing the performance of corresponding algorithms and improving their efficiency, and to provide performance guarantees.

Course Objectives:
- Introduce the advanced methods of designing and analyzing algorithms.
- Identify an appropriate algorithm and implement it for a specific problem.
- Understand different classes of problems concerning their computation difficulties.
- Solve problems using dynamic programming, network flow algorithms, graph algorithms and approximation algorithms.
- Analyze recent developments in the area of algorithmic design.

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

Learning Outcomes
- describe different sorting algorithms and their time complexity(L2)
- apply various graph traversal algorithms to find shortest paths(L3)
- outline the difference between BFS and DFS algorithms(L4)
- review the correctness of algorithm time and space analysis(L2)

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

Learning Outcomes
- calculate the maximum matching in graph related problems(L3)
- compute algorithms for maximum weight and maximal independent set. (L3)
- apply MST for real world problems(L3)
- discover augmenting paths in graphs using various algorithms(L3)

Unit III
Matrix Computations: Strassen's algorithm and introduction to divide and conquer paradigm, inverse of a triangular matrix.

Learning Outcomes
- After completion of this unit the student will be able to
• solve network flow problems using network flow algorithms (L3)
• implement divide and conquer paradigm for matrix multiplication (L3)
• analyze how efficiency can be achieved by matrix computation algorithms (L4)

Unit IV
10 L

Learning Outcomes:
After completion of this unit the student will be able to
• practice more examples on dynamic programming (L3)
• determine shortest paths in a graph using dynamic programming (L5)
• assess various representations of data (L5)
• develop algorithms for interpolation problems (L6)

Unit V
9 L
Linear Programming: Geometry of the feasibility region and Simplex algorithm
NP-completeness: Examples, proof of NP-hardness and NP-completeness. One or more of the following topics based on time and interest. Approximation algorithms, Randomized Algorithms, Interior Point Method.

Learning Outcomes
After completion of this unit, the student will be able to
• explain linear programming concepts (L2)
• examine NP-hardness and NP-completeness problems (L4)
• illustrate approximation algorithms (L4)
• analyze randomized algorithms (L4)

Text Book(s):

Course Outcomes:
After completion of the course, students would be able to:
• analyze the complexity/performance of different algorithms. (L4)
• determine appropriate algorithm that is suitable for solving a particular set of problems. (L3)
• explain more complex algorithms and proofs in written form (L3)
• categorize different problems in various classes according to their complexity. (L4)
• design and analyze techniques for algorithms and ways to approach NP-complete problems (L6)
• apply techniques to solve new problems that may arise in various applications (L3)
This course introduces the student to the fundamentals of research, research process, technical writing and intellectual property rights. Students will be able to use this knowledge to gain interest in their subject area and pursue their career in research.

Course Objectives

• To familiarize the meaning, objectives and sources of research
• To acquaint the student with the importance and methods of literature review/research ethics
• To impart the knowledge of technical writing for preparing reports, presentations, research proposals, conference/journal publications
• To introduce the terminology and process of obtaining intellectual property rights
• To expose the intricacies in the process of obtaining patent rights

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

Learning Outcomes

After the completion of this unit, the student will be able to

• define the meaning of a research problem (L1)
• list the different sources of research problem (L2)
• enumerate the different criteria of good research and list the different errors in selecting research problem (L2)
• contrast the different approaches of research (L3)
• compare the different methods for data collection and analysis (L5)

Unit II
Effective literature studies approaches, analysis Plagiarism, Research ethics

Learning Outcomes

After the completion of this unit, the student will be able to

• list and elaborate the different steps of the research process (L1)
• explain the importance of carrying out an effective literature review (L2)
• identify the research gaps from literature review (L5)
• describe the ethical principles to be following during research process and authorship (L2)
• define the terminology and list the methods to avoid being accused of plagiarism (L1)
• list the different types of research misconduct (L2)

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

Learning Outcomes

After the completion of this unit, the student will be able to
• list the attributes, reasons and guidelines for effective technical writing (L1)
• contrast between conference paper, technical presentation and journal paper (L3)
• choose a particular research contribution for patenting or journal publication (L4)
• describe the terminology related to citation, citation index, h-index etc (L2)

Unit IV 5L

Learning Outcomes
After the completion of this unit, the student will be able to
• describe the codes and standards in building intellectual property rights(L2)
• list the subject, importance and requirements for of patentability(L1)
• explain the process of patenting and commercialization in academia(L2)
• enumerate the procedure for application preparation, filing and grant of Patents(L2)

Unit V 8L

Learning Outcomes
After the completion of this unit, the student will be able to
• explain the scope of patent rights(L2)
• describe the process for licensing and transfer of technology(L2)
• identify the sources of patent information and databases(L1)
• elaborate the administration of patent system(L2)
• describe the new developments in IPR in computer software, biological systems etc(L3)

Text Book(s):

References:
Course Outcomes
After successful completion of the course, the student will be able to
- define the meaning, sources, approaches for research problems (L1)
- explain the guidelines for carrying out effective literature review and identify research gaps (L2)
- describe effective guidelines for preparing technical reports, research publications, presentations and research proposals (L2)
- describe the codes, standards and process of obtaining intellectual property rights (L3)
- enumerate the new developments of IPR in engineering systems (L3)
1. Develop programs for
   a. HeapSort
   b. MergeSort
   c. Quick sort by taking random element as pivot
   d. Selection

2. Program to perform insertion, deletion and search operations on the following:

3. Implement the functions of a dictionary using Hashing.

4. Implement hash tables with linear probing and double hashing. Demonstration of inserting and deleting elements.

5. Skip list: Implementations and operations.

6. Develop a program to perform insertion, deletion and search operations on the following Trees
   a. Binary Search Tree
   b. B-Trees
   c. AVL Tree
   d. Red Black Trees

7. Implement the code for the following problems using Dynamic Programming:
   a. Matrix Chain Multiplication Problem.
   b. String matching algorithm.
1. Introduction to Python Libraries- Numpy, Pandas, Matplotlib, Scikit
2. Perform Data exploration and preprocessing in Python
3. Implement regularised Linear regression
4. Implement Naive Bayes classifier for dataset stored as CSV file.
5. Implement regularized logistic regression
6. Build models using different Ensembling techniques
7. Build models using Decision trees
8. Build model using SVM with different kernels
9. Implement K-NN algorithm to classify a dataset.
Machine Learning is the science of making machines think intelligently without being explicitly programmed. Machine learning is pervasive in everyday life today. This course is designed to enable students get in-depth understanding of different machine learning techniques including deep learning and reinforcement learning and apply them on real-life data.

**Course Objectives:**
- Understand the fundamental concepts of Supervised learning.
- Explore descriptive problem solving through unsupervised learning strategies.
- Acquire skills in developing as well as evaluating different machine learning models.
- Demonstrate the application of different deep learning methodologies.
- Gain an understanding of concepts like Reinforcement Learning and Active Learning.

**Unit I**
Supervised Learning (Regression/Classification): Basic methods: Distance-based methods, Nearest-Neighbors, Decision Trees, Naive Bayes, Linear models: Linear Regression, Logistic Regression, Support Vector Machines, Nonlinearity and Kernel Methods, Beyond Binary Classification: Multi-class

**Learning Outcomes**
After completion of this unit, the student will be able to:
- explain the concept of machine learning and their applications to different real world datasets. (L2)
- demonstrate the working of different supervised learning algorithms and assess their suitability to a given problem. (L3)
- extend a binary classification problem to solve a multi-class classification problem. (L3)

**Unit II**
Unsupervised Learning: Clustering: K-means, Dimensionality Reduction: PCA and kernel PCA, Generative Models (Gaussian Mixture Models and Hidden Markov Models)

**Learning Outcomes**
After completion of this unit, the student will be able to:
- demonstrate the working of different dimensionality reduction techniques on high-dimensional datasets (L3)
- illustrate the working of Generative Models mathematically. (L3)

**Unit III**
Evaluating Machine Learning algorithms, Model Selection, Ensemble Methods (Boosting, Bagging, Random Forests)

**Learning Outcomes**
After completion of this unit, the student will be able to:
- interpret ensemble models as a function of different weak classifiers. (L3)
- compare the performances of different classification models. (L4)

**Unit IV**
Modeling Sequence/Time-Series Data, Deep Learning (Deep generative models, Deep Boltzmann Machines, Deep auto-encoders, Applications of Deep Networks) and Feature Representation Learning

**Learning Outcomes**
After completion of this unit, the student will be able to:

- understand the methods for handling time series and sequence data. (L2)
- demonstrate the working of different deep learning approaches on complex data. (L3)

**Unit V**

Scalable Machine Learning (Online and Distributed Learning) Semi-supervised Learning, Active Learning, Reinforcement Learning, Inference in Graphical Models, Introduction to Bayesian Learning and Inference

**Learning Outcomes**

After completion of this unit, the student will be able to:

- apply reinforcement learning approach to applications like bioinformatics and personalized recommendation. (L3)
- analyses the working of Active Learning approach on complex data. (L4)

**Text Book(s)**

2. Trevor Hastie, Robert Tibshirani, Jerome Friedman, The Elements of Statistical Learning, Springer 2009
3. Jiawei Han, Micheline Kamber, Jian Pei , Data Mining: Concepts and Techniques, 3/e, Morgan Kaufmann, 2011.

**Course Outcomes:**

After successful completion of the course, the student will be able to

- relate knowledge about application of machine learning techniques to real world problems. (L3)
- apply deep learning methodologies to applications such as image recognition, video tagging etc. (L3)
- generate suitable unsupervised learning approaches to descriptive machine learning models. (L4)
- utilize supervised learning approaches to perform predictive modeling of data. (L3)
- assess different machine learning algorithms based on performance evaluation measures. (L5)
The course is designed to enable the student to understand the sensor networking concepts. This course lays the foundation both for developing and implementing networking concepts in real time environment.

Course Objectives:
• Understand the state-of-the-art in network protocols, architectures and applications.
• Analyze existing network simulator to working environment.
• Understand the medium access control protocols and Markov chain properties.
• Learn key routing protocols for sensor networks and main design issues
• Understand the routing protocols for wireless sensor networks and advanced protocols.

