B. Tech. Degree

in

COMPUTER SCIENCE AND ENGINEERING

SYLLABUS FOR

FLEXIBLE CURRICULUM

(For students admitted in 2020-21)

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING
NATIONAL INSTITUTE OF TECHNOLOGY
TIRUCHIRAPPALLI – 620 015
TAMIL NADU, INDIA.
CSE Department Vision and Mission

Department Vision

• To evolve as an internationally recognised centre of excellence for teaching and research in computer science and engineering with societal and industry relevance.

Department Mission

• To offer multidisciplinary and inter disciplinary undergraduate, postgraduate and research programmes with focus on societal research and industrial needs.
• To provide a conducive environment for learning, leading to be efficient employee’s and successful entrepreneurs
• To establish strong and solution oriented industry academia binding for sustainable growth.
• To inculcate ethical values for holistic nation building

Programme Educational Objectives (PEO)

• Graduates are prepared to be employed in IT industries and be engaged in continuous learning, understanding, and applying new ideas
• Graduates are prepared to take up Masters and Research programmes
• Graduates are prepared to be responsible computing professionals in their own area of interest solving societal problems and be successful entrepreneurs

Programme Outcome (PO)

1. Ability to apply mathematical foundations, algorithmic principles, and computer science theory in the modelling and design of computer based systems.
2. Ability to analyse existing literature in computer science and suggest modification to algorithms and create new algorithms for solving engineering problems
3. Ability to apply the computing knowledge and propose solutions in domain such as health care, banking, finance, agriculture and other allied professions.
4. Ability to design software systems based on interpreting available data in all societal and engineering domains and analyse their performance
5. Ability to analyse the problem, subdivide into smaller tasks with well-defined interface for interaction among components, and complete within the specified time frame and domain constraints
6. Ability to propose original ideas and solutions, culminating into a modern, easy to use tool, by a larger section of the society with longevity.
7. Ability to design, implement, and evaluate secure hardware and integrate with software assuring quality and efficiency.
8. Ability to apply ethical principles and commit to professional ethics and responsibilities and norms of the computer science and engineering practices.
9. Ability to modularize the problem statement, allocate to individuals and function effectively as an individual and a team player.
10. Ability to communicate effectively the engineering solution to customers/users or peers by means of sufficient and necessary documentation.
11. Ability to demonstrate knowledge and understanding of computer science and engineering principles and apply these to individual’s and team work.
12. Ability to understand contemporary issues and to get engaged in lifelong learning by independently and continually expanding knowledge and abilities.

Programme Specific Outcome (PSO)

1. Ability to design and develop effective solutions based on state-of-the-art hardware and efficient software with a blend of creativity and performance.
2. Ability to pursue higher studies in a multidisciplinary perspective leading to Masters and Research degrees.
3. Ability to apply the Computer Science and Engineering concepts in different fields of Engineering culminating in successful careers and entrepreneurs with a focus on societal problem solving.
The total minimum credits required for completing the B. Tech. programme in Computer Science and Engineering is 159.

MINIMUM CREDIT REQUIREMENT FOR THE VARIOUS COURSE CATEGORIES:

<table>
<thead>
<tr>
<th>Course Category</th>
<th>Courses</th>
<th>No. of Credits</th>
<th>Weightage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>GIR (General Institute Requirement Courses)</td>
<td>22</td>
<td>50</td>
<td>31.25</td>
</tr>
<tr>
<td>PC (Programme Core)</td>
<td>15</td>
<td>51</td>
<td>32.07</td>
</tr>
<tr>
<td>Programme Electives (PE) / Open Electives (OE)</td>
<td>14</td>
<td>42</td>
<td>26.41</td>
</tr>
<tr>
<td>Essential Laboratory Requirements (ELR)</td>
<td>8</td>
<td>16</td>
<td>10.1</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>159</strong></td>
<td><strong>100</strong></td>
<td></td>
</tr>
</tbody>
</table>

*Minimum of 4 programme core courses shall be 4 credits each

*Out of 14 elective courses (PE/OE), the students should study at least eight programme elective courses (PE)

Table 2 GIR Courses

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Name of the Course</th>
<th>Number of Courses</th>
<th>Max. Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Mathematics</td>
<td>3</td>
<td>10</td>
</tr>
<tr>
<td>2.</td>
<td>Physics</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Physics Lab</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>3.</td>
<td>Chemistry</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Chemistry Lab</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>4.</td>
<td>Industrial Economics and Foreign Trade</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>5.</td>
<td>English for Communication</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>6.</td>
<td>Energy and Environmental Engineering</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>7.</td>
<td>Professional Ethics</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>8.</td>
<td>Engineering Graphics</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>9.</td>
<td>Engineering Practice</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>10.</td>
<td>Basic Engineering</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>11.</td>
<td>Introduction to Computer Programming</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>12.</td>
<td>Branch Specific Course (Introduction to the Branch of Study)</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>13.</td>
<td>Summer Internship</td>
<td>1</td>
<td>2</td>
</tr>
</tbody>
</table>
14. Project Work | - | -
15. Comprehensive Viva | 1 | 1
16. Industrial Lecture | 1 | 1
17. NSS/ NCC/ NSO | 1 | Compulsory participation

| Total | 22 | 50 |

(I) GENERAL INSTITUTE REQUIREMENTS (COURSE AND COURSE DETAILS)

1. MATHEMATICS

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>MAIR12</td>
<td>Linear Algebra and Calculus</td>
<td>3</td>
</tr>
<tr>
<td>2.</td>
<td>MAIR22</td>
<td>Complex Analysis and Differential Equations</td>
<td>3</td>
</tr>
<tr>
<td>3.</td>
<td>MAIR31</td>
<td>Mathematics III - Probability and Operations Research</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Total</strong></td>
<td><strong>10</strong></td>
</tr>
</tbody>
</table>

2. PHYSICS

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>PHIR11</td>
<td>Physics</td>
<td>3</td>
</tr>
<tr>
<td>2.</td>
<td>PHIR12</td>
<td>Physics Lab</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Total</strong></td>
<td><strong>5</strong></td>
</tr>
</tbody>
</table>

3. CHEMISTRY

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>CHIR11</td>
<td>Chemistry</td>
<td>3</td>
</tr>
<tr>
<td>2.</td>
<td>CHIR12</td>
<td>Chemistry Lab</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Total</strong></td>
<td><strong>5</strong></td>
</tr>
</tbody>
</table>
### 4. HUMANITIES

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>HSIR13</td>
<td>Industrial Economics and Foreign Trade</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Total</strong></td>
<td><strong>3</strong></td>
</tr>
</tbody>
</table>

### 5. COMMUNICATION

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>HSIR11 &amp; HSIR12</td>
<td>English for Communication (Theory &amp; Lab)</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Total</strong></td>
<td><strong>4</strong></td>
</tr>
</tbody>
</table>

### 6. ENERGY AND ENVIRONMENTAL ENGINEERING

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>ENIR11</td>
<td>Energy and Environmental Engineering</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Total</strong></td>
<td><strong>2</strong></td>
</tr>
</tbody>
</table>

### 7. PROFESSIONAL ETHICS

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>HSIR14</td>
<td>Professional Ethics</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Total</strong></td>
<td><strong>3</strong></td>
</tr>
</tbody>
</table>

### 8. ENGINEERING GRAPHICS

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>MEIR12</td>
<td>Engineering Graphics</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Total</strong></td>
<td><strong>3</strong></td>
</tr>
</tbody>
</table>
9. ENGINEERING PRACTICE

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>PRIR11</td>
<td>Engineering Practice</td>
<td>2</td>
</tr>
</tbody>
</table>

**Total 2**

10. BASIC ENGINEERING

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>CEIR11</td>
<td>Basics of Civil Engineering</td>
<td>2</td>
</tr>
<tr>
<td>2.</td>
<td>MEIR11</td>
<td>Basics of Mechanical Engineering</td>
<td>2</td>
</tr>
</tbody>
</table>

**Total 4**

11. INTRODUCTION TO COMPUTER PROGRAMMING

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>CSIR11</td>
<td>Introduction to Computer Programming (Theory and Lab)</td>
<td>3</td>
</tr>
</tbody>
</table>

**Total 3**

12. BRANCH SPECIFIC COURSE

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>CSIR21</td>
<td>Branch Specific Course - Essentials of Computer Science</td>
<td>2</td>
</tr>
</tbody>
</table>

**Total 2**

13. SUMMER INTERNSHIP#

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>CSIR71</td>
<td>Internship / Industrial Training / Academic Attachment</td>
<td>2</td>
</tr>
</tbody>
</table>

**Total 2**
The student should undergo industrial training/internship for a minimum period of two months during the summer vacation of 3rd year. Attachment with an academic institution within the country (IISc/ IITs/ NITs/ IIITs and CFTIs) or university abroad is also permitted instead of industrial training.

#To be evaluated at the beginning of VII semester by assessing the report and seminar presentations.

**14. INDUSTRIAL LECTURE**

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>CSIR61</td>
<td>Industrial Lecture</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Total</strong></td>
<td><strong>1</strong></td>
</tr>
</tbody>
</table>

A course based on industrial lectures shall be offered for 1 credit. A minimum of five lectures of two hours duration by industry experts will be arranged by the Department. The evaluation methodology, will in general, be based on quizzes at the end of each lecture.

**15. COMPREHENSIVE VIVA**

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>CSIR81</td>
<td>Comprehensive Viva-Voce</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Total</strong></td>
<td><strong>1</strong></td>
</tr>
</tbody>
</table>

**16. PROJECT WORK (OPTIONAL COURSE)**

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>CSIR82</td>
<td>Project Work (Optional)</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Total</strong></td>
<td><strong>6</strong></td>
</tr>
</tbody>
</table>

**17. NSS / NCC / NSO**

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>SWIR11</td>
<td>NSS / NCC / NSO</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Total</strong></td>
<td><strong>0</strong></td>
</tr>
</tbody>
</table>
## (II) PROGRAMME CORE COURSES

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Course Code</th>
<th>Course Title</th>
<th>Pre-requisites</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>CSPC11</td>
<td>Programme Core I / Discrete Structures</td>
<td></td>
<td>4</td>
</tr>
<tr>
<td>2.</td>
<td>CSPC31</td>
<td>Programme Core II / Principles of Programming Languages</td>
<td></td>
<td>4</td>
</tr>
<tr>
<td>3.</td>
<td>CSPC32</td>
<td>Programme Core III / Data Structures</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>4.</td>
<td>CSPC33</td>
<td>Programme Core IV / Digital Systems Design</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>5.</td>
<td>CSPC34</td>
<td>Programme Core V / Computer Organization</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>6.</td>
<td>CSPC41</td>
<td>Programme Core VI / Formal Languages and Automata Theory</td>
<td>CSPC11</td>
<td>4</td>
</tr>
<tr>
<td>7.</td>
<td>CSPC42</td>
<td>Programme Core VII / Design and Analysis of Algorithms</td>
<td>CSPC32</td>
<td>3</td>
</tr>
<tr>
<td>8.</td>
<td>CSPC43</td>
<td>Programme Core VIII / Operating Systems</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>9.</td>
<td>CSPC51</td>
<td>Programme Core IX / Computer Architecture</td>
<td>CSPC34</td>
<td>4</td>
</tr>
<tr>
<td>10.</td>
<td>CSPC52</td>
<td>Programme Core X / Database Management Systems</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>11.</td>
<td>CSPC53</td>
<td>Programme Core XI / Computer Networks</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>12.</td>
<td>CSPC54</td>
<td>Programme Core XII / Introduction to Artificial Intelligence and Machine Learning</td>
<td>CSPC11</td>
<td>4</td>
</tr>
<tr>
<td>13.</td>
<td>CSPC61</td>
<td>Programme Core XIII / Embedded Systems Architectures</td>
<td>CSPC51</td>
<td>3</td>
</tr>
<tr>
<td>14.</td>
<td>CSPC62</td>
<td>Programme Core XIV / Compiler Design</td>
<td>CSPC41</td>
<td>4</td>
</tr>
<tr>
<td>15.</td>
<td>CSPC63</td>
<td>Programme Core XV / Principles of Cryptography</td>
<td></td>
<td>3</td>
</tr>
</tbody>
</table>

Total: 51

## (III) (a) OPEN ELECTIVE COURSES

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Course Code</th>
<th>Course Title</th>
<th>Pre-requisites</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>CSOE11</td>
<td>Big Data Analytics</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>2.</td>
<td>CSOE12</td>
<td>Cloud &amp; Grid Computing</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>4.</td>
<td>CSOE14</td>
<td>Distributed Architecture</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>5.</td>
<td>CSOE15</td>
<td>Human Computer Interaction</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>6.</td>
<td>CSOE16</td>
<td>Image Processing</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>Sl. No.</td>
<td>Course Code</td>
<td>Course Title</td>
<td>Pre-requisites</td>
<td>Credits</td>
</tr>
<tr>
<td>--------</td>
<td>-------------</td>
<td>--------------------------------------------------</td>
<td>---------------</td>
<td>---------</td>
</tr>
<tr>
<td>7.</td>
<td>CSOE17</td>
<td>Internet of Things</td>
<td>-</td>
<td>3</td>
</tr>
<tr>
<td>8.</td>
<td>CSOE18</td>
<td>Machine learning for Engineering Applications</td>
<td>-</td>
<td>3</td>
</tr>
<tr>
<td>9.</td>
<td>CSOE19</td>
<td>Security Principles</td>
<td>-</td>
<td>3</td>
</tr>
<tr>
<td>10.</td>
<td>CSOE20</td>
<td>Soft Computing</td>
<td>-</td>
<td>3</td>
</tr>
<tr>
<td>11.</td>
<td>CSOE21</td>
<td>Software Project Management</td>
<td>-</td>
<td>3</td>
</tr>
<tr>
<td>12.</td>
<td>CSOE22</td>
<td>Software Testing &amp; Practices</td>
<td>-</td>
<td>3</td>
</tr>
<tr>
<td>13.</td>
<td>CSOE23</td>
<td>Web Technology</td>
<td>-</td>
<td>3</td>
</tr>
</tbody>
</table>