Unit I 10L
Network Architecture: Traditional layered stack, Cross-layer designs, Sensor Network Architecture
Hardware Platforms: Motes, Hardware parameters
Learning Outcomes
After completion of this unit the student will be able to
• Understand the basics of wireless sensor networks (L2).
• list the applications and design factors of sensor networks (L2).
• enable the layer stack and architecture. (L2)

Unit II 8L
Introduction to ns-3: Introduction to Network Simulator 3 (ns-3), Description of the ns-3 core Unit and simulation example.
Learning Outcomes
After completion of this unit, the student will be able to
• understand the working of network simulator-3 (L2).
• develop this simulator to implement protocols (L6).
• demonstrate the simulator with examples. (L3)

Unit III 10L
Medium Access Control Protocol design: Fixed Access, Random Access, WSN protocols: synchronized, duty-cycled
Introduction to Markov Chain: Discrete time Markov Chain definition, properties, classification and analysis
MAC Protocol Analysis: Asynchronous duty-cycled X-MAC Analysis (Markov Chain)
Learning Outcomes
After completion of this unit, the student will be able to
• understand the medium access control protocol design (L3).
• make use of markov chain to implement protocol. (L3)
• solve problems of MAC using Markov chain. (L3)

Unit IV 7L
Security: Possible attacks, countermeasures, SPINS, Static and dynamic key distribution
Learning Outcomes
After completion of this unit, the student will be able to
• understand the concept of attacks (L2).
• apply the spin: sensor protocol for information via negotiation for applications (L3).
• enable the knowledge of static and dynamic key distribution (L3)

Unit V 10L
Routing protocols: Introduction, MANET protocols
Routing protocols for WSN: Resource-aware routing, Data-centric, Geographic Routing, Broadcast, Multicast
Advanced Topics: Recent development in WSN standards, software applications.

Learning Outcomes
After completion of this unit, the student will be able to
• get the knowledge of manet protocols(L1).
• compare and contrast the different protocols of routing protocols of sensor networks(L5).
• make use of protocols working in real time applications(L3).

Text Book(s):

Course Outcomes:
After completion of this course, the student will be able to
• explain the basics concepts of wireless sensor networks (L2).
• understand of network simulator 3 to implement protocols of wsn (L3).
• use of medium access control protocol design issues. (L1)
• knowledge of different security concepts and attacks (L3).
• gain working of different routing protocols (L3).
• learnt advanced topics and make use of real time environment (L3).
This course will help the students to get familiar with Distributed Database System concepts, system architecture, design strategies and issues, query optimization, transaction concepts and issues in reliability.

Course Objectives:
- Understand basic concepts related to Distributed Database System and Architecture.
- Comprehend the underlying design strategies, issues and query processing.
- Demonstrate different query optimization and query optimization algorithms.
- Familiarize fundamentals of transaction management based on concurrency control and reliability.

Unit I
Introduction: Distributed data processing; What is a DDBS; Advantages and disadvantages of DDBS; Problem areas; Overview of database and computer network concepts
Distributed Database Management System Architecture: Transparencies in a distributed DBMS; Distributed DBMS architecture; Global directory issues

Learning Outcomes:
After completion of this unit the student will be able to
- define the key objectives of a distributed database system. (L1)
- discuss some of the advantages of distributed database system. (L1)
- discuss some of the problems in database systems(L2)
- illustrate the architecture of distributed DBMS(L2)

Unit II
Distributed Database Design: Alternative design strategies; Distributed design issues; Fragmentation; Data allocation
Semantics Data Control: View management; Data security; Semantic Integrity Control
Query Processing Issues: Objectives of query processing; Characterization of query processors; Layers of query processing; Query decomposition; Localization of distributed data

Learning Outcomes:
After completion of this unit, the student will be able to
- list the various design strategies and issues. (L1)
- illustrate the data control, integrity and security(L2)
- build the layers of query processing(L3)
- apply the objectives of query processing and query decomposition. (L4)

Unit III
Distributed Query Optimization: Factors governing query optimization; Centralized query optimization; ordering of fragment queries; Distributed query optimization algorithms.
Learning Outcomes:
After completion of this unit, the student will be able to
• compare the various factors governing query optimization(L2)
• build the queries.(L3)
• compare the distributed and centralized query optimization(L4)
• test for different optimization algorithms.(L4)

Unit IV 8L
Transaction Management: The transaction concept; Goals of transaction management; Characteristics of transactions; Taxonomy of transaction models.
Concurrency Control: Concurrency control in centralized database systems; Concurrency control in DDBSs; Distributed concurrency control algorithms; Deadlock management
Learning Outcomes
After completion of this unit, the student will be able to
• apply the transaction management concepts.(L4)
• apply the transaction models (L4)
• distinguish between the concurrency control in centralized ddbss (L4)
• examine the various concurrency control algorithms.(L4)

Unit V 6L
Reliability: Reliability issues in DDBSs; Types of failures; Reliability techniques; Commit protocols; Recovery protocols
Learning Outcomes
After completion of this unit, the student will be able to
• compare the various issues in ddbss. (L4)
• categorize the failures. (L4)
• distinguish between the reliability techniques.(L4)
• evaluate the working of commit and recovery protocols.(L5)

TextBook(s):
2. D. Bell and J. Grimson “Distributed Database Systems”, Addison-Wesley,1992

Course Outcomes:
After completion of this course, the student will be able to
• define the basic concepts, advantages and the architecture of distributed dbms(L1)
• demonstrate the distributed design issues, data control and query processing issues(L2)
• identify the various distributed query optimization factors. (L3)
• evaluate the transaction management models and concurrency control. (L4)
• elaborate on the reliability issues and protocols.(L4)
The purpose of this course is to provide a clear understanding about various data analytic techniques available to solve real world business problems, communicate findings, and effectively present the results using data visualization techniques. The knowledge gained helps in applying the data science concepts and methods to solve problems in real-world contexts.

Course Objectives:
- Familiarize the student about the concepts of data visualization and formal inference procedures.
- Enable the student to interpret wider range of visual and numerical data.
- Train the student on basic machine learning algorithms.
- Demonstrate the Applications of Data Science, Technologies for visualization Handling of variables using Python.

Unit I
Introduction to core concepts and technologies: Introduction, Terminology, data science Process, data science toolkit, Types of data, Example applications.

Learning Outcomes:
After completion of this unit the student will be able to
- understand the basic concepts of data science (L2)
- identify the types of data (L2)

Unit II
Data collection and management: Introduction, Sources of data, Data collection and APIs, Exploring and fixing data, Data storage and management, using multiple data sources.

Learning Outcomes:
After completion of this unit the student will be able to
- understand about how to collect the data, manage the data, explore the data, store the data (L2)

Unit III
Data analysis: Introduction, Terminology and concepts, Introduction to statistics, Central tendencies and distributions, Variance, Distribution properties and arithmetic, Samples/CLT, Basic machine learning algorithms, Linear regression, SVM, Naive Bayes.

Learning Outcomes:
After completion of this unit the student will be able to
- understand the basic measures of central tendency. (L2)
- classify the data using svm and navie Bayesian. (L2)
Unit IV  
Data visualization: Introduction, Types of data visualization, Data for visualization: Data types, Data encodings. Retinal variables, mapping variables to encodings, Visual encodings.

**Learning Outcomes**
After completion of this unit the student will be able to
- familiarize about the visualization of data. (L4)
- apply coding techniques to data for securing the data. (L4)

Unit V  
Applications of Data Science, Technologies for visualisation, Bokeh (Python)

**Learning Outcomes**
After completion of this unit the student will be able to
- understand the various concepts of data science and can be able to handle simple applications of data science using python.(L2)

**Textbooks(s):**

**Course Outcomes:**
After completing this Course, the student should be able to
- identify the types of data (L1).
- understand about how to collect the data, manage the data (L2).
- classify the data using svm and naive bayesian (L3)
- apply coding techniques to data for securing the data (L4)
The purpose of this course is to familiarize you with the basic techniques of artificial intelligence/intelligent systems. An introduction to the theories and algorithms used to create intelligent systems. Topics include search algorithms, logic, planning, knowledge representation, machine learning, and applications from areas such as computer vision, robotics, natural language processing, and expert systems.

Course Objectives:
- Introduces students to the field of Artificial Intelligence (AI) with emphasis on its use to solve real world problems for which solutions are difficult to express using the traditional algorithmic approach.
- Explores the essential theory behind methodologies for developing systems that demonstrate intelligent behaviour including dealing with uncertainty, learning from experience and following problem solving strategies found in nature.

Unit I 9L

Learning Outcomes
After completion of this unit the student will be able to
- demonstrate good knowledge of basic theoretical foundations in Intelligent systems, Artificial neural networks. (L3)

Unit II 6L
Biological foundations to intelligent systems II: Fuzzy logic, knowledge representation and inference mechanism, genetic algorithm, and fuzzy neural networks.

Learning Outcomes
After completion of this unit the student will be able to
- demonstrate Fuzzy inferencing, Rule-based systems. (L3)

Unit III 8L

Learning Outcomes
After completion of this unit the student will be able to
- describe the attributes of various search techniques and the situations to which they are well-suited. (L1)
- implement standard AI algorithms. (L5)

Unit IV 9L
Knowledge representation and logical inference Issues in knowledge representation. Structured representation, such as frames, and scripts, semantic networks and conceptual graphs. Formal logic and logical inference. Knowledge-based systems structures, its basic components. Ideas of Blackboard architectures.

Learning Outcomes
After completion of this unit the student will be able to
- describe and apply various techniques for logic programming and machine learning. (L3)
- apply their knowledge to design solutions to different problems. (L4)
Unit V

Reasoning under uncertainty and Learning Techniques on uncertainty reasoning such as Bayesian reasoning, Certainty factors and Dempster-Shafer Theory of Evidential reasoning. A study of different learning and evolutionary algorithms, such as statistical learning and induction learning. Recent trends in Fuzzy logic, Knowledge Representation.

Learning Outcomes
After completion of this unit the student will be able to
• design and develop an intelligent system for a selected application. (L6)
• understand case-based reasoning - probabilistic reasoning - intelligent agents determine which type of intelligent system methodology would be suitable. (L2)

Text Book(s)

Course Outcomes:
After completing this Course, the student should be able to
• describe the attributes of various search techniques and the situations to which they are well-suited. (L2)
• describe and apply various techniques for logic programming and machine learning. (L2)
• implement standard AI algorithms. (L6)
• discuss the history and implications of artificial intelligence research. (L2)
This course provides an overview of techniques to explore, analyze, and leverage data. The goal of data preparation is to create the data and provide insight into methods for analysis and processing of the data generated by modern information systems. The data that was acquired from different sources will likely have many problems. It requires cleaning the data, and putting the data in the right format for analysis by addressing data quality issues that is checking the data for accuracy. The course also provides methods for how to prepare data for analysis, perform exploratory data analysis, and develop meaningful data visualizations.

Course Objectives:
• Learn gather data from data sources and clean the data.
• Prepare data marts and transform data for statistical analysis.
• Perform exploratory data analysis and apply statistical methods to data for further refining
• Develop meaningful Data Visualizations.
• Create visualizations by using summary statistics and visualization methods for data exploration.