**PROGRAMME ELECTIVE COURSES (PE)**

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Course Code</th>
<th>Course Title</th>
<th>Pre-requisites</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>CSPE31</td>
<td>Linear Algebra and Applications</td>
<td>-</td>
<td>3</td>
</tr>
<tr>
<td>2.</td>
<td>CSPE32</td>
<td>Combinatorics and Graph Theory</td>
<td>CSPC11</td>
<td>3</td>
</tr>
<tr>
<td>3.</td>
<td>CSPE41</td>
<td>Software Engineering</td>
<td>-</td>
<td>3</td>
</tr>
<tr>
<td>4.</td>
<td>CSPE42</td>
<td>Design Thinking</td>
<td>-</td>
<td>3</td>
</tr>
<tr>
<td>5.</td>
<td>CSPE43</td>
<td>Advanced Data Structures and Algorithms</td>
<td>CSPC31</td>
<td>3</td>
</tr>
<tr>
<td>6.</td>
<td>CSPE44</td>
<td>Computer Graphics</td>
<td>-</td>
<td>3</td>
</tr>
<tr>
<td>7.</td>
<td>CSPE45</td>
<td>Multimedia Systems</td>
<td>-</td>
<td>3</td>
</tr>
<tr>
<td>8.</td>
<td>CSPE51</td>
<td>Augmented and Virtual Reality</td>
<td>-</td>
<td>3</td>
</tr>
<tr>
<td>9.</td>
<td>CSPE52</td>
<td>Digital Signal Processing</td>
<td>-</td>
<td>3</td>
</tr>
<tr>
<td>10.</td>
<td>CSPE53</td>
<td>Game Theory</td>
<td>-</td>
<td>3</td>
</tr>
<tr>
<td>11.</td>
<td>CSPE54</td>
<td>Real Time Systems</td>
<td>CSPC43</td>
<td>3</td>
</tr>
<tr>
<td>12.</td>
<td>CSPE55</td>
<td>Software Testing and Automation</td>
<td>-</td>
<td>3</td>
</tr>
<tr>
<td>13.</td>
<td>CSPE56</td>
<td>Cloud Computing</td>
<td>CSPC43</td>
<td>3</td>
</tr>
<tr>
<td>14.</td>
<td>CSPE57</td>
<td>Agile Software Development</td>
<td>-</td>
<td>3</td>
</tr>
<tr>
<td>15.</td>
<td>CSPE61</td>
<td>Web Technology and its Applications</td>
<td>CSPC42</td>
<td>3</td>
</tr>
<tr>
<td>16.</td>
<td>CSPE62</td>
<td>Advanced Database Management Systems</td>
<td>CSPC52</td>
<td>3</td>
</tr>
<tr>
<td>17.</td>
<td>CSPE63</td>
<td>Artificial Intelligence and its Applications</td>
<td>CSPC54</td>
<td>3</td>
</tr>
<tr>
<td>18.</td>
<td>CSPE64</td>
<td>Data Analytics</td>
<td>CSPC52</td>
<td>3</td>
</tr>
<tr>
<td>20.</td>
<td>CSPE66</td>
<td>Mobile Computing</td>
<td>CSPC53</td>
<td>3</td>
</tr>
<tr>
<td>Sl. No.</td>
<td>Course Code</td>
<td>Course Title</td>
<td>Pre-/ Co-requisites</td>
<td>Credits</td>
</tr>
<tr>
<td>--------</td>
<td>-------------</td>
<td>--------------------------------------------------</td>
<td>---------------------</td>
<td>---------</td>
</tr>
<tr>
<td>21.</td>
<td>CSPE67</td>
<td>Internetworking Protocols</td>
<td>CSPC53</td>
<td>3</td>
</tr>
<tr>
<td>22.</td>
<td>CSPE68</td>
<td>Design and Analysis of Parallel Algorithms</td>
<td>CSPC42</td>
<td>3</td>
</tr>
<tr>
<td>23.</td>
<td>CSPE71</td>
<td>Advanced Cryptography</td>
<td>CSPC63</td>
<td>3</td>
</tr>
<tr>
<td>24.</td>
<td>CSPE72</td>
<td>Deep Learning Techniques</td>
<td>CSPC54</td>
<td>3</td>
</tr>
<tr>
<td>25.</td>
<td>CSPE73</td>
<td>Natural Language Processing</td>
<td>CSPC62</td>
<td>3</td>
</tr>
<tr>
<td>26.</td>
<td>CSPE74</td>
<td>Image Processing and Applications</td>
<td>-</td>
<td>3</td>
</tr>
<tr>
<td>27.</td>
<td>CSPE75</td>
<td>Network Security</td>
<td>CSPC63</td>
<td>3</td>
</tr>
<tr>
<td>28.</td>
<td>CSPE76</td>
<td>Wireless Network Systems</td>
<td>CSPC53</td>
<td>3</td>
</tr>
<tr>
<td>29.</td>
<td>CSPE77</td>
<td>Parallel Architectures and Programming</td>
<td>CSPC51</td>
<td>3</td>
</tr>
<tr>
<td>30.</td>
<td>CSPE78</td>
<td>Information Security</td>
<td>-</td>
<td>3</td>
</tr>
<tr>
<td>31.</td>
<td>CSPE79</td>
<td>Human Computer Interaction</td>
<td>-</td>
<td>3</td>
</tr>
<tr>
<td>32.</td>
<td>CSPE70</td>
<td>Undergraduate Research 1</td>
<td>-</td>
<td>3</td>
</tr>
<tr>
<td>33.</td>
<td>CSPE81</td>
<td>Data Science</td>
<td>-</td>
<td>3</td>
</tr>
<tr>
<td>34.</td>
<td>CSPE82</td>
<td>GPU Computing</td>
<td>CSPC51</td>
<td>3</td>
</tr>
<tr>
<td>35.</td>
<td>CSPE83</td>
<td>Internet of Things - Principles and Practices</td>
<td>-</td>
<td>3</td>
</tr>
<tr>
<td>36.</td>
<td>CSPE84</td>
<td>Social Network Analysis</td>
<td>-</td>
<td>3</td>
</tr>
<tr>
<td>37.</td>
<td>CSPE85</td>
<td>Speech Processing Techniques</td>
<td>-</td>
<td>3</td>
</tr>
<tr>
<td>38.</td>
<td>CSPE86</td>
<td>Undergraduate Research 2</td>
<td>-</td>
<td>3</td>
</tr>
</tbody>
</table>

(IV) ESSENTIAL PROGRAMME LABORATORY REQUIREMENTS (ELR)

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Course Code</th>
<th>Course Title</th>
<th>Pre-/ Co-requisites</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>CSLR31</td>
<td>Laboratory I / Data structures Laboratory</td>
<td>CSPC31</td>
<td>2</td>
</tr>
<tr>
<td>2.</td>
<td>CSLR32</td>
<td>Laboratory II / Digital Laboratory</td>
<td>CSPC32</td>
<td>2</td>
</tr>
<tr>
<td>3.</td>
<td>CSLR41</td>
<td>Laboratory III / Algorithms Laboratory</td>
<td>CSPC42</td>
<td>2</td>
</tr>
<tr>
<td>4.</td>
<td>CSLR42</td>
<td>Laboratory IV / Operating Systems Lab</td>
<td>CSPC43</td>
<td>2</td>
</tr>
<tr>
<td>5.</td>
<td>CSLR51</td>
<td>Laboratory V / Database Management Systems Laboratory</td>
<td>CSPC52</td>
<td>2</td>
</tr>
<tr>
<td>6.</td>
<td>CSLR52</td>
<td>Laboratory VI / Networks Laboratory</td>
<td>CSPC53</td>
<td>2</td>
</tr>
<tr>
<td>7.</td>
<td>CSLR61</td>
<td>Laboratory VII / Embedded Systems Laboratory</td>
<td>CSPC61</td>
<td>2</td>
</tr>
<tr>
<td>8.</td>
<td>CSLR62</td>
<td>Laboratory VIII / App Development Laboratory</td>
<td>CSPC31</td>
<td>2</td>
</tr>
</tbody>
</table>

Total 16
## (V) MINOR COURSES (MI)

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Course Code</th>
<th>Course Title</th>
<th>Pre-requisites</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>CSMI11</td>
<td>Data Structures and Algorithms</td>
<td>-</td>
<td>3</td>
</tr>
<tr>
<td>2.</td>
<td>CSMI12</td>
<td>Computer Organization</td>
<td>-</td>
<td>3</td>
</tr>
<tr>
<td>3.</td>
<td>CSMI13</td>
<td>Operating Systems</td>
<td>-</td>
<td>3</td>
</tr>
<tr>
<td>4.</td>
<td>CSMI14</td>
<td>Database Management Systems</td>
<td>-</td>
<td>3</td>
</tr>
<tr>
<td>5.</td>
<td>CSMI15</td>
<td>Software Engineering</td>
<td>-</td>
<td>3</td>
</tr>
<tr>
<td>6.</td>
<td>CSMI16</td>
<td>Computer Networks</td>
<td>-</td>
<td>3</td>
</tr>
<tr>
<td>7.</td>
<td>CSMI17</td>
<td>Artificial Intelligence</td>
<td>-</td>
<td>3</td>
</tr>
</tbody>
</table>

## (VI) ADVANCED LEVEL COURSES FOR B. TECH. (HONOURS)

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Course Code</th>
<th>Course Title</th>
<th>Pre-requisites</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>CSHO11</td>
<td>Software Defined Networking</td>
<td>-</td>
<td>3</td>
</tr>
<tr>
<td>2.</td>
<td>CSHO12</td>
<td>Distributed Systems</td>
<td>CSPC41</td>
<td>4</td>
</tr>
<tr>
<td>3.</td>
<td>CSHO13</td>
<td>Multi-Core Programming</td>
<td>CSPC51</td>
<td>4</td>
</tr>
<tr>
<td>4.</td>
<td>CSHO14</td>
<td>Pervasive and Ubiquitous Computing</td>
<td>CSPC43</td>
<td>3</td>
</tr>
<tr>
<td>5.</td>
<td>CSHO15</td>
<td>Middleware Technologies</td>
<td>-</td>
<td>3</td>
</tr>
<tr>
<td>6.</td>
<td>CSHO16</td>
<td>Randomized Algorithms</td>
<td>CSPC42</td>
<td>4</td>
</tr>
<tr>
<td>7.</td>
<td>CSHO17</td>
<td>Big Data Mining</td>
<td>-</td>
<td>4</td>
</tr>
<tr>
<td>8.</td>
<td>CSHO18</td>
<td>Modelling and Simulation</td>
<td>-</td>
<td>4</td>
</tr>
<tr>
<td>9.</td>
<td>CSHO19</td>
<td>Quantum Computing</td>
<td>-</td>
<td>4</td>
</tr>
</tbody>
</table>
## Semester- / Session-wise Curriculum Structure

### Semester I (July Session)

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Course Code</th>
<th>Course</th>
<th>Credits</th>
<th>Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>ENIR11</td>
<td>Energy and Environmental Engineering</td>
<td>2</td>
<td>GIR</td>
</tr>
<tr>
<td>2.</td>
<td>MAIR12</td>
<td>Linear Algebra and Calculus</td>
<td>3</td>
<td>GIR</td>
</tr>
<tr>
<td>3.</td>
<td>PHIR11</td>
<td>Physics</td>
<td>3</td>
<td>GIR</td>
</tr>
<tr>
<td>4.</td>
<td>PHIR12</td>
<td>Physics Lab</td>
<td>2</td>
<td>GIR</td>
</tr>
<tr>
<td>5.</td>
<td>CSIR11</td>
<td>Introduction to Computer Programming (Theory &amp; Lab)</td>
<td>3</td>
<td>GIR</td>
</tr>
<tr>
<td>6.</td>
<td>MEIR11</td>
<td>Basics of Mechanical Engineering</td>
<td>2</td>
<td>GIR</td>
</tr>
<tr>
<td>7.</td>
<td>CEIR11</td>
<td>Basics of Civil Engineering</td>
<td>2</td>
<td>GIR</td>
</tr>
<tr>
<td>8.</td>
<td>PRIR11</td>
<td>Engineering Practice</td>
<td>2</td>
<td>GIR</td>
</tr>
</tbody>
</table>

**Total** 19

### Semester II (January Session)

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Course Code</th>
<th>Course</th>
<th>Credits</th>
<th>Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>MAIR22</td>
<td>Mathematics II – Complex Analysis and Differential Equations</td>
<td>3</td>
<td>GIR</td>
</tr>
<tr>
<td>2.</td>
<td>CHIR11</td>
<td>Chemistry</td>
<td>3</td>
<td>GIR</td>
</tr>
<tr>
<td>3.</td>
<td>CHIR12</td>
<td>Chemistry Lab</td>
<td>2</td>
<td>GIR</td>
</tr>
<tr>
<td>4.</td>
<td>HSIR11</td>
<td>English for Communication (Theory)</td>
<td>2</td>
<td>GIR</td>
</tr>
<tr>
<td>5.</td>
<td>HSIR12</td>
<td>English for Communication (Lab)</td>
<td>2</td>
<td>GIR</td>
</tr>
<tr>
<td>6.</td>
<td>CSPC11</td>
<td>Programme Core I / Discrete Structures</td>
<td>4</td>
<td>PC</td>
</tr>
<tr>
<td>7.</td>
<td>CSIR21</td>
<td>Branch Specific Course – Essentials of Computer Science</td>
<td>2</td>
<td>GIR</td>
</tr>
<tr>
<td>8.</td>
<td>MEIR12</td>
<td>Engineering Graphics</td>
<td>3</td>
<td>GIR</td>
</tr>
<tr>
<td>9.</td>
<td>SWIR11</td>
<td>NSS/ NCC/ NSO</td>
<td>0</td>
<td>GIR</td>
</tr>
</tbody>
</table>

**Total** 21

### Semester III (July Session)

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Course Code</th>
<th>Course</th>
<th>Credits</th>
<th>Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>MAIR31</td>
<td>Mathematics III – Probability and Operations Research</td>
<td>4</td>
<td>GIR</td>
</tr>
<tr>
<td>2.</td>
<td>CSPC31</td>
<td>Programme Core II / Principles of Programming Languages</td>
<td>4</td>
<td>PC</td>
</tr>
<tr>
<td>3.</td>
<td>CSPC32</td>
<td>Programme Core III / Data Structures</td>
<td>3</td>
<td>PC</td>
</tr>
<tr>
<td>4.</td>
<td>CSPC33</td>
<td>Programme Core IV / Digital Systems Design</td>
<td>3</td>
<td>PC</td>
</tr>
<tr>
<td>5.</td>
<td>CSPC34</td>
<td>Programme Core V / Computer Organization</td>
<td>3</td>
<td>PC</td>
</tr>
<tr>
<td>6.</td>
<td>CSLR31</td>
<td>Laboratory I / Data Structures Laboratory</td>
<td>2</td>
<td>PL</td>
</tr>
<tr>
<td>7.</td>
<td>CSLR32</td>
<td>Laboratory II / Digital Laboratory</td>
<td>2</td>
<td>PL</td>
</tr>
<tr>
<td>8.</td>
<td></td>
<td>Elective I</td>
<td>3</td>
<td>PE</td>
</tr>
</tbody>
</table>

**Total** 24

**Note:** Department(s) to offer Minor (MI) Course, and ONLINE Course (OC) to those willing students in addition to 24 credits.
### Semester IV (January Session)

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Course Code</th>
<th>Course</th>
<th>Credits</th>
<th>Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>HSIR13</td>
<td>Industrial Economics and Foreign Trades</td>
<td>3</td>
<td>GIR</td>
</tr>
<tr>
<td>2</td>
<td>CSPC41</td>
<td>Programme Core VI / Formal Languages and Automata Theory</td>
<td>4</td>
<td>PC</td>
</tr>
<tr>
<td>3</td>
<td>CSPC42</td>
<td>Programme Core VII / Design and Analysis of Algorithms</td>
<td>3</td>
<td>PC</td>
</tr>
<tr>
<td>4</td>
<td>CSPC43</td>
<td>Programme Core VIII / Operating Systems</td>
<td>3</td>
<td>PC</td>
</tr>
<tr>
<td>5</td>
<td>CSLR41</td>
<td>Laboratory III / Algorithms Laboratory</td>
<td>2</td>
<td>PL</td>
</tr>
<tr>
<td>6</td>
<td>CSLR42</td>
<td>Laboratory IV / Operating Systems Lab</td>
<td>2</td>
<td>PL</td>
</tr>
<tr>
<td>7</td>
<td></td>
<td>Elective II</td>
<td>3</td>
<td>PE</td>
</tr>
<tr>
<td>8</td>
<td></td>
<td>Elective III</td>
<td>3</td>
<td>PE</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td></td>
<td><strong>23</strong></td>
<td></td>
</tr>
</tbody>
</table>

**Note:** Department(s) to offer MI/PE/OE/OC and Honours course as 2/3 credits to those willing students in addition to 23 credits.

### Semester V (July Session)

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Course Code</th>
<th>Course</th>
<th>Credits</th>
<th>Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>CSPC51</td>
<td>Programme Core IX / Computer Architecture</td>
<td>4</td>
<td>PC</td>
</tr>
<tr>
<td>2</td>
<td>CSPC52</td>
<td>Programme Core X / Database Management Systems</td>
<td>3</td>
<td>PC</td>
</tr>
<tr>
<td>3</td>
<td>CSPC53</td>
<td>Programme Core XI / Computer Networks</td>
<td>3</td>
<td>PC</td>
</tr>
<tr>
<td>4</td>
<td>CSPC54</td>
<td>Programme Core XII / Introduction to Artificial Intelligence and Machine Learning</td>
<td>4</td>
<td>PC</td>
</tr>
<tr>
<td>5</td>
<td>CSLR51</td>
<td>Laboratory V / Database Management Systems Laboratory</td>
<td>2</td>
<td>PL</td>
</tr>
<tr>
<td>6</td>
<td>CSLR52</td>
<td>Laboratory VI / Networks Laboratory</td>
<td>2</td>
<td>PL</td>
</tr>
<tr>
<td>7</td>
<td></td>
<td>Elective IV</td>
<td>3</td>
<td>PE</td>
</tr>
<tr>
<td>8</td>
<td></td>
<td>Elective V</td>
<td>3</td>
<td>PE/OE</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td></td>
<td><strong>24</strong></td>
<td></td>
</tr>
</tbody>
</table>

**Note:** Department(s) to offer MI/PE/OE/OC and Honours course as 2/3 credits to those willing students in addition to 24 credits.

### Semester VI (January Session)

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Course Code</th>
<th>Course</th>
<th>Credits</th>
<th>Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>CSIR61</td>
<td>Industrial Lecture</td>
<td>1</td>
<td>GIR</td>
</tr>
<tr>
<td>2</td>
<td>CSPC61</td>
<td>Programme Core XIII / Embedded Systems Architectures</td>
<td>3</td>
<td>PC</td>
</tr>
<tr>
<td>3</td>
<td>CSPC62</td>
<td>Programme Core XIV / Compiler Design</td>
<td>4</td>
<td>PC</td>
</tr>
<tr>
<td>4</td>
<td>CSPC63</td>
<td>Programme Core XV / Principles of Cryptography</td>
<td>3</td>
<td>PC</td>
</tr>
<tr>
<td>5</td>
<td>CSLR61</td>
<td>Laboratory VII / Embedded Systems Laboratory</td>
<td>2</td>
<td>PL</td>
</tr>
<tr>
<td>6</td>
<td>CSLR62</td>
<td>Laboratory VIII / App Development Laboratory</td>
<td>2</td>
<td>PL</td>
</tr>
<tr>
<td>7</td>
<td>HSIR14</td>
<td>Professional Ethics</td>
<td>3</td>
<td>GIR</td>
</tr>
<tr>
<td>8</td>
<td></td>
<td>Elective VI</td>
<td>3</td>
<td>PE</td>
</tr>
<tr>
<td>9</td>
<td></td>
<td>Elective VII</td>
<td>3</td>
<td>PE/OE</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td></td>
<td><strong>24</strong></td>
<td></td>
</tr>
</tbody>
</table>

**Note:** Department(s) to offer MI/PE/OE/OC and Honours course as 2/3 credits to those willing students addition to 24 credits.
Semester VII (July Session)

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Course Code</th>
<th>Course</th>
<th>Credits</th>
<th>Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>CSIR71</td>
<td>Summer Internship</td>
<td>2</td>
<td>GIR</td>
</tr>
<tr>
<td>2.</td>
<td></td>
<td>Elective VIII</td>
<td>3</td>
<td>PE</td>
</tr>
<tr>
<td>3.</td>
<td></td>
<td>Elective IX</td>
<td>3</td>
<td>PE</td>
</tr>
<tr>
<td>4.</td>
<td></td>
<td>Elective X</td>
<td>3</td>
<td>PE/OE</td>
</tr>
<tr>
<td>5.</td>
<td></td>
<td>Elective XI</td>
<td>3</td>
<td>PE/OE</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td></td>
<td><strong>14</strong></td>
<td></td>
</tr>
</tbody>
</table>

*Note:* Department(s) to offer MI/PE/OE/OC and Honours course as 2/3 credits to those willing students in addition to 14 credits.

Semester VIII (January Session)

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Course Code</th>
<th>Course</th>
<th>Credits</th>
<th>Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>CSIR81</td>
<td>Comprehensive Viva-Voce</td>
<td>1</td>
<td>GIR</td>
</tr>
<tr>
<td>2.</td>
<td>CSIR82</td>
<td>Project Work(^5) / Equivalent No. of Electives</td>
<td>6</td>
<td>Optional</td>
</tr>
<tr>
<td>3.</td>
<td></td>
<td>Elective XII</td>
<td>3</td>
<td>PE</td>
</tr>
<tr>
<td>4.</td>
<td></td>
<td>Elective XIII</td>
<td>3</td>
<td>PE</td>
</tr>
<tr>
<td>5.</td>
<td></td>
<td>Elective XIV</td>
<td>3</td>
<td>PE/OE</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td></td>
<td><strong>10</strong></td>
<td></td>
</tr>
</tbody>
</table>

*Note:* Department(s) to offer MI/PE/OE/OC and Honours course as 2/3 credits to those willing students in addition to 10 credits.

\(^5\)Optional Course

Credit Distribution

<table>
<thead>
<tr>
<th>Semester</th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
<th>V</th>
<th>VI</th>
<th>VII</th>
<th>VIII</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Credit</td>
<td>19</td>
<td>21</td>
<td>24</td>
<td>23</td>
<td>24</td>
<td>24</td>
<td>14</td>
<td>10</td>
<td>159</td>
</tr>
</tbody>
</table>

*Note:*

1. Minimum of 4 programme core courses shall be 4 credits each.
2. Out of 14 elective courses (PE/OE), the students should study **at least eight programme elective courses (PE).**
3. MI – Minor Degree: **15 credits over and above** the minimum credit as specified by the departments. The details of MINOR will be mentioned only in the transcript not in the Degree certificate.
4. HO – Honours Degree: **15 credits over and above** the minimum credit as specified by the departments. The project work is not compulsory.
### III SEMESTER

**PROGRAMME ELECTIVE 1**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Name</th>
<th>L</th>
<th>T</th>
<th>P</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSPE31</td>
<td>Linear Algebra and Applications</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>CSPE32</td>
<td>Combinatorics and Graph Theory</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
</tbody>
</table>

### IV SEMESTER

**PROGRAMME ELECTIVE 2 & 3**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Name</th>
<th>L</th>
<th>T</th>
<th>P</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSPE41</td>
<td>Software Engineering</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>CSPE42</td>
<td>Design Thinking</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>CSPE43</td>
<td>Advanced Data Structures and Algorithms</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>CSPE44</td>
<td>Computer Graphics</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>CSPE45</td>
<td>Multimedia Systems</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
</tbody>
</table>

### V SEMESTER

**PROGRAMME ELECTIVE 4 & 5**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Name</th>
<th>L</th>
<th>T</th>
<th>P</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSPE51</td>
<td>Augmented and Virtual Reality</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>CSPE52</td>
<td>Digital Signal Processing</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>CSPE53</td>
<td>Game Theory</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>CSPE54</td>
<td>Real Time Systems</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>CSPE55</td>
<td>Software Testing and Automation</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>CSPE56</td>
<td>Cloud Computing</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>CSPE57</td>
<td>Agile Software Development</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
</tbody>
</table>

### VI SEMESTER

**PROGRAMME ELECTIVE 6 & 7**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Name</th>
<th>L</th>
<th>T</th>
<th>P</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSPE61</td>
<td>Web Technology and its Applications</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>CSPE62</td>
<td>Advanced Database Management Systems</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>CSPE63</td>
<td>Artificial Intelligence and its Applications</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>Course Code</td>
<td>Course Name</td>
<td>L</td>
<td>T</td>
<td>P</td>
<td>C</td>
</tr>
<tr>
<td>-------------</td>
<td>-------------------------------------------------</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>CSPE64</td>
<td>Data Analytics</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>CSPE65</td>
<td>Machine Learning Techniques and Practices</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>CSPE66</td>
<td>Mobile Computing</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>CSPE67</td>
<td>Internetworking Protocols</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>CSPE68</td>
<td>Design and Analysis of Parallel Algorithms</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
</tbody>
</table>

**VII SEMESTER**

**PROGRAMME ELECTIVE 8, 9, 10 & 11**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Name</th>
<th>L</th>
<th>T</th>
<th>P</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSPE71</td>
<td>Advanced Cryptography</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>CSPE72</td>
<td>Deep Learning Techniques</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>CSPE73</td>
<td>Natural Language Processing</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>CSPE74</td>
<td>Image Processing and Applications</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>CSPE75</td>
<td>Network Security</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>CSPE76</td>
<td>Wireless Network Systems</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>CSPE77</td>
<td>Parallel Architectures and Programming</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>CSPE78</td>
<td>Information Security</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>CSPE79</td>
<td>Human Computer Interaction</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>CSPE80</td>
<td>Undergraduate Research 1</td>
<td>0</td>
<td>0</td>
<td>6</td>
<td>3</td>
</tr>
</tbody>
</table>

**VIII SEMESTER**

**PROGRAMME ELECTIVE 12, 13 & 14**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Name</th>
<th>L</th>
<th>T</th>
<th>P</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSPE81</td>
<td>Data Science</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>CSPE82</td>
<td>GPU Computing</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>CSPE83</td>
<td>Internet of Things - Principles and Practices</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>CSPE84</td>
<td>Social Network Analysis</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>CSPE85</td>
<td>Speech Processing Techniques</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>CSPE86</td>
<td>Undergraduate Research 2</td>
<td>0</td>
<td>0</td>
<td>6</td>
<td>3</td>
</tr>
</tbody>
</table>
## MINORS

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Name</th>
<th>L</th>
<th>T</th>
<th>P</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSMI11</td>
<td>Data Structures and Algorithms</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>CSMI12</td>
<td>Computer Organization</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>CSMI13</td>
<td>Operating Systems</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>CSMI14</td>
<td>Database Management Systems</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>CSMI15</td>
<td>Software Engineering</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>CSMI16</td>
<td>Computer Networks</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>CSMI17</td>
<td>Artificial Intelligence</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
</tbody>
</table>

## HONOURS

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Name</th>
<th>L</th>
<th>T</th>
<th>P</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSHO11</td>
<td>Software Defined Networking</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>CSHO12</td>
<td>Distributed Systems</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>CSHO13</td>
<td>Multi-Core Programming</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>CSHO14</td>
<td>Pervasive and Ubiquitous Computing</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>CSHO15</td>
<td>Middleware Technologies</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>CSHO16</td>
<td>Randomized Algorithms</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>CSHO17</td>
<td>Big Data Mining</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>CSHO18</td>
<td>Modelling and Simulation</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>CSHO19</td>
<td>Quantum Computing</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>4</td>
</tr>
</tbody>
</table>

## OPEN ELECTIVES

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Name</th>
<th>L</th>
<th>T</th>
<th>P</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSOE11</td>
<td>Big Data Analytics</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>CSOE12</td>
<td>Cloud &amp; Grid Computing</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>CSOE13</td>
<td>Computer Graphics and Multimedia Systems</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>CSOE14</td>
<td>Distributed Architecture</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>CSOE15</td>
<td>Human Computer Interaction</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>CSOE16</td>
<td>Image Processing</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>CSOE17</td>
<td>Internet of Things</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>Course Code</td>
<td>Course Title</td>
<td>Credits</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>------------</td>
<td>--------------------------------------------------</td>
<td>---------</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CSOE18</td>
<td>Machine Learning for Engineering Applications</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CSOE19</td>
<td>Security Principles</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CSOE20</td>
<td>Soft Computing</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CSOE21</td>
<td>Software Project Management</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CSOE22</td>
<td>Software Testing &amp; Practices</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CSOE23</td>
<td>Web Technology</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

LIST OF ONLINE COURSES

1. Fundamentals of Image and Video Processing
2. Deep Learning in Computer Vision
3. Deep Learning in Python
4. Image Processing and Analysis for Life Scientist
5. Interactive Computer Graphics
6. Practical Machine Learning
7. Software Security
8. Introduction to Cyber Security
10. Cyber Security Fundamentals
11. Neural Networks and Deep Learning
12. Text Retrieval and Search Engines
13. Discrete Optimization
14. The Arduino Platform and C Programming
15. Introduction to the Internet of Things and Embedded Systems
16. Computational Neuroscience
17. Introduction to Software Product Management
18. Software Processes and Agile Practices
20. Introduction to Recommender Systems: Non-Personalized and Content-Based
22. Advanced Modelling for Discrete Optimization
23. Improving Deep Neural Networks: Hyper parameter Tuning, Regularization and Optimization
24. Big Data Applications: Machine Learning at Scale
25. Introduction to Cyber security for Business
26. Block Chain Architecture Design and Use Cases
SYLLABUS

II SEMESTER

<table>
<thead>
<tr>
<th>Course Code</th>
<th>CSPC11</th>
</tr>
</thead>
<tbody>
<tr>
<td>Course Title</td>
<td>Discrete Structures</td>
</tr>
<tr>
<td>Number of Credits</td>
<td>3-1-0-4</td>
</tr>
<tr>
<td>Pre-requisites (Course Code)</td>
<td>-</td>
</tr>
<tr>
<td>Course Type</td>
<td>PC</td>
</tr>
</tbody>
</table>

Course Objectives

- To get familiar and understand the fundamental notions in discrete mathematics
- To describe binary relations between two sets; determine if a binary relation is reflexive, symmetric, or transitive or is an equivalence relation; combine relations using set operations and composition
- To understand and demonstrate the basic concept of an algorithm and its application in combinatorial mathematics
- To identify the base step and the recursive or inductive step in applied problems and give a recursive and a non-recursive definition for an iterative algorithm
- To identify the basic properties of graphs and trees and model simple applications

Course Contents

UNIT I Set Theory and Logic

UNIT II Induction and Combinatorics

UNIT III Algebraic Structures

UNIT IV Linear Algebra and Recurrence relations
Linear Algebra: Vector space - Basis - Dimension - Orthogonally - Recurrence Relations: Homogenous and Inhomogenous - Recurrences and their solutions - Solving Recurrences using Generating functions.

UNIT V Graph Theory
Definitions and basic results - Representation of a graph by a matrix and Adjacency list - Trees - Cycles - Properties - Paths and Connectedness - Subgraphs - Graph Isomorphism - Operations on Graphs - Vertex and Edge cuts - Vertex and Edge connectivity.

Course Outcomes

Upon completion of this course, the students will be able to:
- Distinguish between the notion of discrete and continuous mathematical structures
- Prove basic set equalities
- Construct and interpret finite state diagrams and DFSA
- Apply induction and other proof techniques towards problem solving
- Solve problems in Computer Science using graphs and trees
Text Books


Mapping of Course Outcomes with Programme Outcomes

<table>
<thead>
<tr>
<th></th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>✓</td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO5</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
</tbody>
</table>
Course Objectives

- To make the student understand the basic building blocks of a computing system
- To make the student understand the flow of Concept-Program-Input-Processing-Output
- To introduce low level language, translators, operating system

Course Contents

UNIT I Concept - Program - Input - Processing - Output
Demo of simple high level language program to low level machine level language program - tracing their execution from high level to circuit level/gate level - Overview of the Hardware Description Language (HDL) - Designing a set of elementary logic gates from primitive NAND gates.
Design of binary adders - culminating in the construction of a simple ALU (Arithmetic–Logic Unit) using logic gates - Design of memory hierarchy from elementary flip–flop gates to registers and RAM units of arbitrary sizes using logic gates.