Unit I 9 L
Data Gathering and Preparation: Introduction to Big data, Terminology, Big data life cycle, Process for Making Sense of Data, Describing Data, Data sources, Data understanding, Data preparation
Learning Outcomes
After completion of this unit the student will be able to
• outline the different characteristics of data(L2)
• summarize the process of preparing the data(L4)
• collect the data from different sources(L2)
• classify and describe the data types of raw data(L2)

Unit II 9 L
Data Cleaning: Data Tables, Graphs, Understanding Relationships, Visualizing Relationships between Variables, Calculating Metrics about Relationships, Data Visualization
Learning Outcomes
After completion of this unit, the student will be able to
• examine the data formats in the tables(L4)
• identify the relationships and their measures of data variables(L4)
• modify the relationships for analysis purpose(L6)
• construct visualizations to find the relationships. (L6)

Unit III 8 L
Exploratory Analysis: Descriptive statistics, inferential statistics, comparative statistics, Clustering and association
Learning Outcomes
After completion of this unit, the student will be able to

- understand different statistical methods used to prepare data (L2)
- apply statistical methods on data for further analysis (L4)
- use hypothesis tests to re-verify the data (L3)
- develop clusters and associations for the data (L5)

**Unit IV**

**Visualization: Designing visualizations, Time series, Geo-located data**

**Learning Outcomes**

After completion of this unit, the student will be able to

- use various time series in visualization (L3)
- distinguish various forms of visualizations (L4)
- design data visualizations for complex datasets (L6)
- generate visualizations for geo located data (L6)

**Unit V**

**Correlations and connections, Hierarchies and networks, interactivity**

**Learning Outcomes**

After completion of this unit the student will be able to

- understand the concept of correlations and connections (L2)
- explain how interactivity can be used for visualization (L4)
- imagine the basic hierarchies in a network for interactivity (L5)

**Textbook(s):**

4. Tamraparni Dasu, Exploratory Data Mining and Data Cleaning, A John Wiley & Sons, Inc.

**Course outcomes:**

After completing this Course, the student should be able to

- familiarize in converting data into valuable information. (L1)
- develop strategies for dealing with imperfect data. (L5)
- distinguish clustering and association and apply them in solving statistical problems. (L2)
- design visualizations for exploratory analysis. (L3)
- review the concept of correlations and connections for geo located data. (L3)
- visualize the basic hierarchies in a network for interactivity. (L2)
This course gives an introduction to some fields in soft computing with its principal components of Fuzzy logic, Neural Networks and Genetic Algorithms. It also focuses on simple implementation of neural networks and fuzzy logic using Matlab/Python. This course would be quite useful to study the fundamental concepts of soft computing for the pursuit of allied research also.

**Course Objectives:**
- Understand the fundamental concepts of soft computing and machine learning
- Perform operations on fuzzy sets
- Develop neural networks algorithms in machine learning
- Illustrate and apply genetic algorithms in machine learning
- Get practical exposure to implement artificial neural networks and fuzzy logic through matlab/Python

**Unit I**  

**Learning outcomes**
After completion of this unit the student will be able to
- define soft computing and neural network(L-1)
- illustrate the evolution of the field of soft computing(L-1)
- explain the basics of machine learning(L-2)

**Unit II**  

**Learning outcomes**
After completion of this unit the student will be able to
- name what are fuzzy sets, fuzzy operations and relations(L-1)
- define fuzzy reasoning and fuzzy inference systems (L-1)
- illustrate fuzzy expert systems and decision making using fuzzy logic (L-2)

**Unit III**  
Neural Networks: Machine Learning Using Neural Network, Adaptive Networks, Feed forward Networks, Supervised Learning Neural Networks, Radial Basis Function Networks: Reinforcement Learning, Unsupervised Learning Neural Networks, Adaptive Resonance architectures, Advances in Neural networks

**Learning outcomes**
After completion of this unit the student will be able to
• list various forms of neural networks (L1)
• define different types of learning a neural network (L1)
• identify how autonomous agents choose optimal decisions in their environments (L3)
• go through reinforcement learning

Unit IV  
5L

Learning outcomes
After completion of this unit the student will be able to
• model genetic learning method by an analogy to biological evolution (L3)
• experiment with hypothesis space search in genetic learning (L3)
• apply the concepts of genetic programming (L4)

Unit V  
12L
Matlab/Python Lib: Introduction to Matlab/Python, Arrays and array operations, Functions and Files, Study of neural network toolbox and fuzzy logic toolbox, Simple implementation of Artificial Neural Network and Fuzzy Logic

Learning outcomes
After completion of this unit the student will be able to
• identify various fundamental concepts of Matlab/Python (L3)
• experiment with toolboxes of neural network and fuzzy logic (L3)
• inspect a simple implementation of artificial neural network and fuzzy logic (L4)

Text Book(s):

Course outcomes:
After completion of this course, the student will be able to..
• illustrate the evolution and basics of soft computing and machine learning. (L1)
• Experiment with fuzzy sets, operations, fuzzy inference and expert systems. (L5)
• list various forms of neural networks and their learning. (L1)
• illustrate genetic algorithms and their applications. (L3)
• experiment with Matlab/Python to understand the implementation of artificial neural network and fuzzy logic. (L5)
1. Tutorial on Tensorflow
2. Tutorial on keras
3. Implement Union, Intersection, complement and difference operations on Fuzzy sets.
5. Build Logistic Regression Classifier using Neural Networks
6. Build Deep neural network for classification
7. Build neural network for Regression
8. Build a classification model using different parameter initialization techniques.
10. Implement Genetic algorithm.
The following exercises have to be performed using various software tools/utilities mentioned Software Tools:

1. CyberCheck 4.0 - Academic Version
2. CyberCheckSuite
3. MobileCheck
4. Network SessionAnalyser
5. Win-LiFT
6. TrueImager
7. TrueTraveller
8. PhotoExaminer Ver1.1
9. CDRAnalyzer

Forensics Exercises:

I) DiskForensics:
1. Identify digitalevidences
2. Acquire theevidence
3. Authenticate theevidence
4. Preserve theevidence
5. Analyze theevidence
6. Report the findings

II) NetworkForensics:
- Intrusiondetection
- Logging (the best way to track down a hacker is to keep vast records of activity on a network with the help of an intrusion detection system)
- Correlating intrusion detection andlogging

II) Device Forensics

1. PDA
2. Mobilephone
3. DigitalMusic

10. PrinterForensics
11. ScannerForensics
Each student shall survey a technical topic related to a chosen specialization and prepare/submit a report in a specified format. It is advisable for students to choose a topic of interest to be continued as M.Tech Project in the 3rd & 4th Semester. The guidelines to carry out the research shall include the following:

1. Literature Review
2. Identification of Gap
3. Objectives and Expected Outcomes
4. Methodology / Innovative solution

Each student has to prepare a power point presentation on a selected technical topic with a novelty and get it evaluated by the faculty assigned for this purpose.
The course is designed to enable the student to learn the fundamental aspects of wireless networks, with emphasis on current and next-generation wireless networks. Various aspects of wireless networking will be covered including: fundamentals of cellular communication, mobile radio propagation, multiple access techniques, mobility support, channel allocation, Wireless PAN/LAN/MAN standards, mobile ad-hoc networks, wireless sensor networks, mobile networks. The goal of this course is to introduce the students to state-of-the-art wireless network protocols and architectures and will introduce the students to wireless networking research and guide them to investigate novel ideas in the area via semester-long research projects.

Course Objectives:

- Understanding on functioning of wireless communication system and evolution of different wireless communication systems and standards.
- Compare recent technologies used for wireless communication.
- Explain the architecture, functioning, protocols, capabilities and application of various wireless communication networks and wireless cellular networks.
- Explain multiple access techniques for Wireless Communication.
- Evaluate design challenges, constraints and security issues associated with wireless networks and mobile networks.

Unit I 12L
Wireless Local Area Networks: IEEE 802.11 Wireless LANs Physical & MAC layer, 802.11 MAC Modes (DCF & PCF) IEEE 802.11 standards, Architecture & protocols, Infrastructure vs Adhoc Modes, Hidden Node & Exposed Terminal Problem, Problems, Fading Effects in Indoor and outdoor WLANs, WLAN Deployment issues.

Learning Outcomes
After completing this Unit, students will be able to
- demonstrate WLAN architecture. [L2]
- learn the characteristics of the wireless channel and multiple access technologies [L2]
- analyze the functionality of MAC layer of WLAN [L4]

Unit II 10L

Learning Outcomes
After completing this Unit, students will be able to
- determine the coverage and capacity of Wireless Cellular Networks. [L5]
- analyze different technologies in Wireless Cellular Networks [L4]
- compare the strategies in TCP over wireless networks [L4]
- demonstrate Cellular Architecture [L2]
Unit III 8L
WiMAX (Physical layer, Media access control, Mobility and Networking), IEEE 802.22 Wireless Regional Area Networks, IEEE 802.21 Media Independent Handover Overview

Learning Outcomes
After completing this Unit, students will be able to
- demonstrate WSN architecture. [L2]
- select which protocol can be used for a specific application [L4]
- evaluate the power management in WSN [L4]

Unit IV 6L
Wireless PANs: Bluetooth AND ZigBee, Introduction to Wireless Sensors,

Learning Outcomes
After completing this Unit, students will be able to
- demonstrate Wireless PANs technology. [L2]
- determine different protocols and sensors in Wireless communication [L5]
- compare the different sensors in wireless communication [L5]

Unit V 6L

Learning Outcomes
After completing this Unit, students will be able to
- evaluate design challenges, constraints and security issues associated with wireless networks and mobile networks.[L4]
- learn different security techniques in Wireless communication [L2]
- compare the different DoS attacks in wireless communication [L5]

Text Book(s)
1. Schiller J., Mobile Communications, Addison Wesley 2000
2. Stallings W., Wireless Communications and Networks, Pearson Education 2005
5. Pandya Raj, Mobile and Personal Communications Systems and Services, PHI.

Course Outcomes:
After completion of this course, the student will be able to
- demonstrate their understanding on functioning of wireless communication system and evolution of different wireless communication systems and standards.[L2]
- compare different technologies used for wireless communication systems.[L5]
- explain the architecture, functioning, protocols, capabilities and application of various wireless communication networks.[L2]
- demonstrate multiple access techniques for wireless communication.[L2]
- demonstrate design challenges, constraints and security issues associated with wireless networks and wireless cellular networks.[L2]
The course takes a software development perspective to the challenges of engineering software systems that are secure. This course addresses design and implementation issues critical to producing secure software systems. The course deals with the question of how to make the requirements for confidentiality, integrity, and availability integral to the software development process from requirements gathering to design, development, configuration, deployment, and ongoing maintenance.