UNIT II Introduction to Low Level Language
Introducing an instruction set in both binary and assembly (symbolic) versions - Writing some low-level assembly programs - Other details of computer architecture - Basic language translation techniques: parsing - symbol table - macro - assembly

UNIT III Introduction to Virtual Machine

UNIT IV Introduction to Compilers
Context-free grammars and recursive parsing algorithms - Building a syntax analyzer (tokenizer and parser) - The syntax analyzer to generate XML code reflecting the structure of the translated program - Code generation - low-level handling of arrays and objects.

UNIT V Introduction to OS
Discussion of OS/hardware and OS/software design trade–offs - and time/space efficiency considerations - Design and implementation of OS - memory management - string processing - I/O handling algorithms.

Course Outcomes

Upon completion of this course, the students will be able to:
- Trace the fundamentals of digital logic design
- Virtualize any environment
- Prepare themselves for designing a compiler
- Generate low level code for simple programs
- Design simple arithmetic and memory units

Text Books


Mapping of Course Outcomes with Programme Outcomes

<table>
<thead>
<tr>
<th></th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO5</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
III SEMESTER

<table>
<thead>
<tr>
<th>Course Code</th>
<th>MAIR31</th>
</tr>
</thead>
<tbody>
<tr>
<td>Course Title</td>
<td>Mathematics III - Probability and Operations Research</td>
</tr>
<tr>
<td>Number of Credits</td>
<td>3-1-0-4</td>
</tr>
<tr>
<td>Pre-requisites (Course Code)</td>
<td>-</td>
</tr>
<tr>
<td>Course Type</td>
<td>GIR</td>
</tr>
</tbody>
</table>

**Course Objectives**

- To introduce the fundamental concepts and results in probability and to learn some standard distributions
- To study one dimensional and multi-dimensional random variables
- To understand elementary queuing concepts and Markov chain and process
- To introduce linear programming problem and discuss several methods to solve it
- To study the transportation and assignment problems and to explore the project management techniques

**Course Contents**

**UNIT I**

**UNIT II**

**UNIT III**

**UNIT IV**

**UNIT V**
Transportation and Assignment Problems - Project Management and Network - Critical Path Method (CPM) - Program Evaluation and Review Technique (PERT).

**Course Outcomes**

Upon completion of this course, the students will be able to:

- Find the probability of an event and the moment generating function of Binomial, Poisson and Normal distributions
- Determine marginal and conditional probability distributions and correlation of two dimensional random variables
- Approximate and solve the real problems using random process and queuing theory
- Solve linear programming problems using Graphical, Simplex, Big-M and Dual Simplex methods
- Determine an optimal solution for transportation and assignment problems and determine the expected project completion time in a project network

**Text Books**


Mapping of Course Outcomes with Programme Outcomes

<table>
<thead>
<tr>
<th></th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>✓</td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td>✓</td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO5</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Course Code : CSPC31
Course Title : Principles of Programming Languages
Number of Credits : 3-0-2-4
Pre-requisites (Course Code) : -
Course Type : PC

Course Objectives
- To understand the various ways to describe syntax and semantics of programming languages
- To understand data, data types, and basic statements of programming languages
- To understand parameter passing and function call mechanisms
- To understand object-orientation, concurrency, and event handling in programming languages
- To acquire knowledge about functional and logic programming paradigms

Course Contents

UNIT I  Syntax and Semantics and Basic Statements
Lab Component (Exercises similar to the following):
1. Simple test programs to determine type compatibility rules of a C compiler.
2. Simple test program to determine the scope of variables having the same name and different names declared within a while / for loop.
3. Program that behaves differently if name equivalence is used against structural equivalence.
4. Write a program to convert one form of comments in C to alternate comments form.

UNIT II  Subprograms and Implementations
Lab Component (Exercises similar to the following):
1. Write a program to determine the ratio of the time required to pass a large array by reference and the time required to pass the same array by value.
2. Write a program that determines whether it is legal to call a function that has been passed by passing a pointer to it to another function.
3. Devise a subprogram and calling code in which pass-by-reference and pass-by-value-result of one or more parameters produces different results.
4. Design a skeletal program and a calling sequence that results in an activation record instance in which the static and dynamic links point to different activation recorded instances in the run-time stack.

UNIT III  Object-Orientation, Concurrent, and Event Driven Programming
Object-orientation design issues for OOP languages - implementation of object-oriented constructs - concurrency - semaphores - monitors - message passing - threads - statement level concurrency - exception handling - Event driven control - Event Handling
Lab Component (Exercises similar to the following):
1. Chess / checkers game using object oriented programming – C++/Smalltalk / Python / Java.
2. Design a Tic-tac-toe game that uses even driven programming concepts.
3. The bouncing ball game is one where, there are more than 2 balls bouncing around a window. When the ball reaches the edge of a window, it reverses direction. Write program using concurrent programming concepts to implement this game. Try alternate ways of changing the ball’s direction.
UNIT IV  Functional Programming
Introduction to lambda calculus - fundamentals of functional programming languages - Programming with Scheme - Introduction to LISP - Lists - Storage allocation for lists - Some useful functions - Error handling.
Lab Component (Exercises similar to the following):
1. Scheme functions to compute mathematical formula, roots of a quadratic equation, count of characters in a string, set computation like, Union, Intersection, complementation, etc.
2. Lisp recursive function to return ‘nth’ item from a list, diagonal of a matrix, sum of the diagonal of matrix, a sub-string from a string, etc.

UNIT V  Logic Programming
Introduction to logic and logic programming - Computing with relations - Programming with Prolog - Data structures in Prolog - Programming techniques - Control in Prolog - Cuts - multi-paradigm languages.
Lab Component (Exercises similar to the following):
1. Prolog program to find the factorial of a number, simplification of arithmetic expression involving additive, multiplicative identity, solve Sudoku puzzle, etc.

Course Outcomes
Upon completion of this course, the students will be able to:
- Define data types, functions, syntax and semantics of all programming languages
- Use the various styles of programming languages for any given problem
- Compare and use appropriate parameter passing technique for solving problems
- Distinguish between the usage of all programming languages
- Apply the appropriate programming language to solve real-world problems

Text Books

Reference Books

Mapping of Course Outcomes with Programme Outcomes

<table>
<thead>
<tr>
<th></th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO5</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

CSE Dept. Flexible Curriculum  NITTUGCSE20  27
Course Objectives

- To find the Time Complexity and Space Complexity for algorithm
- To understand the various techniques of sorting and searching
- To design and implement arrays, stacks, queues, and linked lists
- To understand the complex data structures such as trees and graphs
- To solve real time problems

Course Contents

UNIT I  Introduction
Development of Algorithms - Notations and analysis - Storage structures for arrays - Sparse matrices - Stacks and Queues: Representations and applications.

UNIT II  Linked List, Stacks, and Queues
Linked Lists - Linked stacks and queues - Operations on polynomials - Doubly linked lists - Circularly linked lists - Dynamic storage management - Garbage collection and compaction.

UNIT III  Trees

UNIT IV  Graphs
Graphs - Representation of graphs - BFS - DFS - Topological sort - String representation and manipulations - Pattern matching.

UNIT V  Sorting and Searching

Course Outcomes

Upon completion of this course, the students will be able to:

- Develop programs to implement linear data structures such as stacks, queues, linked lists, etc.
- Apply the concept of trees and graph data structures in real world scenarios
- Appropriately to decide on the data structure for any practical problem
- Comprehend the implementation of sorting and searching algorithms
- Compare Time Complexity and Space Complexity for algorithm

Text Books

Reference Book


Mapping of Course Outcomes with Programme Outcomes

<table>
<thead>
<tr>
<th></th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO5</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Course Code : CSPC3
Course Title : Digital Systems Design
Number of Credits : 3-0-0-3
Pre-requisites (Course Code) : -
Course Type : PC

Course Objectives

- To understand the overview on the design principles of digital computing systems
- To learn the various number systems
- To learn Boolean Algebra and Understand the various logic gates
- To be familiar with various combinational circuits
- To be familiar with designing synchronous and asynchronous sequential circuits
- To be exposed to designing using PLD

Course Contents

UNIT I  Boolean Algebra

UNIT II  Combinational Circuits

UNIT III  Sequential Circuits

UNIT IV  VLSI Design

UNIT V  Advanced Concepts
Advanced Verilog Concepts - Synthesis concepts - Inferring latches and flip-flops - Modelling techniques for efficient circuit design - Design of high-speed arithmetic circuits - Parallelism Pipelined Wallace tree tipliers - Systolic algorithms - Systolic matrix multiplication.

Course Outcomes

Upon completion of this course, the students will be able to:
- Design and implement complicated digital systems using Verilog
- Design a VLSI circuit for an application
- Comprehend the digital design logic
- Design and Analysis of a given digital circuit – combinational and sequential
- Use Boolean simplification techniques to design a combinational hardware circuit

Text Books

Reference Books


Mapping of Course Outcomes with Programme Outcomes

<table>
<thead>
<tr>
<th>CO1</th>
<th>CO2</th>
<th>CO3</th>
<th>CO4</th>
<th>CO5</th>
</tr>
</thead>
<tbody>
<tr>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>

Legend:
- ✓: Met
- -: Not Met
Course Code : CSPC34
Course Title : Computer Organization
Number of Credits : 3-0-0-3
Pre-requisites (Course Code) : -
Course Type : PC

Course Objectives

- To understand the basic hardware and software issues of computer organization
- To understand the representation of data at machine level
- To understand how computations are performed at machine level
- To understand the memory hierarchies, cache memories and virtual memories
- To learn the different ways of communication with I/O devices

Course Contents

UNIT I

UNIT II
MIPS Addressing for 32-Bit Immediates and Addresses - Parallelism and Instructions: Synchronization - Translating and Starting a Program - Addition and Subtraction - Multiplication - Division - Floating Point - Parallelism and Computer Arithmetic: Subword Parallelism - Streaming SIMD Extensions and Advanced Vector Extensions in x86.

UNIT III
Logic Design Conventions - Building a Datapath - A Simple Implementation Scheme - overview of Pipelining - Pipelined Datapath - Data Hazards: Forwarding versus Stalling - Control Hazards - Exceptions - Parallelism via Instructions - The ARM Cortex–A8 and Intel Core i7 Pipelines - Instruction–Level Parallelism and Matrix Multiply Hardware Design language.

UNIT IV

UNIT V
Disk Storage and Dependability - Parallelism and Memory Hierarchy: RAID levels - performance of storage systems - Introduction to multi threading clusters - message passing multiprocessors.

Course Outcomes

Upon completion of the course, the students will be able to:

- Analyze the abstraction of various components of a computer
- Analyze the hardware and software issues and the interfacing
- Work out the trade-offs involved in designing a modern computer system
- Understand the various memory systems and I/O communication

Text Books

**Reference Books**


**Mapping of Course Outcomes with Programme Outcomes**

<table>
<thead>
<tr>
<th></th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td></td>
<td></td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Course Code : CSLR31
Course Title : Data Structures Laboratory
Number of Credits : 0-0-3-2
Pre-requisites (Course Code) : CSPC31
Course Type : PL

Course Objectives

- To analyze the time and space complexities and efficiency of various algorithms
- To understand the practical application of linear and nonlinear data structures
- To introduce and practice advanced algorithms, programming techniques necessary for developing sophisticated computer application programs

Exercises

1. Problems in C/C++/ Java using data structures involving arrays, stacks, queues, strings, linked lists, trees, graphs.
2. Operations on stacks, queues and linked lists.
3. Applications of stack - Conversion of infix expressions to postfix and evaluation of postfix expressions.
5. Implementation of priority queue.
8. Implementation of Sorting Techniques.

Course Outcomes

Upon completion of this course, the students will be able to:

- Apply and implement the learned algorithm for problem solving
- Identify the data structure to develop program for real time applications
- Design and develop optimal algorithms using appropriate data structures

Text Book


Mapping of Course Outcomes with Programme Outcomes

<table>
<thead>
<tr>
<th></th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>CO2</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>CO3</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
</tr>
</tbody>
</table>

CSE Dept. Flexible Curriculum NITTUGCSE20 34
Course Code : CSLR32
Course Title : Digital Laboratory
Number of Credits : 0-0-3-2
Pre-requisites (Course Code) : CSPC32
Course Type : PL

Course Objectives
- To understand the overview on the design principles of digital computing systems
- To learn Boolean Algebra and Understand the various logic gates
- To develop programs in Hardware Description Language
- To design and implement synchronous sequential, asynchronous sequential circuits
- To be familiar with basic combinational and sequential components used in the typical data path designs

Exercises
1. Verification of Boolean Theorems using basic gates.
2. Design and implementation of combinational circuits for arbitrary functions and code converters.
3. Design and implement Adder and Subtractor.
4. Implement Parity generator / checker.
5. Design and implement combinational circuits: 4 –bit binary adder / subtractor.
7. Design and implement synchronous and asynchronous counters.
8. Coding sequential circuits using HDL.
9. Coding combinational circuits using HDL.
11. Design of a Wallace tree multiplier using Verilog.
12. Design and implementation of board using Verilog.

Course Outcomes
Upon completion of this course, the students will be able to:
- Comprehend the digital design logic
- Design synchronous sequential circuits using basic flip-flops, counters, PLA, PAL
- Design and develop basic digital systems
- Debug digital circuits
- Use boolean simplification techniques to design a combinational hardware circuit

Text Books

Reference Books
<table>
<thead>
<tr>
<th></th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td>✔</td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td>✔</td>
<td></td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td>✔</td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO5</td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
IV SEMESTER

<table>
<thead>
<tr>
<th>Course Code</th>
<th>CSPC41</th>
</tr>
</thead>
<tbody>
<tr>
<td>Course Title</td>
<td>Formal Languages and Automata Theory</td>
</tr>
<tr>
<td>Number of Credits</td>
<td>3-1-0-4</td>
</tr>
<tr>
<td>Pre-requisites (Course Code)</td>
<td>CSPC11</td>
</tr>
<tr>
<td>Course Type</td>
<td>PC</td>
</tr>
</tbody>
</table>

**Course Objectives**

- To know about Chomsky hierarchy for organizing languages
- To introduce concepts in automata theory and theory of computation
- To identify different formal language classes and their relationships
- To design grammars and recognizers for different formal languages
- To understand undecidability and decide on languages that are undecidable

**Course Contents**

**UNIT I Finite Automata**

**UNIT II Regular Expression (RE)**
Definition - Operators of regular expression and their precedence - Algebraic laws for Regular expressions - Kleen’s Theorem - Regular expression to FA - DFA to Regular expression - Arden Theorem - Non Regular Languages - Pumping Lemma for regular Languages. Application of Pumping Lemma - Closure properties of Regular Languages - Decision properties of Regular Languages - FA with output: Moore and Mealy machine - Equivalence of Moore and Mealy Machine - Applications and Limitation of FA.

**UNIT III Context Free Grammar (CFG) and Context Free Languages**
Definition - Examples - Derivation - Derivation trees - Ambiguity in Grammar - Inherent ambiguity - Ambiguous to Unambiguous CFG - Useless symbols - Simplification of CFGs - Normal forms for CFGs: CNF and GNF - Closure properties of CFLs - Decision Properties of CFLs: Emptiness - Finiteness and Membership - Pumping lemma for CFLs.

**UNIT IV Push Down Automata (PDA)**
Description and definition - Instantaneous Description - Language of PDA - Acceptance by Final state - Acceptance by empty stack - Deterministic PDA - Equivalence of acceptance by empty stack and final state - Conversion of CFG to PDA and PDA to CFG.

**UNIT V Turing Machines (TM) and Undecidability**
Basic model - definition and representation - Instantaneous Description - Language acceptance by TM - Variants of Turing Machine - TM as Computer of Integer functions - Universal TM - Church’s Thesis - Recursive and recursively enumerable languages - Halting problem - Introduction to Undecidability - Undecidable problems about TMs - Post correspondence problem (PCP) - Modified PCP and undecidable nature of post correspondence problem - Introduction to recursive function theory.