Course Objectives:
- Fix software flaws and bugs in various software.
- Aware of various issues like weak random number generation, information leakage, poor usability, and weak or no encryption on data traffic
- Understand the Techniques for successfully implementing and supporting network services on an enterprise scale and heterogeneous systems environment.
- Learn methodologies and tools to design and develop secure software containing minimum vulnerabilities and flaws.
- Study and handle the various threats, attacks and malwares methodologies.

Unit I 8L
Secure Software Design: Identify software vulnerabilities and perform software security analysis, Master security programming practices, Master fundamental software security design concepts, perform security testing and quality assurance.

Learning Outcomes
After completion of this unit the student will be able to
- understand the software vulnerabilities and to know the security design concepts (L1)
- perform software security analysis, programming practices (L2)

Unit II 11L
Enterprise Application Development: Describe the nature and scope of enterprise software applications, Design distributed N-tier software application, Research technologies available for the Presentation, business and data tiers of an enterprise software application, Design and build a database using an enterprise database system, Develop components at the different tiers in an enterprise system, Design and develop a multi-tier solution to a problem using technologies used in enterprise system, Present software solution.

Learning Outcomes
After completion of this unit the student will be able to
- understand the nature and scope of enterprise software applications (L2)
- design N-tier software application and built database system(L4)
- develop multi-tier solution to a problem using technologies used in enterprise system (L5)

Unit III 8L
Enterprise Systems Administration: Design, implement and maintain a directory-based server infrastructure in a heterogeneous systems environment, Monitor server resource utilization for system reliability and availability, Install and administer network services (DNS/DHCP/Terminal Services/Clustering/Web/Email).

Learning Outcomes
After completion of this unit the student will be able to
- implement a directory-based server infrastructure. (L5)
- install and monitor network services for system reliability and availability. (L6)
Unit IV 8L
Obtain the ability to manage and troubleshoot a network running multiple services, Understand the requirements of an enterprise network and how to go about managing them.

**Learning Outcomes**
After completion of this unit the student will be able to
- understand the requirements of an enterprise network (L2)
- troubleshoot a network running multiple services (L5)

Unit V 7L
Handle insecure exceptions and command/SQL injection, defend web and mobile applications against attackers, software containing minimum vulnerabilities and flaws.

**Learning Outcomes**
After completion of this unit the student will be able to
- understand the concepts of exceptions and command/SQL injection. (L2)
- handle web and mobile applications against attackers. (L4)

**Text Book(s)**
1. Theodor Richardson, Charles N Thies, Secure Software Design, Jones &Bartlett

**Course Outcomes:**
After completion of course, students would be able to:
- differentiate between various software vulnerabilities. (L4)
- describe software process vulnerabilities for an organization. (L5)
- monitor resources consumption in a software. (L4)
- interrelate security and software development process. (L4)
- design the Software which can able to overcome all threats. (L5)
This course introduces students the fundamentals of image formation with major ideas, methods, and techniques of computer vision and pattern recognition. It develops an appreciation for various issues in the design of computer vision and object recognition systems. The student with programming experience from implementing computer vision and object recognition applications.

Course Objectives:
- Introduce the fundamentals of image formation.
- Introduce major ideas, methods, and techniques of computer vision and pattern recognition.
- Develop an appreciation for various issues in the design of computer vision and object recognition systems.
- Provide with programming experience from implementing computer vision and object recognition applications.

Unit I 8L
Overview, computer imaging systems, lenses, Image formation and sensing, Image analysis, pre-processing and Binary image analysis

Learning Outcomes
After completion of this unit the student will be able to
- familiar with both the theoretical and practical aspects of computing with images. (L1)
- describe the foundation of image formation, measurement, and analysis. (L1)
- implement common methods for robust image matching and alignment. (L5)

Unit II 8L
Edge detection, Edge detection performance, Hough transform, corner detection

Learning Outcomes
After completion of this unit the student will be able to
- understand the geometric relationships between 2d images and the 3d world. (L2)
- get exposure to object and scene recognition and categorization from images (L1)

Unit III 8L
Segmentation, Morphological filtering, Fourier transform

Learning Outcomes
After completion of this unit the student will be able to
- develop fourier transform for image processing in frequency domain. (L4)
- design and implement algorithms for advanced image analysis (e.g., image compression, image segmentation & image representation). (L3)
- assess the performance of image processing algorithms and systems. (L1)

Unit IV 8L
Feature extraction, shape, histogram, color, spectral, texture, using CVIP tools, Feature analysis, feature vectors, distance /similarity measures, data pre-processing

Learning Outcomes
After completion of this unit the student will be able to
- identify the limitations of vision systems.(L1)
- develop skills to implement boundary detection and motion related techniques. (L2)

Learning Outcomes
After completion of this unit the student will be able to
- apply different de-noising models to recover original image. (L4)
- identify different pattern recognition methods and apply them in problem area. (L1)

Textbook(s):

Course Outcomes:
After completion of this course, the student will be able to
- identify basic concepts, terminology, theories, models and methods in the field of computer vision. (L4)
- describe known principles of human visual system. (L2)
- describe basic methods of computer vision related to multi-scale representation, edge detection and detection of other primitives, stereo, motion and object recognition. (L2)
- design a computer vision system for a specific problem. (L5)
HCI is the study of how people interact with computers and up to what level computers are for triumphant communication with human beings. It deals with the design, execution and assessment of computer systems and related phenomenon that are for human use. Because of the name, the three parts of HCI are: the user, the computer itself, and how they work together. HCI can be used in all disciplines wherever there is a possibility of computer installation.

**Course Objectives:**
- Learn the foundations of Human Computer Interaction
- Familiar with the design technologies for individuals and persons with disabilities
- Aware of mobile HCI.
- Design HCI implications for designing multimedia/ecommerce/e-learning Web sites.
- Learn the guidelines for user interface.

**Unit I**


**Learning Outcomes**
After completion of this unit the student will be able to
- understand the concept of I/O Channels, Memory (L2).
- learn in detail about Memory and networks (L2).
- make use of various Models. (L3)

**Unit II**


**Learning Outcomes**
After completion of this unit the student will be able to
- list the Interactive Design Basics (L2).
- make use of HCI in Software Process (L3).
- understand various designing rules (L2).

**Unit III**

Cognitive models –Socio-Organizational issues and stake holder requirements–Communication and collaboration models-Hypertext, Multimedia and WWW.

**Learning Outcomes**
After completion of this unit the student will be able to
- make use of cognitive models (L3).
- design effective HCI for individuals and persons with disabilities (L6).

**Unit IV**


**Learning Outcomes**
After completion of this unit the student will be able to..

- understand types of mobile applications (L2).
- develop HCI implications for designing multimedia/ecommerce/e-learning Web sites (L6).

Unit V


Learning Outcomes

After completion of this unit the student will be able to

- make use of various Contextual tools and Overlays (L3).
- develop meaningful user interface (L6).

Text Book(s):


Course Outcomes:

After completion of this course, the student will be able to

- make use of various Models. (L1)
- make use of HCI in Software Process. (L1)
- design effective HCI for individuals and persons with disabilities. (L6)
- develop HCI implications for designing multimedia/ecommerce/e-learning Web sites. (L6)
Most modern computers come with Graphical Processing Units (GPUs) that can be used for general purpose computing. GPUs provide much more computing power than CPUs do, by using more of their hardware resources for computing than CPUs do. GPUs deal with memory access latency primarily through multi-threading; when some threads are stalled accessing data, other threads can perform computation without a significant context-switch penalty. This course will describe different approaches to solve such problems, in order to develop efficient parallel algorithms for a variety of problems.

Course Objectives:

- Explain theoretical and empirical knowledge about graphics programming, memory management using for evaluating various parameters across the devices.
- Enable to acquire knowledge about different synchronization methods exists within the CPU and learn about common application kernels.
- Familiarize algorithms to provide parallel solutions to computationally challenging problems.
- Enable to implement such solutions on GPU using CUDA, and show effectiveness of the GPU based solutions using standard benchmarks and tools.

Unit I
Introduction: History, Graphics Processors, Graphics Processing Units, GPGPUs. Clock speeds, CPU / GPU comparisons, Heterogeneity, Accelerators, Parallel programming, CUDA OpenCL / OpenACC ,Hello World Computation Kernels, Launch parameters, Thread hierarchy, Warps/Wavefronts, Thread blocks / Workgroups, Streaming multiprocessors, 1D / 2D/ 3D thread mapping, Device properties, Simple Programs

Learning Outcomes:
After completion of this unit the student will be able to
- show the various parallel programs. (L1)
- understand the different graphics processors(L2).
- identify the kernels and Thread mappings .(L2)
- develop simple programs(L6)

Unit II
Memory: Memory hierarchy, DRAM / global, local / shared, private / local, textures, Constant Memory, Pointers, Parameter Passing, Arrays and dynamic Memory, Multi-dimensional Arrays, Memory Allocation, Memory copying across devices, Programs with matrices, Performance evaluation with different memories

Learning Outcomes:
After completion of this unit, the student will be able to
- understand the categories of memories.(L2)
- implement dynamic memory allocation (L3).
- explain arrays and pointers(L2).

Unit III
Synchronization: Memory Consistency, Barriers (local versus global), Atomics, Memory fence. Prefix sum, Reduction. Programs for concurrent Data Structures such as Worklists, Linked-lists. Synchronization across CPU and GPU Functions: Device functions, Host functions, Kernels functions, Using libraries(such as Thrust), and developing libraries.

Learning Outcomes:
After completion of this unit, the student will be able to
- explain the synchronization procedures (L2).
- summarize about CPU and GPU functions (L4).
- explain the concurrent data structures (L2).

**Unit IV**

Support: Debugging GPU Programs. Profiling, Profile tools, Performance aspects

**Learning Outcomes:**
After completion of this unit, the student will be able to
- understand the debugging process of GPU programs (L2).
- explain about pitfalls and event based synchronization (L2).

**Unit V**

Case Studies: Image Processing, Graph algorithms, Simulations, Deep Learning
Advanced topics: Dynamic parallelism, Unified Virtual Memory, Multi-GPU processing, Peer access, Heterogeneous processing

**Learning Outcomes:**
After completion of this unit, the student will be able to
- implement the different scenarios using graph simulations (L4)
- explain Image processing (L2).
- outline about deep learning (L2).

**Text Book(s)**

**Course Outcomes**
After completion of course, students would be able to:
- understand the GPU and its aspects (L1)
- demonstrate synchronization and kernel functions (L3).
- determine different web based applications using deep learning (L3).
The course is designed to enable the student to understand underlying principles and many of the techniques associated with the digital forensic practices and cybercrime, investigate attacks, handling evidences. Student can have a sneak review of Computer Forensics, Network Forensics, And Mobile Forensics.