**Course Outcomes**

Upon completion of this course, the students will be able to:

- Design finite automata or regular expression for any tokenization task
- Construct a context free grammar for parsing any language
• Design Turing machine for any language
• Conclude the decidable / undecidable nature of any language
• Apply mathematical and formal techniques for solving real-world problems

Text Book


Reference Books


Mapping of Course Outcomes with Programme Outcomes

<table>
<thead>
<tr>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO5</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Course Code : CSPC42
Course Title : Design and Analysis of Algorithms
Number of Credits : 3-0-0-3
Pre-requisites (Course Code) : CSPC32
Course Type : PC

Course Objectives

- To understand the importance of algorithm
- To analyze the complexity of an algorithm in terms of time and space complexities
- To understand various problem solving techniques
- To learn about amortized analysis of algorithms
- To design and implement various programming paradigms and its complexity

Course Contents

UNIT I  Introduction

UNIT II  Divide & Conquer and Greedy Approaches

UNIT III Dynamic Programming Approaches

UNIT IV  Amortization
Randomized Algorithms and Amortized Analysis - Las Vegas and Monte Carlo types - Randomized quick sort and its analysis - Min-Cut algorithm.

UNIT V NP Problems
NP-Hard and NP-complete problems - Basic concepts - Reducibility - Vertex cover-3 - CNF - clique - Hamiltonian cycle - TSP - Approximation algorithms - Vertex cover - TSP.

Course Outcomes

Upon completion of this course, the students will be able to:
- Analyze the time and space complexity for any algorithm
- Apply the design techniques of algorithm in solving real world problems
- Perform amortize analysis for any algorithm
- Understand NP class of problems and propose approximation algorithms for the same

Text Book


Reference Books

### Mapping of Course Outcomes with Programme Outcomes

<table>
<thead>
<tr>
<th></th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Course Objectives

- To provide knowledge about the services rendered by operating systems
- To explore the various scheduling policies and to provide solutions for critical section and deadlock problems
- To provide a detailed discussion of the various memory management techniques
- To discuss the various file-system design and implementation issues
- To discuss how the protection domains, help to achieve security in a system
- To explore the design and implementation issues of Distributed OS

Course Contents

UNIT I Introduction

UNIT II Process Management

UNIT III Memory Management
Memory Management Strategies - Contiguous and Non-Contiguous allocation - Virtual memory Management - Demand Paging - Page Placement and Replacement Policies.

UNIT IV File Management

UNIT V Distributed Systems
Distributed Systems - Distributed operating systems - Distributed file systems - Distributed Synchronization - OS architecture - Case study on LINUX and Windows OS.

Course Outcomes

Upon completion of the course, the students will be able to:

- Comprehend the techniques used to implement the process manager
- Comprehend virtual memory abstractions in operating systems
- Design and develop file system and I/O system
- Apply various mechanisms in storage management
- Design and develop OS modules for Distributed Environment

Text Book


Reference Books


Mapping of Course Outcomes with Programme Outcomes

<table>
<thead>
<tr>
<th></th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>✔</td>
<td>✔</td>
<td></td>
<td>✔</td>
<td>✔</td>
<td></td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td>✔</td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
<td>✔</td>
<td></td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td>✔</td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td>✔</td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✔</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO5</td>
<td>✔</td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✔</td>
<td>✔</td>
</tr>
</tbody>
</table>
Course Code : CSLR41
Course Title : Algorithms Laboratory
Number of Credits : 0-0-3-2
Pre-requisites (Course Code) : -
Course Type : PL

Course Objectives

• To learn how to analyze the complexity of algorithms
• To compare and evaluate algorithms in terms of time and space complexity
• To program brute force, divide and conquer, decrease and conquer, transform and conquer, greedy, and dynamic techniques

Exercises

2. Determining machine constants.
3. Programs involving some advanced data structures.
4. Implementing example problems.
5. Illustrating the different paradigms of algorithm design.
6. Solving miscellaneous problems e.g. problems in string manipulation, graph theory, optimization.

Course Outcomes

Upon completion of this course, the students will be able to:

• Solve and analyze general algorithms based on space and time complexity
• Implement and empirically compare fundamental algorithms and data structures to real-world problems
• Design, develop, and optimize algorithms in different paradigms

Text Books


Mapping of Course Outcomes with Programme Outcomes

<table>
<thead>
<tr>
<th>CO1</th>
<th>CO2</th>
<th>CO3</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
</tr>
</thead>
<tbody>
<tr>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>

CSE Dept. Flexible Curriculum NITTUGCSE20 43
Course Objectives

- To understand the concept of Operating System
- To have insight knowledge on different system calls and Unix Utilities
- To experience the practical side of the functioning of various blocks in OS
- To design a real world application by considering process synchronization, Memory management

Exercises

1. Hands on Unix Commands.
2. Shell programming for file handling.
3. Shell Script programming using the commands grep, awk, and sed.
4. Programs on Multithread using Pthread.
5. Implementation of CPU scheduling algorithms.
6. Implementation of Synchronization problems using Semaphores, Message Queues and Shared Memory.
8. Implementation of various Disk scheduling algorithms.

Course Outcomes

Upon completion of the course, the students will be able to:

- Write program on shell script and Pthread
- Solve synchronization problems
- Compare and contrast various CPU scheduling algorithms, Memory allocation policy
- Differentiate the disk scheduling algorithms

Text Books


Reference Books


Mapping of Course Outcomes with Programme Outcomes

<table>
<thead>
<tr>
<th></th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Course Code : CSPC51
Course Title : Computer Architecture
Number of Credits : 3-1-0-4
Pre-requisites (Course Code) : CSPC34
Course Type : PC

Course Objectives

- To understand the concept of advanced pipelining techniques
- To understand the current state of art in memory system design
- To know the working principle of I/O devices
- To understand the memory management techniques

Course Contents

UNIT I

UNIT II
Basic and Intermediate pipelining Concepts - The Major Hurdle of Pipelining - Pipeline Hazards - Pipelining Implementation - Implementation issues that makes Pipelining hard - Extending the MIPS Pipeline to Handle Multicycle Operations - The MIPS R4000 Pipeline.

UNIT III
Instruction-Level Parallelism: Concepts and Challenges - Basic Compiler Techniques for Exposing ILP - Reducing Branch Costs with Prediction - Overcoming Data Hazards with Dynamic Scheduling - Dynamic Scheduling - Hardware-Based Speculation - Exploiting ILP Using Multiple Issue and Static Scheduling - Exploiting ILP - Advanced Techniques for Instruction Delivery and Speculation - Studies of the Limitations of ILP.

UNIT IV

UNIT V
Review of Memory Hierarchy Design - Cache Performance - Basic Cache Optimizations - Virtual Memory - Protection and Examples of Virtual Memory - Advanced Optimizations of Cache Performance - Memory Technology and Optimizations - Protection: Virtual Memory and Virtual Machines - Crosscutting Issues: The Design of Memory Hierarchies - Case Studies / Lab Exercises.

Course Outcomes

Upon completion of the course, the students will be able to:

- Apply performance metrics to find the performance of systems
- Identify the program block that requires parallelism for any program
- Comprehend and differentiate various computer architectures and hardware
- Design algorithms for memory management techniques

Text Books


Reference Books


Mapping of Course Outcomes with Programme Outcomes

<table>
<thead>
<tr>
<th></th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>CO3</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Course Code: CSPC52
Course Title: Database Management Systems
Number of Credits: 3
Pre-requisites (Course Code): -
Course Type: PC

Course Objectives

- To learn data models, conceptualize and depict a database system using ER diagram
- To understand the internal storage structures in a physical DB design
- To know the fundamental concepts of transaction processing techniques
- To understand the concept of Database Design in Normalization techniques
- To know the manipulation of SQL Queries

Course Contents

UNIT I Introduction

UNIT II Relational Model
Relational Data Model - Concept of relations - schema-instance distinction - keys - referential integrity and foreign keys - relational algebra operators - SQL - Introduction - data definition in SQL - table - key and foreign key definitions - update behaviours - Querying in SQL - notion of aggregation - aggregation functions groupby and having clauses - embedded SQL.

UNIT III Database Design
dependencies and Normal forms - dependency theory - functional dependencies - Armstrong’s axioms for FD’s - closure of a set of FD’s - minimal covers - definitions of 1NF - 2NF - 3NF and BCNF - decompositions and desirable properties of them - algorithms for 3NF and BCNF normalization - 4NF and 5NF.

UNIT IV Transactions
Transaction processing and Error recovery - concepts of transaction processing - ACID properties - concurrency control - locking based protocols for CC - error recovery and logging - undo - redo - undo-redo logging and recovery methods.

UNIT V Implementation Techniques
Data Storage and Indexes - file organizations - primary and secondary index structures - various index structures - hash-based dynamic hashing techniques - multi-level indexes - B+ trees.

Course Outcomes

Upon completion of this course, the students will be able to:
- Install, configure, and interact with a relational database management system
- Master the basics of SQL and construct queries using SQL
- Design and develop a large database with optimal query processing
- Develop efficient storage scheme of saving and retrieving Records and Files
- Design the database with normalization techniques
**Text Books**


**Reference Books**


**Mapping of Course Outcomes with Programme Outcomes**

<table>
<thead>
<tr>
<th></th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO5</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Course Code : CSPC53
Course Title : Computer Networks
Number of Credits : 3-0-0-3
Pre-requisites (Course Code) : -
Course Type : PC

Course Objectives

- To provide insight about fundamental concepts and reference models (OSI and TCP/IP) and its functionalists
- To gain comprehensive knowledge about the principles, protocols, and significance of Layers in OSI and TCP/IP
- To know the implementation of various protocols and cryptography techniques

Course Contents

UNIT I

UNIT II

UNIT III

UNIT IV

UNIT V
Transport Layer: Transport Services - UDP - TCP - Congestion Control - Quality of Services (QOS) - Application Layer: Domain Name Space (DNS) - Electronic Mail - WWW - Cryptography Techniques.

Course Outcomes

Upon completion of the course, the students will be able to:

- Gain insight about basic network theory and layered communication architectures
- Propose algorithms at the appropriate layer for any communication network task
- Provide solutions to various problems in network theory
- Conceptualize and design a network stack

Text Books


Reference Books


Mapping of Course Outcomes with Programme Outcomes

CSE Dept. Flexible Curriculum NITTUGCSE20
<table>
<thead>
<tr>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Course Title: Introduction to Artificial Intelligence and Machine learning
Number of Credits: 3-0-2-4
Pre-requisites (Course Code): CSPC11
Course Type: PC

Course Objectives

- To learn the concepts of searching for AI problems
- To learn about agents and knowledge representation
- To understand the various factors involved in inferences
- To get introduced to fundamentals of machine learning
- To learn about the possibilities of Supervised and Unsupervised learning

Course Contents

UNIT I
Lab Component (Exercises similar to the following):
2. Implement n-queens problem using Hill-climbing, simulated annealing, etc.

UNIT II
Lab Component (Exercises similar to the following):
1. Tic-tac-toe game simulation using search and heuristics.
2. Solve 3-SAT, 3-CNF algorithms using agents.
3. Describe the Sudoku game and represent the actions using First-order / Propositional logic.

UNIT III
Knowledge Base - Knowledge representation - Production based system - Frame based system - Inference - Backward chaining - Forward chaining.
Lab Component (Exercises similar to the following):
1. Sorting algorithms employing forward chaining.
2. Logical reasoning examples for E-commerce stores using forward/backward chaining.

UNIT IV
Learning from agents - inductive learning - Types of Machine learning - Supervised learning - learning decision trees - support vector machines - Neural and Belief networks - Perceptron - Multi-layer feed forward networks - Bayesian belief networks.
Lab Component (Exercises similar to the following):
2. Exercises on decision trees, SVM using the tool.

UNIT V
Lab Component (Exercises similar to the following):

**Course Outcomes**

Upon completion of the course, the students will be able to:

- Suggest appropriate search strategies for any AI problem
- Design agents for any given problem
- Represent real world knowledge using first order or propositional logic
- Solve problems by appropriated using the supervised or unsupervised machine learning algorithms
- Suggest appropriate clustering algorithm for solving real-world problems

**Text Books**


**Reference Books**


**Mapping of Course Outcomes with Programme Outcomes**

<table>
<thead>
<tr>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO5</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
</tr>
</tbody>
</table>

Course Code : CSLR51

CSE Dept. Flexible Curriculum NITTUGCSE20 52
Course Title: Database Management Systems Laboratory
Number of Credits: 0-0-3-2
Pre-requisites (Course Code): -
Course Type: PL

Course Objectives

- To explore the features of a Database Management Systems
- To interface a database with front end tools
- To understand the internals of a database system
- To identify Structure Query Language statements used in creation and manipulation of Database
- To identify the methodology of conceptual modeling through Entity Relationship model

Exercises

1. Working with DDL, DML and DCL.
2. Inbuilt functions in RDBMS.
3. Nested Queries & Join Queries.
4. Set operators & Views in SQL.
5. Control structures.
7. Triggers.
8. Dynamic & Embedded SQL.
9. Working with XML.
10. Forms & Reports.
11. Database Design and implementation (Mini Project).

Course Outcomes

Upon completion of this course, the students will be able to:

- Identify Structure Query Language statements used in creation and manipulation of Database
- Use databases for building client server applications
- Comprehend the internal working of a database system
- Design and develop a database using SQL and the mechanism in connecting with a Web based GUI
- Analyze and design a real database application

Text Books


Mapping of Course Outcomes with Programme Outcomes

<table>
<thead>
<tr>
<th></th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Course Code: CSLR52
Course Objectives

- To create client and server applications using the "Sockets" API and the implementation of Data link layer protocol and TCP layer
- To conduct computer communication network simulations
- To have a hands on experience of computer network simulation and modelling techniques using NS-3 simulation software

Exercises

1. Exercises on Socket Programming using C and Java
2. Exercises using NS-3 Network Simulator
   a. Basics of Network Simulation
      - Introduction, Platform required to run network simulator, Backend Environment of Network Simulator, Agents and applications, Tracing
   b. Simulating a Local Area Network
      - Local Area Network, LAN Topologies, MAC Protocol, Taking turns, Ethernet, Ethernet Frame Structure, Ethernet Versions, Simulating a LAN using Network Simulator3
      - Implementation of various MAC protocols
      - Setting up of various network topologies
      - Measurement of routing protocols
   c. Measuring Network Performance
      - Setting up of network that carries various application protocols and analyzing the performances
3. Hands on experiments on Network equipments
   a. Switches, Routers
   b. Hardware firewall

Course Outcomes

Upon completion of the course, the students will be able to:

- Invoke analytical studies of Computer Networks through network simulation
- Design a network using NS-3 toolkit and its importance in designing a real network
- Measure and analyze the network parameters for a high throughput network
- Practice experiments on Network Equipments

Text Books


Reference Book

## Mapping of Course Outcomes with Programme Outcomes

<table>
<thead>
<tr>
<th></th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td></td>
<td>✓</td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
VI SEMESTER

<table>
<thead>
<tr>
<th>Course Code</th>
<th>CSPC61</th>
</tr>
</thead>
<tbody>
<tr>
<td>Course Title</td>
<td>Embedded Systems Architectures</td>
</tr>
<tr>
<td>Number of Credits</td>
<td>3-0-0-3</td>
</tr>
<tr>
<td>Pre-requisites</td>
<td>CSPC51</td>
</tr>
<tr>
<td>Course Type</td>
<td>PC</td>
</tr>
</tbody>
</table>

Course Objectives
- To understand basics of Embedded Systems Architecture
- To understand the intricacies of Embedded programming

Course Contents

**Unit I Introduction to Embedded System**

**Unit II Embedded Hardware: Hardware Building Blocks**

**Unit III Embedded Software: Device Drivers**

**Unit IV OS for Embedded Systems**

**Unit V Design, Development and Case studies**

Course Outcomes
- Ability to comprehend the architecture of Embedded systems
- Ability to design embedded systems for simple tasks
- Ability to design and develop programs for specific embedded applications

Text Books

Reference Books
CSE Dept. Flexible Curriculum NITTUGCSE20 56

Mapping of Course Outcomes with Programme Outcomes

<table>
<thead>
<tr>
<th></th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td>√</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>√</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td>√</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Pre-requisites (Course Code) : CSPC41
Course Type : PC

Course Objectives

- To introduce the major concept areas in compiler design and know the various phases of the compiler
- To understand the various parsing algorithms and comparison of the same
- To provide practical programming skills necessary for designing a compiler
- To gain knowledge about the various code generation principles
- To understand the necessity for code optimization

Course Contents

UNIT I  Introduction to Compilation
Compilers - Analysis of the source program - Phases of a compiler - Cousins of the Compiler - Grouping of Phases - Compiler construction tools - Lexical Analysis - Role of Lexical Analyzer - Input Buffering - Specification of Tokens.
Lab Component: Tutorial on LEX / FLEX tool, Tokenization exercises using LEX.

UNIT II  Syntax Analysis
Lab Component: Tutorial on YACC tool, Parsing exercises using YACC tool.

UNIT III  Intermediate Code Generation
Lab Component: A sample language like C-lite is to be chosen. Intermediate code generation exercises for assignment statements, loops, conditional statements using LEX/YACC.

UNIT IV  Code Optimization and Run Time Environments
Lab Component: Local optimization to be implemented using LEX/YACC for the sample language.

UNIT V  Code Generation
Lab Component: DAG construction, Simple Code Generator implementation, DAG based code generation using LEX/YACC for the sample language.

Course Outcomes

Upon completion of this course, the students will be able to:

- Apply the knowledge of LEX & YACC tool to develop a scanner and parser
- Design and develop software system for backend of the compiler
- Suggest the necessity for appropriate code optimization techniques
- Conclude the appropriate code generator algorithm for a given source language
- Design a compiler for any programming language

Text Books

CSE Dept. Flexible Curriculum  NITTUGCSE20  58

Reference Books

Mapping of Course Outcomes with Programme Outcomes

<table>
<thead>
<tr>
<th></th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>CO2</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>CO3</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>CO4</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>CO5</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>
Course Code: CSPC63
Course Title: Principles of Cryptography
Number of Credits: 3-0-3-3
Pre-requisites (Course Code): -
Course Type: PC

Course Objectives
- To gain knowledge about the mathematics of the cryptographic algorithms
- To get an insight into the working of different existing cryptographic algorithms
- To learn about key exchange protocols and attacks on such protocols
- To introduce the fundamental concepts of hash functions and digital signatures
- To learn how to use cryptographic algorithms in security

Course Contents
UNIT I   Mathematical Foundations

UNIT II  Classical Cryptosystems
Cryptography and cryptanalysis - Classical Cryptography - different type of attack: CMA - CPA - CCA - Shannon perfect secrecy - OTP - Pseudo random bit generators - stream ciphers and RC4.*

UNIT III Symmetric Key Ciphers
Block ciphers: Modes of operation - DES and its variants - finite fields (2^n) - AES - linear and differential cryptanalysis.*

UNIT IV  Asymmetric Key Ciphers
One-way function - trapdoor one-way function - Public key cryptography - RSA cryptosystem - Diffie-Hellman key exchange algorithm - ElGamal Cryptosystem.*

UNIT V Message Authentication

*Programming assignments are mandatory.

Course Outcomes
Upon completion of this course, the students will be able to:
- Understand the basic concepts of symmetric cryptosystem, public key cryptosystem and digital signature scheme
- Reason about the security of cryptographic algorithms
- Evaluate the security of a protocol based on security metrics
- Justify the usage of security principles and digital signatures for any application

Text Book

Reference Books

Mapping of Course Outcomes with Programme Outcomes

<table>
<thead>
<tr>
<th></th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Course Code : CSLR61
Course Title : Embedded Systems Laboratory
Number of Credits : 0-0-3-2
Pre-requisites (Course Code) : -
Course Type : PL

Course Objectives

- To introduce embedded systems design tools
- To write programs to interface the memory and I/Os with processors
- To program and test the ARM processor based circuits and their interfaces
- To implement the basic building blocks of a microcontroller including counters, I/O techniques and requirements, A/D conversion

Exercises

1. To interface LED and perform the flashing of LEDs with ARM processor using mbed LPC 1768.
2. To create a waveforms using ARM processor using mbed LPC 1768 and display it using CRO.
   a. Triangular waveform
   b. Square waveform
   c. Saw-tooth waveform
3. To interface the DC motor with ARM processor using mbed LPC 1768 and perform the speed control.
4. To write and read data from EEPROM interfaced with ARM processor.
5. To interface LCD with ARM processor and display the text.
6. To implement SISO and PISO using Zybo board.
7. To implement SIPO and PIPO using Zybo board.
8. To implement 3-bit Counters in Zybo board.
   a. Ring Counter
   b. Johnson counter
9. To interface temperature sensor with Raspberry Pi.
10. To interface humidity sensor with Raspberry Pi.
11. To interface RFID sensor with Raspberry Pi.
14. To interface external memory with Zedboard.
15. To interface monitor and external source with Zedboard.

Course Outcomes

Upon completion of this course, the students will be able to:

- Assemble and troubleshoot hardware devices
- Write programs for interfacing keyboard, display, motor and sensor
- Design and program an embedded system at the basic level
- Write programs in ARM for a specific Application
- Formulate a mini project using embedded systems

Text Books

### Mapping of Course Outcomes with Programme Outcomes

<table>
<thead>
<tr>
<th></th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO5</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Course Code : CSLR62
Course Title : App Development Laboratory
Number of Credits : 0-0.3-2
Pre-requisites (Course Code) : -
Course Type : PL

Course Objectives

- To be familiar with Web page design using HTML/XML and style sheets
- To learn to write Client Server applications
- To be familiar with the PHP programming
- To be exposed to creating applications with AJAX
- Know the components and structure of mobile application development frameworks for Android and windows OS based mobiles
- Learn the basic and important design concepts and issues of development of mobile applications

Exercises

A. Web Applications

1. Create a web page for user registration using HTML, CSS and validate the details using Javascript.
2. Write programs in Java using Servlets: (i) To invoke servlets from HTML forms; (ii) Session tracking using hidden form fields and Session tracking for a hit count.
3. Create three-tier applications using JSP for conducting on-line examination for displaying student mark list. Assume that student information is available in a database which has been stored in a database server.
4. Create a database with user information and books information and create a webpage in which books catalogue should be dynamically loaded from the database using AJAX.
5. Create and save an XML document at the server, which contains 10 users Information. Write a Program, which takes user Id as an input and returns the User details by taking the user information from the XML document.
6. Develop email verification application using PHP.

B. Mobile Applications

1. Design restaurant data entry form using Table Layout and show different events using activity class.
2. Write a program to capture image using built in camera and store it in database.
3. Develop a banking application that registers the user by verifying OTP.
4. Develop a native application that uses GPS location information and convert into speech.
5. Write a program to call a number.

Course Outcomes

Upon completion of this course, the students will be able to:

- Construct Web pages using HTML/XML and style sheets
- Build dynamic web pages with validation using Java Script objects and by applying different event handling mechanisms
- Develop Web application which makes use of PHP programming
- Construct web applications using AJAX
- Design and Implement various mobile applications using emulators
- Deploy applications to hand-held devices

Text Books

<table>
<thead>
<tr>
<th></th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>CO2</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>CO3</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>CO4</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>CO5</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>CO6</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>
Course Code : HSIR14
Course Title : Professional Ethics
Number of Credits : 3-0-0-3
Pre-requisites (Course Code) : -
Course Type : GIR

Course Objectives

- Identify the core values that shape the ethical behavior of an engineer
- To create an awareness on professional ethics and human values
- To introduce loyalty, moral and social values
- To develop as a competent and trustworthy professionals
- To enable the students to appreciate the rights of others

Course Contents

UNIT I Human Values

UNIT II Engineering Ethics

UNIT III Engineering as Social Experimentation
Engineering as experimentation - engineers as responsible experimenters - Research ethics - Codes of ethics - Industrial Standard - Balanced outlook on law - the challenger case study.

UNIT IV Safety, Responsibilities and Rights

UNIT V Global Issues
Multinational corporations - Business ethics - Environmental ethics - computer ethics - Role in Technological Development - Weapons development - engineers as managers - consulting engineers - engineers as expert witnesses and advisors - Honesty - Leadership - sample code of conduct ethics like ASME - ASCE - IEEE - Institution of Engineers (India) - Indian Institute of Materials Management - Institution of Electronics and Telecommunication Engineers (IETE India).

Course Outcomes

Upon completion of this course, the students will be able to:
- Understand the core values that shape the ethical behavior of an engineer
- Expose awareness on professional ethics and human values
- Understand the importance of research ethics and moral issues while conducting social experimentation
- Demonstrate universally accepted ethical standards
- Gain adequate knowledge about moral leadership and code of conduct
Text Books


Reference Books


Mapping of Course Outcomes with Programme Outcomes

<table>
<thead>
<tr>
<th></th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO5</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
PROGRAMME ELECTIVES

III SEMESTER

<table>
<thead>
<tr>
<th>Course Code</th>
<th>:</th>
<th>CSPE31</th>
</tr>
</thead>
<tbody>
<tr>
<td>Course Title</td>
<td>:</td>
<td>Linear Algebra and Applications</td>
</tr>
<tr>
<td>Number of Credits</td>
<td>:</td>
<td>3-0-0-3</td>
</tr>
<tr>
<td>Pre-requisites (Course Code)</td>
<td>:</td>
<td>-</td>
</tr>
<tr>
<td>Course Type</td>
<td>:</td>
<td>PE</td>
</tr>
</tbody>
</table>

Course Objectives

- To understand linear system of equations
- To gain knowledge about vector spaces and the operations performed on it
- To understand orthogonality principle of vectors and how it is useful in solving problems
- To acquire knowledge about properties of determinants
- To have an idea about eigen value and eigen vectors

Course Contents

UNIT I  Matrices and Gaussian Elimination

UNIT II  Orthogonality
Orthogonality of vectors - subspaces - notion of orthogonal compliment of a subspace - orthogonality relations between the four fundamental subspaces of a matrix - Solutions to least square error problems - connection to pseudo-inverse Projection onto a vector space as a matrix operation - projection onto a line - Minimum norm solution in the under-determined case - connection to pseudo-inverse Orthogonal vector and matrices - Gram-Schmidt process of orthonormalization - QR decomposition of a matrix - Hilbert spaces - function spaces and the concept of orthogonality in these spaces.

UNIT III  Determinants

UNIT IV  Eigen value and Eigen Vectors
Definition and a few properties of the matrix eigen value problem - Algebraic and geometric multiplicity of an eigen value - some properties - Proof regarding multiplicity - Diagonalization of a matrix (also called its eigen decomposition) - its use to compute powers of a matrix - Cayley-Hamilton theorem - Powers of a matrix: application based on Fibonacci numbers - Hermitian matrices and their properties - Spectral theorem - Unitary matrices - change of basis and similarity transforms - On the Schur decomposition of a matrix.

UNIT V  Applications
Graphs and Networks - Linear programming - Markov matrices - Linear programming - fourier series.

Course Outcomes

Upon completion of this course, the students will be able to:

- Solve linear system of equations with LU decomposition
- Perform linear transformation with matrices
- Apply orthogonality relations between the subspaces of a matrix
- Understand the properties of determinants
- Use eigen value and eigen vectors to compute powers of a matrix
**Text Book**


**Mapping of Course Outcomes with Programme Outcomes**

<table>
<thead>
<tr>
<th></th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>✔</td>
<td>✔</td>
<td></td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td>✔</td>
<td>✔</td>
<td></td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td>✔</td>
<td>✔</td>
<td></td>
<td>✔</td>
<td></td>
<td></td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td>✔</td>
<td></td>
<td></td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO5</td>
<td>✔</td>
<td>✔</td>
<td></td>
<td></td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
**Course Code**: CSPE32  
**Course Title**: Combinatorics and Graph Theory  
**Number of Credits**: 3-0-0-3  
**Pre-requisites (Course Code)**: CSPC11  
**Course Type**:  

### Course Objectives

- To introduce basic concepts of combinatorics and graph theory  
- To study graphs, trees and networks  
- To discuss Euler formula, Hamilton paths, planar graphs and coloring problem  
- To practice useful algorithms on networks such as shortest path algorithm, minimal spanning tree algorithm and min-flow max-cut algorithm

### Course Contents

**UNIT I**  
Introduction to combinatorics - permutation of multisets - Combinations of Multisets - distribution of distinct objects into distinct cells - distribution of non-distinct objects into distinct cells - Shamire secret sharing - Catalan number - Principle of inclusion and exclusion - Derangement.

**UNIT II**  
Generating functions - Partitions of integer - Ferrer graph - Solving recurrence relations using generating functions - Generating permutations and combinations - Pigeonhole principle: simple and strong Form - A THEOREM OF RAMSEY.

**UNIT III**  

**UNIT IV**  
Eular graph - Fleury’s algorithm - Hamiltonian graph - Planar and Dual Graphs - Kuratowski's graphs Coloring - Greedy coloring algorithm - chromatic polynomial.

**UNIT V**  

### Course Outcomes

Upon completion of the course, the students will be able to:  
- Comprehend the fundamentals of combinatorics and apply combinatorial ideas in mathematical arguments in analysis of algorithms, queuing theory, etc.  
- Comprehend graph theory fundamentals and tackle problems in dynamic programming, network flows, etc.  
- Design and develop real time application using graph theory  
- Construct and communicate proofs of theorems

### Text Books

Reference Books


Mapping of Course Outcomes with Programme Outcomes

<table>
<thead>
<tr>
<th></th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>CO4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>
Course Code : CSPE41
Course Title : Software Engineering
Number of Credits : 3-0-0-3
Pre-requisites (Course Code) : -
Course Type : PE

Course Objectives

• To understand the Software Engineering Practice
• To understand the Software Engineering Process Models
• To understand Design Engineering, Web applications
• To gain knowledge of the software testing
• To understand Software Project Management

Course Contents

UNIT I

UNIT II

UNIT III
Assessment: Framing SQA Plan, ISO 9000 Models, SEI-CMM Model and their relevance to project Management, other emerging models like People CMM.

UNIT IV
Assessment: Team Analysis in Metrics Calculation.

UNIT V
Assessment: Preparation of Risk mitigation plan.
Course Outcomes

Upon completion of the course, the students will be able to:

- Assess each module given the overall Software engineering practice
- Enhance the software project management skills
- Comprehend the systematic methodologies involved in SE
- Design and develop a software product in accordance with SE principles

Text Books


Mapping of Course Outcomes with Programme Outcomes

<table>
<thead>
<tr>
<th>CO1</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
</tr>
</thead>
<tbody>
<tr>
<td>✓</td>
<td></td>
<td>✓</td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>✓</td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
<td>✓</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>✓</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td>✓</td>
</tr>
</tbody>
</table>
Course Code  :  CSPE42  
Course Title  :  Design Thinking  
Number of Credits  :  3-0-0-3  
Pre-requisites (Course Code)  :  -  
Course Type  :  PE  

Course Objectives  
• To understand processes that enhances innovation activities  
• To develop capabilities to identify problems/issues/needs  
• To develop sound hypotheses, collect and analyze appropriate data  
• To translate broadly defined opportunities into actionable innovation possibilities  

Course Contents  

UNIT I  

UNIT II  
Three visualizations - Visualization basics - Journey mapping - Value Chain analysis - Mind mapping.  