Course Objectives:
- Familiarize the student about digital and computer forensics.
- Enable the student to learn analysis of crime scene.
- Manage and present evidences
- Demonstrate investigation process with case study.

Unit I 8L
Digital Forensics Science: Forensics science, computer forensics, and digital forensics.
Computer Crime: Criminalistics as it relates to the investigative process, analysis of cyber-criminalistics area, holistic approach to cyber-forensics

Learning Outcomes
After completion of this unit, the student will be able to
- understand the functionalities of Forensic Science (L1).
- list the types of computer and digital crimes (L1).
- analyze areas that are vulnerable to cybercrimes (L5).

Unit II 8L
Cyber Crime Scene Analysis: Discuss the various court orders etc., methods to search and seizure electronic evidence, retrieved and un-retrieved communications, Discuss the importance of understanding what court documents would be required for a criminal investigation.

Learning Outcomes
After completion of this unit, the student will be able to
- understand the legal procedures to seize evidence (L2).
- learn types of information retrieval procedures from evidences (L2).
- generate necessary documents that assist criminal investigation (L3).

Unit III 10L
Evidence Management & Presentation: Create and manage shared folders using operating system, importance of the forensic mindset, define the workload of law enforcement, explain what the normal case would look like, define who should be notified of a crime, parts of gathering evidence, Define and apply probable cause.

Learning Outcomes
After completion of this unit, the student will be able to
- understand various Operating System functionalities (L1).
- know necessity of forensic mindset to judge the crime instincts (L1).
- learn the acts to be performed at the crime scene (L2).

Unit IV 10L
Computer Forensics: Prepare a case, begin an investigation, understand computer forensics workstations and software, conduct an investigation, complete a case, Critique a case, Network Forensics: open-source security tools for network forensic analysis, requirements for preservation of network data.
Learning Outcomes
After completion of this unit, the student will be able to
• investigates and Judges a crime from a given case study (L5).
• familiarize with network forensic analysis tools (L4).

Unit V
Mobile Forensics: mobile forensics techniques, mobile forensics tools.
Learning Outcomes
After completion of this unit, the student will be able to
• learn about the mobile specific forensic techniques(L2).
• acquaint with the tools that support mobile forensics (L4).
• familiarize with the various legal acts with respect to Digital Forensics (L2).

Text Book(s)

Course Outcomes:
After completion of this course, the student will be able to
• define the concept of Forensics and its associates. (L1)
• underline the need of digital forensic and role of digital evidences. (L2)
• explain the methodology of incident response and various security issues in ICT world, and identify digital forensic tools for data collection. (L3)
• recognize the importance of various digital forensic tools for analysis to achieve adequate perspectives of digital forensic investigation in various applications/devices like Windows/Unix system. (L4)
• list the method to generate legal evidence and supporting investigation reports and will also be able to use various digital forensic tools. (L5)
This course is designed to enable the student to deploy the mobile based applications using android operating system as platform. First the basics of mobile applications and android system are taught then application deployment is explained in terms of network perspective and in line with the standard security protocols which can be consumed as a service.

**Course Objectives:**
- Familiarize the student with the basics of mobile applications and android operating system.
- Enable the student to build mobile applications.
- Explain with the features and constructs of android operating system and networking.
- Demonstrate the handling of various functionalities such as graphical user interfaces, Data framework and tools.

**Unit I**

**Learning Outcomes**
After completion of this unit, the student will be able to
- gain insights on mobile computing and android environment (L1).
- understand various factors of development, framework and tools involved (L2).

**Unit II**
More on UIs: VUIs and Mobile Apps, Text-to-Speech Techniques, Designing the Right UI, Multichannel and Multimodal UIs, Storing and Retrieving Data, Synchronization and Replication of Mobile Data, Getting the Model Right, Android Storing and Retrieving Data, Working with a Content Provider

**Learning Outcomes**
After completion of this unit, the student will be able to
- select an appropriate model of UI that suits his requirement. (L1)
- familiarize themselves with data access and content providers. (L2)

**Unit III**

**Learning Outcomes**
After completion of this unit, the student will be able to
- deal with the communication domain such telephony, notification management. (L1)
- analyse performance and memory management. (L3)

**Unit IV**
Putting It All Together: Packaging and Deploying, Performance Best Practices, Android Field Service App, Location Mobility and Location Based Services Android Multimedia: Mobile Agents and Peer-to-Peer Architecture, Android Multimedia

**Learning Outcomes**
After completion of this unit, the student will be able to

- adapt a best field practice for deployment of service apps. (L3)
- gain fundamental knowledge on android related multimedia. (L1)

**Unit V**


**Learning Outcomes**

After completion of this unit, the student will be able to

- build a final version of the app that is tested and deployed. (L5)
- deal with unforeseen circumstances such as hacking and other network related threats (L4).

**Text Book(s)**


**Course Outcomes:**

After completion of this course, the student will be able to

- understand and analyze various factors of development, framework and tools involved in mobile computing and android environment. (L4)
- select an appropriate model of UI that suits the requirement and data access and content providers. (L6)
- deal with the communication domain prospects such as telephony, notification management. Analyse performance and memory management. (L4)
- choose best field practice for deployment of service apps in android related multimedia. (L5)
- deploy a final version of the app that is tested and deployed and to deal with hacking and other network related threats. (L5)
Optimizing compilers play a critical role in modern computer systems ranging from mobile devices to supercomputers. Compilers can optimize for performance, power consumption and/or code size. Practically all computer scientists and engineers may benefit for a deep knowledge of compiler optimizations: programmers and application optimizers write programs that are better optimized by the compiler, computer designers design hardware features that are easy to use by compilers, and finally compiler writers develop new compiler optimizations.

Course Objectives:
- Know the most common machine independent optimizations.
- Know scheduling techniques and register allocation for exploiting Instruction Level Parallelism
- Know the most common memory locality optimizations
- Learn the concept and compiler techniques for exploiting Data Level Parallelism
- Compiler techniques and tools for exploiting Thread Level Parallelism
- Make a technical report on some advanced compiler technique
- Make a presentation so that the other students learn some advanced compiler technique

Unit I
High Performance Systems, Structure of a Compiler, Programming Language Features, Languages for High Performance.

Learning Outcomes:
After completing the course, you will be able to
- understand large-scale simulations. (L1)
- learn parallel architecture and programming models. (L1)

Unit II
Data Dependence: Data Dependence in Loops, Data Dependence in Conditionals, Data Dependence in Parallel Loops, Program Dependence Graph. Scalar Analysis with Factored Use-Def Chains: Constructing Factored Use-Def Chains, FUD Chains for Arrays, Induction Variables Using FUD Chains, Constant Propagation with FUD Chains, Data Dependence for Scalars.

Learning Outcomes:
After completing the course, you will be able to
- learn the concept and compiler techniques for exploiting data level parallelism. (L1)
- understand Compiler techniques and tools for exploiting Thread Level Parallelism. (L2)

Unit III
Optimizing for Locality: Single Reference to Each Array, Multiple References, General Tiling, Fission and Fusion for Locality.

Learning Outcomes:
After completing the course, you will be able to
- understand the components and operation of a memory hierarchy and the range of performance issues influencing its design. (L2)
- understand compiler techniques and tools for exploiting thread level parallelism. (L2)
Unit IV

Learning Outcomes:
After completing the course, you will be able to
• understand students, learn some advanced compiler technique. (L2)
• rectify the error and bug with well-known techniques. (L5)

Unit V
Message-Passing Machines: SIMD Machines, MIMD Machines, Data Layout, Parallel Code for Array Assignment, Remote Data Access, Automatic Data Layout, Multiple Array Assignments, Other Topics.
Scalable Shared-Memory Machines: Global Cache Coherence, Local Cache Coherence, Latency Tolerant Machines.

Learning Outcomes:
After completing the course, you will be able to
• describe architectural hardware and software issues for high performance computing systems. (L5)
• explain programming models of parallelism. (L2)
• describe selected parallel algorithms and approaches for computer modelling and simulations of selected applications. (L5)

Text Book(s):
1. Michael Wolfe, High-Performance Compilers for Parallel Computing, Pearson

Course outcomes:
• learn the advantages, issues and challenges of the current processors. (L1)
• learn how to optimize a parallel code. (L1)
• understand the various parallel programming paradigms and learn how to choose the right one based on the application domain. (L1)
• implement parallel codes that are optimized for performance. (L5)
Introduction to optimization techniques using programming. After an adequate introduction to branches of mathematical Programming and Optimization Algorithms, students will learn to solve engineering problems in the framework of optimization problems.

Course Objectives:
- Analyze real-life problems, especially, logistics problems, through the use of mathematical modeling techniques.
- Gain familiarity with various modeling techniques to build mathematical models for computer engineering problems.
- Perform evaluation and interpretation of optimization results.

Unit I
Engineering application of Optimization, Formulation of design problems as mathematical programming problems.
Learning Outcomes
After completion of this unit the student will be able to
- learn efficient computational procedures to solve optimization problems. (L1)
- cast engineering problems into optimization framework. (L1)

Unit I
General Structure of Optimization Algorithms, Constraints, The Feasible Region.
Learning Outcomes:
After completion of this unit the student will be able to
- formulate a wide range of problems. (L2)
- model and give appropriate solutions to issues related to computer science. (L1)

Unit III
Learning Outcomes:
After completion of this unit the student will be able to:
- identify the mathematical nature of a given optimization problem. (L1)
- analyze a range of classes of optimization problems. (L3)

Unit IV
Optimization Algorithms like Genetic Optimization, Particle Swarm Optimization, Ant Colony Optimization etc.
Learning Outcomes:
After completion of this unit the student will be able to
- develop the skills to analyse Optimization Algorithms. (L3)
- identify solution methods for the optimization problems study. (L1)

Unit V
Real life Problems and their mathematical formulation as standard programming problems.
Learning Outcomes:
After completion of this unit the student will be able to
- model real-life problems as optimization problems. (L3)
• devise a solution method appropriate to the characteristics of a given problem. (L4)

Text Book(s):

Course Outcomes:
After completion of this course, the student will be able to
• cast engineering problems into optimization framework. (L1)
• model and give appropriate solutions to issues related to computer science. (L1)
• analyze a range of classes of optimization problems. (L4)
• develop the skills to analyse optimization algorithms. (L5)
• develop solution method appropriate to the characteristics of a given problem.(L5)
This course introduces the student to the different aspects of research paper writing including planning, preparation, layout, literature review write-up etc. Specifically the perspective and style of writing in different sections of a research paper is highlighted. Students will be exposed to English language skills relevant to research paper writing.