UNIT III  

UNIT IV  
Assumption testing - Rapid Prototyping - Surface Key assumptions - make prototypes.  

UNIT V  
Customer co-creation - learning launch - Feedback from stake holders - Design the on-ramp - Case study.  

Course Outcomes  
Upon completion of the course, the students will be able to:  
• Convert real-life problems into methodical problems  
• Apply various visualization principles for problem and solution representation  
• Design solutions by applying an integrated approach to design thinking  
• Justify and prototype solutions to problems  

Text Books  

Mapping of Course Outcomes with Programme Outcomes  

<table>
<thead>
<tr>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

CSE Dept. Flexible Curriculum  
NITTUGCSE20  
74
Course Code : CSPE43
Course Title : Advanced Data Structures and Algorithms
Number of Credits : 3-0-0-3
Pre-requisites (Course Code) : CSPC31
Course Type : PE

Course Objectives

- To explore various heaps
- To study the need for various balanced and multimedia tree structures
- To study about geometric algorithms and their applications
- To understand the approximation algorithms for the various NP complete problems
- To study about the various string matching algorithms

Course Contents

UNIT I

UNIT II
Splay Trees - Point trees - Quad trees - K-d trees - TV-trees - Segment trees.

UNIT III
Dynamic programming - Optimal Binary search trees - TSP - Graph coloring - Knapsack problem - Backtracking algorithms - N-queens - Hamiltonian cycle - Graph coloring - Branch and bound method – Knapsack - TSP.

UNIT IV
Number-theoretic algorithms - FFT - String matching algorithms - KMP - Rabin-Karp - Boyer Moore algorithms.

UNIT V
Computational Geometry - convex hull - NP Complete problems - Reducibility - Vertex cover–clique - Hamiltonian cycle - TSP.

Course Outcomes

Upon completion of this course, the students will be able to:

- Apply the appropriate heap data structure for solving real-world problems
- Use special tree data structures for a given real-world problem
- Decide on appropriate string matching algorithms for solving practical problems
- Appreciate the backtracking and branch and bound technique to solving NP problems

Text Books

## Mapping of Course Outcomes with Programme Outcomes

<table>
<thead>
<tr>
<th>CO1</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
</tr>
</thead>
<tbody>
<tr>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td>✔️</td>
<td>✔️</td>
<td></td>
<td>✔️</td>
<td></td>
<td></td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Course Code : CSPE44
Course Title : Computer Graphics
Number of Credits : 3-0-0-3
Pre-requisites (Course Code) : -
Course Type : PE

Course Objectives

• To understand the basics of various input and output devices used in computer graphics
• To learn the basic to build 2D and 3D objects
• To understand 2D and 3D transformations and Viewing
• To provide comprehensive knowledge on hidden surface detection
• To be familiar with Animation, Morphing

Course Contents

UNIT I

UNIT II
OpenGL primitives: Functions - pipeline - sample programs for drawing 2-D and 3-D objects; event handling and view manipulation.

UNIT III
2D Transformations and Viewing: Rotation - Translation - Scale - Reflection and Shear Transform - Matrix representation - homogeneous co-ordinates - composite transformations - Clipping algorithms for point - line and polygon - Text.

UNIT IV
3D object representation: 3D display methods - polygon surfaces - tables - equations - meshes.
Curves and Surfaces: curved lines and surfaces - quadric surfaces - spline representation - cubic spline interpolation methods - Bezier curves and surfaces - B-spline curves and surfaces.
3D transformation and viewing: 3D translation - rotation and scaling - composite transformation - viewing pipeline and coordinates - parallel and perspective transformation - view volume and general (parallel and perspective) projection transformations.

UNIT V

Course Outcomes

Upon completion of the course, the students will be able to:
• Differentiate various computer graphics hardware and display technologies
• Implement and develop various 2D and 3D objects
• Apply 2D and 3D transformation and viewing into the real world applications
• Project realistic view of an object
• Develop applications using Animation and Morphing

**Text Books**


**Reference Books**


**Mapping of Course Outcomes with Programme Outcomes**

<table>
<thead>
<tr>
<th></th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td></td>
<td>✓</td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>CO5</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
</tr>
</tbody>
</table>
Course Code : CSPE45
Course Title : Multimedia Systems
Number of Credits : 3-0-3
Pre-requisites (Course Code) : -
Course Type : PE

Course Objectives

- To understand the different media and design issues in multimedia systems
- To understand communication standards for Multimedia
- Exploration of security for multimedia systems

Course Contents

UNIT I  Multimedia Elements

UNIT II  Audio and Speech
Data acquisition - sampling and quantization - human speech - digital model of speech production - analysis and synthesis - psychoacoustics - low bit rate speech compression - MPEG audio compression.

UNIT III  Images and Video

UNIT IV  Multimedia Networks

UNIT V  Multimedia Security and Forensics

Course Outcomes

Upon completion of this course, the students will be able to:

- Design multimedia components efficiently
- Develop integrated, collaborative multimedia systems
- Understand protocols for multimedia
- Develop security algorithms for the specialized applications

Text Books


Reference Books


Mapping of Course Outcomes with Programme Outcomes

<table>
<thead>
<tr>
<th></th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>✔</td>
<td>✔</td>
<td></td>
<td>✔</td>
<td></td>
<td></td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td>✔</td>
<td></td>
<td>✔</td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td></td>
<td>✔</td>
<td></td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td>✔</td>
<td></td>
<td>✔</td>
<td></td>
<td>✔</td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
<td>✔</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
V SEMESTER

<table>
<thead>
<tr>
<th>Course Code</th>
<th>CSPE51</th>
</tr>
</thead>
<tbody>
<tr>
<td>Course Title</td>
<td>Augmented and Virtual Reality</td>
</tr>
<tr>
<td>Number of Credits</td>
<td>3-0-0-3</td>
</tr>
<tr>
<td>Pre-requisites (Course Code)</td>
<td>-</td>
</tr>
<tr>
<td>Course Type</td>
<td>PE</td>
</tr>
</tbody>
</table>

Course Objectives

- To know basic concepts of virtual reality
- To understand visual computation in computer graphics
- To understand interaction between system and computer
- To know application of VR in Digital Entertainment
- To know basic concepts of augmented reality

Course Contents

UNIT I

UNIT II

UNIT III

UNIT IV
Application of VR in Digital Entertainment: VR Technology in Film & TV Production - VR Technology in Physical Exercises and Games - Demonstration of Digital Entertainment by VR.

UNIT V

Course Outcomes

Upon completion of this course, the students will be able to:

- Provide opportunity to explore the research issues in Augmented Reality and Virtual Reality (AR & VR)
- Know the basic concept and framework of virtual reality
- Know the computer-human interaction

Text Books


Reference Books


Mapping of Course Outcomes with Programme Outcomes

<table>
<thead>
<tr>
<th></th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>✔</td>
<td>✔</td>
<td></td>
<td>✔</td>
<td></td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td></td>
<td></td>
<td></td>
<td>✔</td>
<td></td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td></td>
<td></td>
<td>✔</td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Course Objectives

- To introduce the various time domain to frequency domain transformations
- To learn about the IIR and FIR filter design and their representations
- To understand the issues in designing DSP systems
- To introduce multi-rate signal processing
- To know about few applications of signal processing systems

Course Contents

UNIT I  Fundamentals of Signals and Systems
Basic elements of DSP - concepts of frequency in Analog and Digital Signals - sampling theorem - Discrete-time signals – systems – Analysis of discrete time LTI systems - Z transform - Convolution - Correlation.

UNIT II  Frequency Transformations
Introduction to DFT - Properties of DFT - Circular Convolution - Filtering methods based on DFT - FFT Algorithms - Radix-2 - Decimation in time Algorithms - Decimation in frequency Algorithms - Use of FFT in Linear Filtering - DCT - Use and Application of DCT.

UNIT III  IIR Filter Design
Structures of IIR - Analog filter design - Discrete time IIR filter from analog filter - IIR filter design by Impulse Invariance - Bilinear transformation - Approximation of derivatives (LPF - HPF - BPF - BRF) – Butterworth and Chebyshev approximation.

UNIT IV  FIR Filter Design
Structures of FIR - Linear phase FIR filter - Fourier Series - Filter design using windowing techniques (Rectangular Window - Hamming Window - Hanning Window) - Binary fixed point and floating point number representations - Comparison - Quantization noise - truncation and rounding - quantization noise power - input quantization error - coefficient quantization error - limit cycle oscillations - dead band - Overflow error - signal scaling.

UNIT V  Multi-Rate Signal Processing and Applications
Decimator - Interpolator - Fractional Decimation - Applications - Speech processing - Image Enhancement and Image processing system.

Course Outcomes

Upon completion of the course, students will be able to:

- Perform frequency transforms for the signals.
- Suggest appropriate IIR and FIR filter design techniques for any given application
- Predict the loss and decide on its acceptability for any application that requires digital signal processing
- Appreciate and use decimators and interpolators for any given application
- Apply DSP for Image and Speech processing systems

Text Book


Reference Books
CSE Dept. Flexible Curriculum NITTUGCSE20 83

**Mapping of Course Outcomes with Programme Outcomes**

<table>
<thead>
<tr>
<th></th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO5</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
</tbody>
</table>
Course Code : CSPE53
Course Title : Game Theory
Number of Credits : 3-0-0-3
Pre-requisites (Course Code) : -
Course Type : PE

Course Objectives

- To explain and predict how individuals behave in a specific strategic situation, and therefore help improve decision making
- To explain in depth the standard equilibrium concepts in Game Theory
- To illustrate the concepts, real-world examples and case studies
- To design Repeated Games with public information
- To design static and Dynamic games with incomplete information

Course Contents

UNIT I Introduction to Game Theory

UNIT II Extensive-Form Games
Definition - Strategies and Equilibria in Extensive Form Games - Backward Induction and Subgame Perfection and its Critiques.

UNIT III Repeated Games
Infinitely/finitely repeated games - Pareto Perfection and Renegotiation - Proofness in Repeated Games - Repeated Games with incomplete Public Information - Trigger strategies - Fork Theorem with Imperfect Public Information.

UNIT IV Static Games with incomplete information
Mixed and Behavioral strategies - Bayesian Nash equilibrium - Applications in auctions - Different auction formats - Revenue and efficiency properties of different auctions - Bayesian Games and Mechanism Design Principle - Single Agent - Several Agents - Further topics in Mechanism Design.

UNIT V Dynamic Games with incomplete information
Introduction - Perfect Bayesian Equilibrium in Multi-stage games - Extensive-Form and Strategic-Form Refinements - Reputation Effects - Sequential Bargaining under Incomplete Information.

Course Outcomes

Upon completion of this course, the students will be able to:
- Identify strategic situations and represent them as games
- Solve simple games using various techniques
- Recommend and prescribe which strategies to implement
- Develop Static and Dynamic Games
- Develop Repeated Games

Text Book

Reference Books


Mapping of Course Outcomes with Programme Outcomes

<table>
<thead>
<tr>
<th></th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>√</td>
<td></td>
<td></td>
<td>√</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td>√</td>
<td>√</td>
<td></td>
<td></td>
<td>√</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>√</td>
</tr>
<tr>
<td>CO4</td>
<td>√</td>
<td></td>
<td>√</td>
<td></td>
<td>√</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO5</td>
<td>√</td>
<td>√</td>
<td></td>
<td></td>
<td>√</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Course Code : CSPE54
Course Title : Real Time Systems
Number of Credits : 3.0.0.3
Pre-requisites (Course Code) : CSPC43
Course Type : PE

Course Objectives

- To study issues related to the design and analysis of systems with real-time constraints
- To learn the features of Real time OS
- To study the various Uniprocessor and Multiprocessor scheduling mechanisms
- To learn about various real time communication protocols
- To study the difference between traditional and real time databases

Course Contents

UNIT I  Introduction to Real-time systems

UNIT II  Task Assignment and Scheduling
Real time OS - Threads and Tasks - Structure of Microkernel - Time services - Scheduling Mechanisms - Communication and Synchronization - Event Notification and Software interrupt - Uniprocessor scheduling algorithms - Task assignment - Mode changes - Fault tolerant scheduling.*

UNIT III  Real-Time Communication
Network topologies and architecture issues - Protocols - Contention-based - token–based - polled bus - Fault tolerant routing.*

UNIT IV  Real-Time Databases
Transaction priorities and aborts - Concurrency control issues - Scheduling algorithms – Two-phase approach to improve predictability.*

UNIT V  Programming Languages and Tools
Hierarchical decomposition - Run–time error handling - Overloading - Timing specification - Recent trends and developments.*

*Programming Assignments are mandatory.

Course Outcomes

Upon completion of this course, the students will be able to:

- Analyze scheduling problems
- Appreciate and apply Real–time programming environment tasks for solving practical problems
- Develop real time systems.
- Understand basic multi-task scheduling algorithms

Text Book

Reference Books


Mapping of Course Outcomes with Programme Outcomes

<table>
<thead>
<tr>
<th></th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>CO2</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>CO3</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>CO4</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>
Course Code : CSPE55
Course Title : Software Testing And Automation
Number of Credits : 3-0-0-3
Pre-requisites (Course Code) : -
Course Type : PE

Course Objectives

• Summarize to learn the criteria for test cases
• Develop and design test cases
• Analyse test management and test automation techniques
• Assess test metrics and measurements
• Design and validate website testing

Course Content

UNIT I Introduction

UNIT II Test Case Design Strategies
Test case Design Strategies - Using Black Box Approach to Test Case Design - Boundary Value Analysis - Equivalence Class Partitioning - State based testing - Cause-effect graphing - Compatibility testing - user documentation testing - domain testing - Random Testing - Requirements based testing - Using White Box Approach to Test design - Test Adequacy Criteria - static testing vs. structural testing - code functional testing - Coverage and Control Flow Graphs - Covering Code Logic - Paths - code complexity testing - Additional White box testing approaches - Evaluating Test Adequacy Criteria.

UNIT III Levels of Testing
The need for Levels of Testing - Unit Test - Unit Test Planning - Designing the Unit Tests - The Test Harness - Running the Unit tests and Recording results - Integration tests - Designing Integration Tests - Integration Test Planning - Scenario testing - Defect bash elimination System Testing - Acceptance testing - Performance testing - Regression Testing - Internationalization testing - Ad-hoc testing - Alpha- Beta Tests - Testing OO systems - Usability and Accessibility testing - Configuration testing - Compatibility testing - Testing the documentation - Website testing.

UNIT IV Test Management
People and organizational issues in testing - Organization structures for testing teams - testing services - Test Planning - Test Plan Components - Test Plan Attachments - Locating Test Items - test management - test process - Reporting Test Results - Introducing the test specialist - Skills needed by a test specialist - Building a Testing Group - The Structure of Testing Group - The Technical Training Program.

UNIT V Test Automation
Software test automation - skills needed for automation - scope of automation - design and architecture for automation - requirements for a test tool - challenges in automation - Test metrics and measurements – project-progress and productivity metrics.