Course Objectives:
- To write clearly, concisely and carefully by keeping the structure of the paper in mind.
- To use standard phrases in English and further improve his command over it.
- To write with no redundancy, no ambiguity and increase the readability of the paper.
- To plan and organize his paper by following a logical buildup towards a proper conclusion.
- To decide what to include in various parts of the paper.
- To write a suitable title and an abstract in order to attract the attention of the reader.
- To identify the correct style and correct tense.
- To retain the scientific value of the paper by using minimum number of words.

Unit I
Planning and Preparation, Word Order, breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness.

Learning Outcomes:
After the completion of this unit, the student will be able to
- To know the expectations of various journals and referees (L2)
- To know the typical structure of a paper (L3)
- Learn to put words in a sentence in the correct order (L4)
- To write short and clear sentences from the very beginning of the paper (L4)
- To increase the readability of the paper by making it easy to read and 100% clear (L4)
- Learn to be concise without losing any important content (L4)
- To avoid some typical grammar mistakes made in research papers (L4)

Unit II

Learning Outcomes:
After the completion of this unit, the student will be able to
- Learn to make useful contribution worth recommending for publication (L4)
- Learn good use of language to make readers notice the key findings (L4)
- Learn to anticipate or predict possible objections to the claims made in the paper (L5)
- To understand what is plagiarism, and how to paraphrase other people’s work (L4)
- Learn to attract the right kind of readers with a suitable title (L3)
- Learn to sell the abstract to potential readers by attracting their curiosity (L2)
Unit III
Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check. Key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature.

Learning Outcomes:
After the completion of this unit, the student will be able to
• Have a deep knowledge about everything that has been previously written on the topic and decide what is important to know in Introduction. (L3)
• Learn to provide the right amount of literature regarding the sequence of events leading up to the current situation in the Literature review (L4)

Unit IV
Writing Skills: skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions.

Learning Outcomes:
After the completion of this unit, the student will be able to
• Learn to describe the materials used in experiments and/or the methods used to carry out the research (L2)
• The key skill is in reporting the results simply and clearly (L3)
• Learn to structure the Discussion and satisfy the typical requirements of the referees (L4)
• Learn to provide a clear and high-impact take-home message in the conclusion (L5)

Unit V
Good Paper Writing: Useful phrases, how to ensure paper is as good as it could possibly be the first-time submission.

Learning Outcomes:
After the completion of this unit, the student will be able to
• Learn various lists of frequently used phrases that have a general acceptance in all disciplines and use in specific sections of the paper (L3)
• Learn various kinds of things one should look for when doing the final check (L3)

Text Book(s):

References:

Course Outcomes:
By the end of the course the students will be able to:
• Frame the structure of the paper precisely. (L2).
• Improve his command over English by using standard phrases. (L3).
• Avoid repetition and mistakes in the paper and increase its readability. (L3).
• Organize the paper logically towards a proper conclusion. (L4).
• Decide on the content to be included in various parts of the paper. (L5).
• Identify whether to use personal or impersonal style in the paper. (L5).
• Express the content in a clear and concise way. (L6).
• Attract the attention of the reader by providing a suitable title and an appropriate abstract. (L6).
19EAC742: DISASTER MANAGEMENT

This course is intended to provide fundamental understanding of different aspects of Disaster Management. It will expose the students to the concept and functions of Disaster Management and to build competencies of Disaster Management professionals and development practitioners for effective supporting environment as put by the government in legislative manner. It would also provide basic knowledge, skills pertaining to Planning, Organizing and Decision-making process for Disaster Risk Reduction.

Course Objectives
• to provide students an exposure to disasters, their significance, types & Comprehensive understanding on the concurrence of Disasters and its management.
• to ensure that students begin to understand the relationship between vulnerability, disasters, disaster prevention, risk reduction and the basic understanding of the research methodology for risk reduction measures.
• equipped with knowledge, concepts, and principles, skills pertaining to Planning, Organizing, Decision-making and Problem solving methods for Disaster Management.
• to develop rudimentary ability to respond to their surroundings with potential disaster response in areas where they live, with due sensitivity.

Unit I
Introduction
Disaster: Definition, Factors and Significance; Difference Between Hazard and Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude.

Learning Outcomes
After the completion of this unit, the student will be able to
• define the meaning, list the factors and mention the significance of disaster (L1)
• distinguish between hazard and disaster (L3)
• compare manmade and natural disaster (L3)
• list the types of disaster and describe their magnitude (L2)

Unit II

Learning Outcomes
After the completion of this unit, the student will be able to
• list the different repercussions of disasters and hazards(L1)
• describe the characteristics of natural disasters and the magnitude of their losses(L2)
• describe the characteristics of man-made disasters and the magnitude of their losses(L2)
• elaborate the outbreaks of diseases and epidemics after disasters (L3)
Unit III  6L

Disaster Prone Areas in India Study of Seismic Zones; Areas Prone to Floods and Droughts, Landslides and Avalanches; Areas Prone to Cyclonic and Coastal Hazards with Special Reference to Tsunami; Post-Disaster Diseases and Epidemics.

Learning Outcomes
After the completion of this unit, the student will be able to
• describe the seismic zones and their characteristics(L2)
• identify the areas prone to floods and droughts(L1)
• distinguish between landslides and avalanches(L3)
• identify areas prone to cyclonic and coastal hazards(L4)
• enumerate the post disaster diseases and epidemics(L2)

Unit IV  6L

Disaster Preparedness and Management Preparedness: Monitoring of Phenomena Triggering a Disaster or Hazard; Evaluation of Risk: Application of Remote Sensing, Data from Meteorological and Other Agencies, media reports: governmental and Community Preparedness.

Learning Outcomes
After the completion of this unit, the student will be able to
• describe the monitoring of phenomena triggering a disaster/hazard(L2)
• evaluate the risk with the use of remote sensing and meteorological data(L5)
• list the governmental and community measures for disaster preparedness(L2)

Unit V  6L


Learning Outcomes
After the completion of this unit, the student will be able to
• define and list the elements of disaster risk(L1)
• enumerate the measures for risk reduction(L2)
• apply the techniques of risk assessment (L4)
• identify the means of people’s participation in risk assessment(L2)

Text Book(s):
2. Sahni, Pardeep, Disaster Mitigation Experiences and Reflections, Prentice Hall of India, New Delhi., 2012
Course Outcomes
At the end of the course, student will be able to

• Identify management activities in pre, during and post phases of Disasters. (L1)
• Plan disaster management activities and specify measure for risk reduction(L4)
• apply risk assessment techniques in real life disaster scenarios(L4)
This course is intended to expose the student to the need for human values and methods to cultivate them for leading an ethical life with good moral conduct. Students taking this course will be able to experience a change in personal and professional behavior with these ethical principles guiding him throughout life.

**Course Objectives**

- to expose the student to need for values, ethics, self-development and standards
- to make the student understand the meaning of different values including duty, devotion, self-reliance etc.
- to imbibe the different behavioral competencies in students for leading an ethical and happy life
- to expose the student to different characteristic attributes and competencies for leading a successful, ethical and happy profession life.

**Unit I**

**Learning Outcomes**

After the completion of this unit, the student will be able to

- define the social values and individual attitudes for self development (L1)
- describe the Indian vision of humanism (L2)
- distinguish between moral and non-moral acts (L3)
- list the standards and value principles for moral conduct (L2)

**Unit II**

**Learning Outcomes**

After the completion of this unit, the student will be able to

- describe the importance of cultivating values (L2)
- list the different traits of self-developed individual (L1)
- explain the need for loving nature/country/humanity (L2)

**Unit III**

**Learning Outcomes**

After the completion of this unit, the student will be able to
• describe the benefits of positive thinking, integrity and discipline (L2)
• list the different methods for avoiding fault finding, anger (L1)
• explain the methods to overcome suffering, religious intolerance, self-destructive habits (L2)

Unit IV


Learning Outcomes

After the completion of this unit, the student will be able to
• describe the science of reincarnation (L2)
• explain the relation between self-management and good health (L1)
• elaborate the role of different religions in reaching the common goal (L3)
• list the different techniques for mind-control to improve personality and studies (L1)

Text Book(s):

Course Outcomes

After successful completion of the course, the student will be able to
• describe the need for human values and methods for self development (L2)
• elaborate the different traits and benefits of a self-developed individual (L1)
• list the different attributes of self-developed individual (L1)
• elaborate the role and scope of books/faith/health/religions in character building and competence development (L3)
19EAC745: CONSTITUTION OF INDIA

This course is intended to expose the student to the philosophy of Indian constitution. Students will be able to understand their fundamental rights/duties and governance structure. Students also appreciate the role of election commission in establishing a democratic society.

Course Objectives

- to familiarize the student about the need for a constitution
- to make the student understand the role of constitution in a democratic society
- to acquaint the student with key constitutional features and fundamental rights of a citizen
- to impart the organs of governance and local administration hierarchy and their responsibilities
- to familiarize the student with the role, responsibilities and administration hierarchy of election commission

Unit I 5L


Learning Outcomes

After the completion of this unit, the student will be able to

- list the outline of drafting committee and their roles in the making of Indian constitution (L1)
- describe the need and role of a constitution in a democratic society (L2)
- elaborate the salient features of Indian constitution (L3)

Unit II 5L


Learning Outcomes

After the completion of this unit, the student will be able to

- list the fundamental rights of a citizen (L1)
- explain the intricacies in the different rights (L2)
- elaborate the fundamental duties of a citizen (L3)
- describe the principles of state policy (L2)

Unit III 6L

Organs of Governance: Parliament, Composition, Qualifications and Disqualifications, Powers and Functions, Executive, President, Governor, Council of Ministers, Judiciary, Appointment and Transfer of Judges, Qualifications, Powers and Functions

Learning Outcomes

After the completion of this unit, the student will be able to

- present the hierarchy of governance (L2)
- list the role/responsibilities/powers of different organs of governance (L1)
- elaborate the guidelines for appointment/transfer of judges (L2)
Unit IV


Learning Outcomes
After the completion of this unit, the student will be able to
• describe the administrative organizational hierarchy of municipalities and panchayats(L2)
• appreciate the role/responsibilities/powers of mayor, CEO, elected officials(L3)
• appreciate the importance of grass root democracy(L3)

Unit V


Learning Outcomes
After the completion of this unit, the student will be able to
• describe the administrative hierarchy of election commission(L2)
• elaborate the roles/responsibilities/powers of election commissioners at different levels of hierarchy(L3)
• outline the welfare activities of SC/ST/OBC/Women by different bodies(L3)

Text Book(s):
1. The Constitution of India, 1950 (Bare Act), Government Publication.
2. S. N. Busi, Dr. B. R. Ambedkar, Framing of Indian Constitution, 1/e, 2015.

Course Outcomes
After successful completion of the course, the student will be able to
• describe the philosophy and salient features of Indian constitution(L2)
• list the constitutional rights and duties of a citizen(L1)
• elaborate the central and local administrative hierarchy and their roles(L2)
• describe the roles/responsibilities/powers of different governing and administrative bodies(L2)
• explain the structure/functioning and power of election commission(L2)
This course is aimed to familiarizing the student with pedagogical principles, practices and methodologies. This course is intended for students interested in pursuing a career in teaching and research.

Course Objectives
- to familiarize the student about the need for pedagogy studies, background and conceptual framework
- to expose the student to pedagogical practices in formal/informal classrooms
- to acquaint the student with type of curriculum and guidance materials for effective pedagogy
- to familiarize the student with classroom practices and curriculum assessment procedures
- to make the student understand the effect of undertaking research on teaching quality

Unit I 5L

Learning Outcomes
After the completion of this unit, the student will be able to
- define the aim and rationale behind teacher education (L1)
- classify the different theories of learning (L1)
- elaborate the need and role of curriculum, teacher education (L1)

Unit II 5L
Thematic overview: Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries. Curriculum, Teacher education.

Learning Outcomes
After the completion of this unit, the student will be able to
- describe the different pedagogical practices used by teachers in formal and informal classrooms (L1)
- explain the pedagogical practices employed in developing countries (L1)
- enumerate the duties of faculty in terms of teaching, research, consultancy, administration (L1)

Unit III 6L
Evidence on the effectiveness of pedagogical practices, Methodology for the in-depth stage: quality assessment of included studies. How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy? Theory of change. Strength and nature of the body of evidence for effective pedagogical practices. Pedagogic theory and pedagogical approaches. Teachers’ attitudes and beliefs and Pedagogic strategies.

Learning Outcomes
After the completion of this unit, the student will be able to
- list the measures for effective pedagogy (L1)
- identify the different documentation required to formalize curriculum implementation and quality assessment (L1)
- describe the teachers attitudes and beliefs in pedagogic strategies (L2)
Unit IV 6L
Professional development: alignment with classroom practices and follow-up support, Peer support, Support from the head teacher and the community. Curriculum and assessment, Barriers to learning: limited resources and large class sizes.

Learning Outcomes
After the completion of this unit, the student will be able to
- define the organizational hierarchy in a school administration system(L1)
- list the different barriers to learning(L3)
- enumerate the methods to overcome limited resources and handle large class sizes(L3)
- describe the follow-up support and peer-support in classroom practices(L2)

Unit V 6L
Research gaps and future directions: Research design, Contexts, Pedagogy, Teacher education, Curriculum and assessment, Dissemination and research impact.

Learning Outcomes
After the completion of this unit, the student will be able to
- explain the need for and role of research in teaching profession(L2)
- list the different research activities to be taken up by teachers(L1)
- describe the impact of research on teaching quality and learning process(L2)

Text Book(s):

Course Outcomes
After successful completion of the course, the student will be able to
- describe the theories of learning and conceptual framework of pedagogy(L2)
- explain the pedagogical practices used by teachers in formal and informal classrooms(L2)
- visualize the administrative hierarchy of schools and colleges and define the role(L3)
- appreciate the need for research and define the future direction of teaching career(L3)
- describe the impact of curriculum and assessment on the teaching learning process of a student(L3)
This course is aimed to familiarize the student with basic principles of yoga and different physical/mental practices for managing mind and body. This course helps the student in managing stress during education, home and workplace. Further, principles learnt in this course help in building overall personality for a stress-free, happy and independent life.

Course Objectives
• to familiarize the student about eight parts of yoga and their significance
• to expose the student to the importance and meaning of Yam and Niyam
• to make the student understand the meaning and importance of yogic principles including Ahimsa, Satya, Astheya etc
• to introduce the different yogic poses with a knowledge of their benefits for mind and body
• to familiarize the effect of different types of breathing techniques in concept and in activity

Unit I 9L
Definitions of Eight parts of yoga (Ashtanga).

Learning Outcomes
After the completion of this unit, the student will be able to
• list the eight parts of yoga (L1)
• describe the effects of different parts of yoga on mind and body (L2)
• elaborate the importance of yoga in stress management and personality development (L3)

Unit II 9L
Yam and Niyam.
Do’s and Don’t’s in life.
   i) Ahinsa, satya, astheya, bramhacharya and aparigraha
   ii) Shaucha, santosh, tapa, swadhyay, ishwarpranidhan.

Learning Outcomes
After the completion of this unit, the student will be able to
• elaborate the importance of Yam and Niyam (L2)
• describe the meaning and significance of Ahinsa, satya, astheya etc (L2)
• explain the need for shaucha, santosh, tapa, swadhyay in leading a healthy and fruitful life (L3)

Unit III 9L
Asan and Pranayam
   i) Various yog poses and their benefits for mind & body
   ii) Regularization of breathing techniques and its Effects-Types of pranayam.

Learning Outcomes
After the completion of this unit, the student will be able to
• demonstrate the different physical asanas and explain their physical and psychological effects (L4)
• demonstrate the different breathing techniques and describe their physical and mental effects (L4)
• distinguish between different types of pranayamam (L5)
Text Books
1. Janardan, Yogic Asanas for Group Tarining-Part-I, Swami Yogabhyasi Mandal, Nagpur
2. Swami Vivekananda, “Rajayoga or conquering the Internal Nature”, Advaita Ashrama, Kolkata

Course Outcomes
After successful completion of the course, the student will be able to
• describe the eight parts of yoga and their significance(L1)
• explain the importance and meaning of Yama and Niyama(L2)
• define the meaning and importance of yogic principles including Ahimsa, Satya, Astheya etc(L1)
• demonstrate the different yogic poses and explain their benefits for mind and body(L4)
• demonstrate the different types of breathing techniques and explain their physical and mental benefits(L5)
This course is aimed to familiarize the student with life enlightenment skills for personality development. This course helps the student in building his holistic personality through human values, ethics and spiritual attributes.

Course Objectives
- to familiarize the student to good personality traits through moral stories
- to make the student understand the goal of human life and importance of good personality in reaching the goal
- to expose the student to the study of Shrimad-Bhagwad-Geeta for developing his/her personality and achieve the highest goal in life
- to familiarize the student to leadership skills for driving nation and mankind to peace and prosperity
- to expose the role of Neetishatakam for developing versatile personality of students.

Unit I
Neetisatakam-Holistic development of personality
Verses- 19,20,21,22 (wisdom)
Verses- 29,31,32 (pride & heroism)
Verses- 26,28,63,65 (virtue)
Verses- 52,53,59 (dont’s)
Verses- 71,73,75,78 (do’s).

Learning Outcomes
After the completion of this unit, the student will be able to
- describe the moral stories illustrating the traits of good personality(L2)
- define the meaning and importance of wisdom, pride, heroism, virtue etc(L1)
- identify do and donts in life from the foundations of human morals/ethics(L5)

Unit II
Approach to day to day work and duties.
Shrimad BhagwadGeeta: Chapter 2- Verses 41, 47,48,
Chapter 3- Verses 13, 21, 27, 35, Chapter 6- Verses 5,13,17, 23, 35,
Chapter 18- Verses 45, 46, 48.

Learning Outcomes
After the completion of this unit, the student will be able to
- describe the characteristics and principles of bhakti yogam, jnana yogam and karma yogam (L1)
- identify the use of different yogic characteristics in different activities of daily life/duties(L4)
- apply the use of yogic principles for leading a stress-free, happy and fruitful life with good developed personality(L4)
Unit III

Statements of basic knowledge.
Shrimad BhagwadGeeta: Chapter2-Verses 56, 62, 68
Chapter 12 -Verses 13, 14, 15, 16,17, 18
Personality of Role model. Shrimad BhagwadGeeta:
Chapter2-Verses 17, Chapter 3-Verses 36,37,42,
Chapter 4-Verses 18, 38,39
Chapter18 – Verses 37,38,63

Learning Outcomes
After the completion of this unit, the student will be able to
• list the characteristics of role model proposed by verses of bhagavad gita(L1)
• explain the methods for obtaining life enlightenment through the practice of four yoga appropriately (L2)
• describe the characteristics of karma yogi/jnana yogi for developing leadership personality (L2)

Text Book(s):
1. Swami Swarupananda, “Srimad Bhagavad Gita”, Advaita Ashram (Publication Department), Kolkata
2. P. Gopinath, Bhartrihari’s Three Satakam (Niti-Sringar-vairagya), Rashtriya Sanskrit Sansthanam, New Delhi.

Course Outcomes
After successful completion of the course, the student will be able to
• List the different parables of neethisathakam and identify their morals(L1)
• enumerate the different traits of human personality for life enlightenment(L2)
• describe the leadership attributes for driving nation and mankind to peace and prosperity(L2)
• explain the applicability of different types of yoga to day-to-day work and duties resulting in responsible personality (L2)
Soft skills comprise pleasant and appealing personality traits as self-confidence, positive attitude, emotional intelligence, social grace, flexibility, friendliness, and effective communication skills. The course aims to cause a basic awareness within the students about the significance of soft skills in professional and interpersonal communications and facilitate an all-round development of personality.

Course Objectives
- to familiarize the student to the criteria for self-assessment and significance of self-discipline
- to expose the student to attitudes, mindsets, values and beliefs
- to acquaint the student to plan career and goals through constructive thinking
- to enable the student to overcome barriers for active listening and persuasive speaking
- to familiarize the skill of conducting meetings, writing minutes and involving in active group discussions

Unit I 8L
Self-Assessment; Identifying Strength & Limitations; Habits, Will-Power and Drives; Developing Self-Esteem and Building Self-Confidence, Significance of Self-Discipline

Learning Outcomes
After the completion of this unit, the student will be able to
- identify strengths & limitations through self-assessment(L3)
- list the attributes of personalities with good will-power and self-drives(L1)
- describe the reasons for building self-esteem and self-confidence(L2)
- explain the significance of self-discipline(L2)

Unit II 8L
Understanding Perceptions, Attitudes, and Personality Types: Mind-Set: Growth and Fixed; Values and Beliefs

Learning Outcomes
After the completion of this unit, the student will be able to
- define the characteristics of different perceptions, attitudes and personality types(L1)
- distinguish between fixed and growing mindsets(L3)
- define the importance and meaning of values and beliefs(L2)

Unit III 8L
Motivation and Achieving Excellence; Self-Actualisation Need; Goal Setting, Life and Career Planning; Constructive Thinking

Learning Outcomes
After the completion of this unit, the student will be able to
- describe the need for having high motivation and achieving excellence(L2)
- define the need for self-actualization(L1)
- plan the life and career goals based on self-assessment(L4)
- explain the attributes of constructive thinking(L2)
Unit IV
8L
Communicating Clearly: Understanding and Overcoming barriers; Active Listening; Persuasive Speaking and Presentation Skills.

Learning Outcomes
After the completion of this unit, the student will be able to

• self-assess the barriers for communicating clearly (L4)
• list the attributes of active listening(L1)
• describe the minimal aspects of effective presentation(L2)
• organize ideas resulting a persuasive talk(L3)

Unit V
8L
Conducting Meetings, Writing Minutes, Sending Memos and Notices; Netiquette: Effective E-mail Communication; Telephone Etiquette; Body Language in Group Discussion and Interview.

Learning Outcomes
After the completion of this unit, the student will be able to

• describe the format and structure of writing meeting minutes(L2)
• identify the essential components of memos and notices(L3)
• explain the principles of effective email communication(L2)
• list the basic etiquette of telephone conversation(L1)
• describe the effective body traits during group discussion and interviews(L2)

Text Books

Course Outcomes
After successful completion of the course, the student will be able to

• carry out self assessment and describe the significance of self-discipline(L4)
• define, classify and compare attitudes, mindsets, values and beliefs(L3)
• plan career and goals through constructive thinking and personal assessment(L4)
• overcome barriers for active listening and persuasive speaking (L5)
• conduct meetings, write minutes and involve in active group discussions(L3)
This course introduces students to the science of business analytics. The goal is to provide students with the foundation needed to apply data analytics to real-world challenges they confront daily in their professional lives. Students will learn to identify the ideal analytic tool for their specific needs; understand valid and reliable ways to collect, analyze, and visualize data; and utilize data in decision making for managing agencies, organizations or clients in their workspace.

Course Objectives
- To familiarize the scope, process and advantages of business analytics
- To acquaint the student with the modeling and problem solving skills in business analytics
- To impart the organization and management of business analytics
- To introduce the forecasting models and techniques used in analytics
- To expose the formulation and decision strategies used in business analytics

Unit I

Learning Outcomes
After the completion of this unit, the student will be able to
- define the scope and process of business analytics (L1)
- choose an organizational structure to implement a business analytics process (L4)
- describe the statistical tools and methods used for data modeling and analysis (L2)
- identify the sampling and estimation requirements for data analysis (L1)

Unit II

Learning Outcomes
After the completion of this unit, the student will be able to
- identify the relationships and trends in data (L1)
- utilize linear regression methods for identifying data relationships (L4)
- list the types of data and their models used for business analytics (L1)
- describe the methods for visualization and exploration of data (L2)

Unit III
Organization Structures of Business analytics: Team management, Management Issues, Designing Information Policy, Outsourcing, Ensuring Data Quality, measuring contribution of Business analytics, Managing Changes. Descriptive Analytics, predictive analytics, predicative Modelling, Predictive analytics analysis, Data Mining, Data Mining Methodologies, Prescriptive analytics and its step in the business analytics Process, Prescriptive Modelling, nonlinear Optimization.
Learning Outcomes

After the completion of this unit, the student will be able to

• describe the management issues in the organization structures (L2)
• define the designing information policy and its usage (L1)
• list the methods for ensuring data quality measuring contribution (L1)
• explain the use of data mining methodologies for predictive analytics analysis (L3)
• describe the use of prescriptive analytics methods in business analytics process (L2)

Unit IV


Learning Outcomes

After the completion of this unit, the student will be able to

• classify and describe the use of forecasting models (L3)
• model the use of regression forecasting with casual variables (L5)
• identify the appropriate forecasting model for a given data (L5)
• explain the use of monte carlo simulation for forecasting and identify the involved risk (L2)

Unit V


Learning Outcomes

After the completion of this unit, the student will be able to

• formulate decision problems (L2)
• list the decision strategies with and without probabilities (L1)
• use the decision trees for analysis (L4)
• describe the value of information, utility and its use in decision making (L4)

Textbook(s):


Course Outcomes

Upon successful completion of the course, the student will be able to

• define the scope, process and advantages of business analytics (L1)
• explain the modeling and problem solving skills in business analytics (L2)
• describe the organization and management of business analytics (L3)
• utilize the forecasting models and techniques used in analytics (L4)
• enumerate and utilize the formulation and decision strategies (L2)
Optimization problems arise in all walks of human activity—particularly in engineering, business, finance and economics. The simplest optimization problems are linear in nature which may be subject to a set of linear constraints. This course will equip the student with the expertise to mathematically model real-life optimization problems as Linear Programming (Optimization) Problems and subsequently educate the student to solve these models with the help of the available methods.

Course Objectives

- to impart knowledge on developing mathematical formulation for linear programming and transportation problem
- to familiarize the student in the construction of the required activities in an efficient manner to complete it on or before a specified time limit and at the minimum cost.
- to expose the development of mathematical model for interactive decision-making situations, where two or more competitors are involved under conditions of conflict and competition.
- to illustrate PERT and CPM techniques for planning and implementing projects.
- To impart the knowledge of formulating and analysis of real-life problems using advanced tools and techniques for resource optimization
- to provide frameworks for analyzing waiting lines using advanced queuing theory concepts

Unit I

Optimization Techniques, Model Formulation, models, General L.R Formulation, Simplex Techniques, Sensitivity Analysis, Inventory Control Models

Learning Outcomes

- identify and develop operational research models from the verbal description of the real system. [L4]
- understand the classification systems of effective Inventory control models [L2]

Unit II

Formulation of a LPP - Graphical solution revised simplex method - duality theory - dual simplex method - sensitivity analysis - parametric programming

Learning Outcomes

- translate a real-world problem, given in words, into a mathematical formulation. [L2]
- utilize the mathematical tools that are needed to solve optimization problems. [L2]

Unit III

Nonlinear programming problem - Kuhn-Tucker conditions min cost flow problem - max flow problem - CPM/PERT

Learning Outcomes

- describe the need and origin of the optimization methods [L2]
• classify optimization problems to suitably choose the method needed to solve the particular type of problem [L3]

Unit IV

Scheduling and sequencing - single server and multiple server models - deterministic inventory models - Probabilistic inventory control models - Geometric Programming.

Learning Outcomes

After completing this unit, the student will be able to
• choose linear programming problems to suitably choose the method needed to solve the particular type of problem [L1]
• identify industrial problems involved in inventory, MRP and scheduling [L2]

Unit V

Competitive Models, Single and Multi-channel Problems, Sequencing Models, Dynamic Programming, Flow in Networks, Elementary Graph Theory, Game Theory Simulation

Learning Outcomes

After completing this unit, the student will be able to
• identify the values, objectives, attributes, decisions, uncertainties, consequences, and trade-offs in a real decision problem [L2]
• Apply the models to incorporate rational decision-making process in real life situations [L3]
• Analyze various modeling alternatives & select appropriate modeling techniques for a given situation.. [L3]

Text Book(s):

Course Outcomes

After the successful completion of the course, the students will be able to:
• Understand the basic concepts of different advanced models of operations research and their applications. (L2)
• Solve linear programming problems using appropriate techniques and optimization solvers, interpret the results obtained and translate solutions into directives for action. (L4)
• Apply the models to incorporate rational decision-making process in real life situations. (L4)
• Analyze various modeling alternatives & select appropriate modeling techniques for a given situation. (L3)
• Validate output from model to check feasibility of implementations. (L5)
• Create innovative modeling frameworks for a given situation. (L6)
• Conduct and interpret post-optimal and sensitivity analysis and explain the primal-dual relationship. (L3)
This course will equip the student with the expertise to mathematically model engineering projects and use effective methods and techniques to plan and execute engineering activities.

Course Objectives
- to introduce the basic principles of strategic cost management and the related terminology
- to familiarize the project planning and execution process involving technical/nontechnical activities
- to acquaint the student with detailed engineering activities and their cost management analysis
- to impart the knowledge of cost analysis and profit planning of engineering projects
- to familiarize the quantitative techniques for optimization of budget allocation

Unit I

Learning Outcomes
- describe the cost concepts in decision making(L2)
- define the various costs involved in the cost management process(L2)
- list the objectives of cost control(L2)
- identify the different fields of a database for operational control(L2)

Unit II
Project: meaning, Different types, why to manage, cost overruns centres, various stages of project execution: conception to commissioning. Project execution as conglomeration of technical and nontechnical activities.

Learning Outcomes
- define the meaning of a project and list the different types(L2)
- identify the measures to manage cost overruns(L2)
- describe the various stages of project execution from conception to commissioning(L2)
- plan the proper order of technical/nontechnical activities as part of project execution(L2)

Unit III
Detailed Engineering activities. Pre project execution main clearances and documents Project team: Role of each member. Importance Project site: Data required with significance. Project contracts. Types and contents. Project execution Project cost control. Bar charts and Network diagram. Project commissioning: mechanical and process.

Learning Outcomes
- identify the different clearance norms required in the pre-project execution phase(L2)
• describe the hierarchy of project team and identify the role of each member(L2)
• list the different contents of project contracts(L2)
• present the project cost control and planning through bar charts, network diagrams etc(L2)

Unit IV 8L

Learning Outcomes
After the completion of this unit, the student will be able to
• describe the cost behavior and profit planning(L2)
• distinguish between marginal costing and absorption costing(L2)
• analyze the variance of standard costing(L2)
• analyze the pricing strategies in project costing(L2)
• identify the quality measures satisfying the appropriate constraints(L2)

Unit V 10L
Budgetary Control; Flexible Budgets; Performance budgets; Zero-based budgets. Measurement of Divisional profitability pricing decisions including transfer pricing. Quantitative techniques for cost management, Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Simulation, Learning Curve Theory

Learning Outcomes
After the completion of this unit, the student will be able to
• define and compare the different budgeting strategies(L2)
• model the cost management as a linear programming problem(L2)
• measure the divisional profitability and decide the appropriate pricing(L2)

Textbook(s):

References:

Course Outcomes
After the successful completion of the course, the students will be able to
• list the basic principles of strategic cost management and define the related terminology(L1)
• plan the project execution process involving technical/nontechnical activities(L4)
• describe the detailed engineering activities and their cost management analysis(L2)
• carry out the cost analysis and profit planning of engineering projects(L5)
• utilize quantitative techniques for optimization of budget allocation(L6)
Each student is required to submit a report of first part of project work i.e. about the problem definition, literature review and methodology to be adopted including experiments and tests to be performed on topic of project as per the guidelines decided by the department. The project work is to be evaluated through Presentations and Viva-Voce during the semester end.
Each student is required to submit a detailed project report about the work on topic of project as per the guidelines decided by the department. The project work is to be evaluated through Presentations and Viva-Voce during the semester and Final evaluation will be done at the end of semester as per the guidelines decided by the department from time to time. The candidate shall present/publish one paper in national/international conference/seminar/journal of repute. However candidate may visit research labs/institutions with the due permission of chairperson on recommendation of supervisor concerned.