Course Outcomes

Upon completion of this course, the students will be able to:

• Design test cases suitable for a software development for different domains
• Identify suitable tests to be carried out
• Prepare test planning based on the document
• Document test plans and test cases designed
• Use automatic testing tools
• Develop and validate a test plan

**Text Books**

**Reference Books**

**Mapping of Course Outcomes with Programme Outcomes**

<table>
<thead>
<tr>
<th></th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>CO2</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>CO3</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>CO4</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>CO5</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>CO6</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>
Course Objectives

- To provide an in-depth and comprehensive knowledge of the deployment models in Cloud Computing
- To understand the enabling technologies needed for establishing cloud environment
- To motivate students to do programming and experiment with the various cloud computing environments
- To shed light on the cloud providers and software platforms
- To introduce about different programming models in cloud computing

Course Contents

UNIT I Introduction
Evolution: Clustering - Grid computing – Virtualization – Basic concepts - Benefits and Risks - Roles and Boundaries - Characteristics - XaaS based service offerings - Basic Deployment models.

UNIT II Enabling Technologies

UNIT III Computing Mechanisms

UNIT IV Cloud Providers & Software Platforms

UNIT V Programming Models & Advances

Course Outcomes

Upon completion of this course, the students will be able to:

- Articulate the main concepts, key technologies, strengths, and limitations of cloud computing and the possible applications for state-of-the-art cloud computing
- Identify the architecture and infrastructure of cloud computing, including SaaS, PaaS, IaaS, public cloud, private cloud, hybrid cloud
- Adopt suitable computing mechanisms for establishing a cloud environment
- Provide the appropriate cloud computing solutions and recommendations according to the applications used

Text Book

**Reference Books**


**Mapping of Course Outcomes with Programme Outcomes**

<table>
<thead>
<tr>
<th></th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
<td>✔</td>
<td></td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>CO2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Course Objectives

- To develop an understanding on agile software development
- To learn about the principles, planning and requirement in agile software development
- To understand the testing methodologies in agile software development
- To explore the metrics and measurement in agile software development

Course Contents

UNIT I Introduction

UNIT II Principles

UNIT III Planning and Product Management

UNIT IV Requirements and Testing

UNIT V Measurement

Course Outcomes

Upon completion of this course, the students will be able to:

- Distinguish between agile software development and traditional software development
- Suggest agile software development approaches for any real-time problem
- Design and provide measurement, metrics necessary for problems involving agile software development
- Integrate best practices of traditional and agile software development and use in real-time problem solving

Text Books

Reference Book


Mapping of Course Outcomes with Programme Outcomes

<table>
<thead>
<tr>
<th></th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✔</td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✔</td>
<td></td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✔</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td></td>
<td></td>
<td></td>
<td>✔</td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✔</td>
<td>✔</td>
<td></td>
</tr>
</tbody>
</table>
VI SEMESTER

<table>
<thead>
<tr>
<th>Course Code</th>
<th>CSPE61</th>
</tr>
</thead>
<tbody>
<tr>
<td>Course Title</td>
<td>Web Technology and its Applications</td>
</tr>
<tr>
<td>Number of Credits</td>
<td>3-0-0-3</td>
</tr>
<tr>
<td>Pre-requisites (Course Code)</td>
<td>CSPC42</td>
</tr>
<tr>
<td>Course Type</td>
<td>PE</td>
</tr>
</tbody>
</table>

Course Objectives

- To understand the basics of Web Designing using HTML, DHTML, and CSS
- To learn the basics about Client side scripts and Server side scripts

Course Contents

UNIT I

UNIT II

UNIT III

UNIT IV
PHP - Basic Syntax - Defining variable and constant - PHP Data types - Operator and Expression - Operator Precedence - Decisions and Loop - Functions & Recursion - String Processing and Regular Expressions - Form Processing - Working with file and Directories* - Cookies.

UNIT V
Database Connectivity with MySQL - Servlets - JSP - PHP - MongoDB - NOSQL Database* - Fundamentals of JQuery and Bootstrap.

*Programming assignments are mandatory.

Course Outcomes

Upon completion of the course, the students will be able to:
- Understand and interpret standard web technologies
- Build real world applications using client side and server side scripting languages
- Design and develop applications using web technologies
- Suggest appropriate web technologies for any application

Text Books


Reference Books

Mapping of Course Outcomes with Programme Outcomes

<table>
<thead>
<tr>
<th></th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>CO2</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>CO3</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>CO4</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
</tr>
</tbody>
</table>
Course Code : CSPE62
Course Title : Advanced Database Management Systems
Number of Credits : 3-0-0-3
Pre-requisites (Course Code) : CSPC52
Course Type : PE

Course Objectives

- To understand the different database models and language queries to access databases
- To understand the normalization forms in building an effective database tables
- To protect the data and the database from unauthorized access and manipulation

Course Contents

UNIT I  Relational Model Issues
ER Model - Normalization - Query Processing - Query Optimization - Transaction Processing - Concurrency Control - Recovery - Database Tuning.

UNIT II  Distributed Databases
Parallel Databases - Inter and Intra Query Parallelism - Distributed Database Features - Distributed Database Architecture - Fragmentation - Distributed Query Processing - Distributed Transactions Processing - Concurrency Control - Recovery - Commit Protocols.*

UNIT III  Object Oriented Databases

UNIT IV  Emerging Systems with Current Issues

UNIT V  Advanced Databases

*Programming assignments are mandatory.

Course Outcomes

Upon completion of this course, the students will be able to:

- Comprehend the complex query processing techniques
- Design and implement multimedia databases and writing query structure
- Develop skill set in file organization, Query Optimization, Transaction management, and database administration techniques

Text Books


Reference Books


Mapping of Course Outcomes with Programme Outcomes

<table>
<thead>
<tr>
<th></th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✔</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td></td>
<td></td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td></td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Course Code : CSPE63
Course Title : Artificial Intelligence and its Applications
Number of Credits : 3-0-0-3
Pre-requisites (Course Code) : CSPC54
Course Type : PE

Course Objectives

- To learn about agents and knowledge representation
- To understand the various logical reasoning systems
- To familiarize in planning activities for agents
- To explore the uncertainty involves in reasoning systems
- To get introduced to communicating agents and robotics

Course Contents

Unit I
Fundamentals of AI - Search techniques review - knowledge representation review - logical agents - simple reflex agent - Building knowledge base - Knowledge Engineering - General ontology - Representing categories - measures - composite objects - Resolution - complete inference procedure.*

Unit II
Logical Reasoning systems - indexing - retrieval and unification - theorem provers - forward-chaining production systems - frame systems and semantic networks - Certainty factors - Bayesian Theory - Bayesian Network - Dempster - Shafer theory.*

Unit III
Planning - simple planning agent - representation for planning - partial-order planning - Planning with partial instantiated operators - Knowledge engineering for planning - practical planners - hierarchical decomposition - expressive operator decomposition - Conditional planning - simple replanning agent - Fully integrated planning and execution.*

Unit IV

Unit V
Agents that communicate - Types of communicating agents - Introduction to Robotics - Architectures - configuration spaces - navigation and motion planning.*

*Programming assignments are mandatory.

Course Outcomes

Upon completion of the course, the students will be able to:
- Design agents for any given problem
- Suggest appropriate knowledge representation technique for any problem
- Develop algorithms involving planning agents
- Appreciate the uncertainty in designing AI systems and propose algorithms for the same
- Propose new architectures for communicating agents
Text Books

Reference Books

Mapping of Course Outcomes with Programme Outcomes

<table>
<thead>
<tr>
<th></th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>✔</td>
<td></td>
<td>✔</td>
<td></td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td></td>
<td>✔</td>
<td></td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
<td>✔</td>
<td></td>
<td>✔</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td>✔</td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO5</td>
<td></td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
**Course Objectives**

- To understand the basic principles of Data Analytics
- To learn the various Data Analytic methods
- To understand the various clustering algorithms and its application on data
- To work with stream data model and computing

**Course Contents**

**UNIT I**
Introduction to Data Analytics - Types of Data Analytics - Predictive Analytics - Simple linear regression - Multiple linear regression - Auto regression - Moving Average - Autoregressive Integrated Moving Average - Data Pre-processing - Data Cleaning - Data Integration and Transformation - Data Reduction - Descriptive data analytics - measures of central tendency - measures of location of dispersions.

**UNIT II**

**UNIT III**

**UNIT IV**
Using Graph Analytics for Big Data: Graph Analytics - The Graph Model - Representation as Triples - Graphs and Network Organization - Choosing Graph Analytics - Graph Analytics Use Cases - Graph Analytics Algorithms and Solution Approaches - Technical Complexity of Analyzing Graphs - Features of a Graph Analytics Platform - Considerations: Dedicated Appliances for Graph - Graph QL

**UNIT V**
NoSQL Databases - Schema-less Models - Increasing Flexibility for Data Manipulation - Key Value Stores - Document Stores - Tabular Stores - Object Data Stores - Graph Databases Hive-Sharding-Hbase - Analyzing big data with twitter - Big data for E-Commerce - Big data for blogs - Review of Basic Data Analytic Methods using R.

**Course Outcomes**

Upon completion of this course, the students will be able to:

- Evaluate the use of data from acquisition through cleaning, warehousing, analytics, and visualization to the ultimate business decision
- Mine data and carry out predictive modeling and analytics to support business decision-making
- Suggest prescriptive modeling techniques for real-world problems
- Execute real-time analytical methods on streaming datasets to react quickly to customer needs
Text Books


Reference Books


Mapping of Course Outcomes with Programme Outcomes

<table>
<thead>
<tr>
<th></th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Course Code : CSPE65
Course Title : Machine Learning Techniques and Practices
Number of Credits : 3-0-0-3
Pre-requisites (Course Code) : CSPC54
Course Type : PE

Course Objectives

- To understand the principles and concepts of machine learning
- To learn the clustering techniques and their utilization in machine learning
- To study the neural network systems for machine learning
- To understand reinforcement and deep learning
- To learn methodology and tools to apply machine learning algorithms to real data and evaluate their performance

Course Contents

UNIT I

UNIT II
Linear models for regression - Maximum Likelihood Estimation (MLS) - least squares - regularized least squares - The Bias-Variance Decomposition - Bayesian Linear Regression - Linear models for classification - Discriminant functions - Fisher’s linear discriminant - Probabilistic generative models - Probabilistic discriminative models - Bayesian logistic regression - Bayesian learning - maximum a posterior (MAP) estimation.

UNIT III
Clustering - K-Means clustering - Hierarchical Clustering - Mixture of Gaussians - Expectation maximization for mixture models (EM) - Dimensionality Reduction - Principal Component Analysis (PCA) - Linear Discriminant Analysis (LDA).

UNIT IV

UNIT V

Course Outcomes

Upon completion of this course, the students will be able to:

- Appreciate the underlying mathematical relationships within and across machine learning algorithms and the paradigms of supervised and un-supervised learning
- Have an understanding of the strengths and weaknesses of machine learning algorithms
- Appreciate machine learning challenges and suggest solutions for the same
- Design and implement various machine learning algorithms in a range of real-world applications
- Suggest supervised / unsupervised machine learning approaches for any application
Text Books


Reference Books


Mapping of Course Outcomes with Programme Outcomes

<table>
<thead>
<tr>
<th></th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td>✓</td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO5</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Course Objectives

- To understand the fundamentals of mobile communication
- To understand the architecture of various Wireless Communication Networks
- To understand the significance of different layers in mobile system

Course Contents

UNIT I

UNIT II

UNIT III

UNIT IV

UNIT V
WAP Model - Mobile Location based services - WAP Gateway - WAP protocols - WAP user agent profile caching model - wireless bearers for WAP - WML - WML Scripts – WTA – iMode - SyncML.*

*Programming assignments are mandatory.

Course Outcomes

Upon completion of the course, the students will be able to:
- Develop a strong grounding in the fundamentals of mobile Networks
- Apply knowledge in MAC, Network, and Transport Layer protocols of Wireless Network
- Comprehend, design, and develop a lightweight network stack

Text Books


Reference Books


### Mapping of Course Outcomes with Programme Outcomes

<table>
<thead>
<tr>
<th></th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Course Objectives

- To provide insight about networks, topologies, and the key concepts
- To gain comprehensive knowledge about the layered communication architectures (OSI and TCP/IP) and its functionalities
- To understand the principles, key protocols, design issues, and significance of each layers in ISO and TCP/IP
- To know the implementation of various layers

Course Contents

UNIT I  Network Topology

UNIT II  Introduction to IPV4

UNIT III  IPV6
IPV6 Transition issues - Protocol basics - Addressing - Options and Extension headers - ICMPv6 - Neighbor Discovery - Routing - Autoconfiguration - Multicast Listener Discovery (MLD) - IPv6 and DNS.

UNIT IV  Transmission Control Protocol

UNIT V  Overview of Mobile IP
Need for Mobile IP - Overview of Mobile IP - Details of Mobile IP - Tunneling - Mobility for IPv6 - Applications of Mobile IP – Security primer - Campus Mobility - Internet wide mobility - A service provider perspective.

Course Outcomes

Upon completion of this course, the students will be able to:

- Gain insight about basic network theory and layered communication architectures
- Code and implement MAC protocols, IPv4, IPv6, and TCP
- Design and develop Mobile IP
- Design and develop a communication protocol

Text Books


Reference Books


## Mapping of Course Outcomes with Programme Outcomes

<table>
<thead>
<tr>
<th></th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>CO2</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>CO3</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>CO4</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td>✓</td>
</tr>
</tbody>
</table>

CSE Dept. Flexible Curriculum

NITTUGCSE20

108
Course Code: CSPE68
Course Title: Design and Analysis of Parallel Algorithms
Number of Credits: 3-0-0-3
Pre-requisites (Course Code): CSPC42
Course Type: PE

Course Objectives

- To understand different parallel architectures and models of computation
- To introduce the various classes of parallel algorithms
- To study parallel algorithms for basic problems
- To study graph Algorithms

Course Contents

UNIT I  Introduction to Parallel Computers
Need for parallel processing - SM-SIMD algorithms - Shared memory SIMD - Tree and mesh interconnection computers - Classifying MIMD Algorithms - parallel computational models such as PRAM - LMCC - Hypercube - Cube Connected Cycle - Butterfly - Perfect Shuffle Computers - Tree model - Pyramid model - Fully Connected model - PRAM - CREW - EREW models - simulation of one model from another one.

UNIT II  Matrix Operations and Performance Measures
Matrix operations - Mesh transpose - Shuffle transpose - EREW transpose - Mesh multiplication - Cube multiplication - Matrix by vector multiplication - Tree multiplication - Performance Measures of Parallel Algorithms - speed-up and efficiency of PA - Cost optimality - An example of illustrate Cost-optimal algorithms such as summation - Min/Max on various models.

UNIT III  Selection and Sorting
Sequential algorithm - Parallel Sorting Networks - Algorithm for parallel selection - Sorting on a linear array - broadcasting a datum - Computing all sums - Sorting on a mesh - Sorting on EREW SIMD computer - enumeration sort - parallel quick sort - hyper quick sort - Sorting on other networks - Parallel Merging Algorithms on CREW/EREW/MCC/ - Parallel Sorting Networks on CREW/EREW/MCC.

UNIT IV  Searching and Numerical Problems

UNIT V  Graph Problems

Course Outcomes

Upon completion of this course, the students will be able to:
- Develop parallel algorithms for standard problems and applications
- Explain and derive the complexity of algorithms for basic and collective communication operations
- Apply different methods and performance measures to analyze algorithms with respect to cost and scalability
- Describe the basic methods of problem and data partitioning for efficient memory utilization and minimization of communication costs in parallel computers
- Perform design and analysis of parallel algorithms in real time applications
Text Books


Reference Books

2. F. T. Leighton, “Introduction to Parallel Algorithms and Architectures: Arrays, Trees”.

Mapping of Course Outcomes with Programme Outcomes

<table>
<thead>
<tr>
<th></th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO5</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
VII SEMESTER

<table>
<thead>
<tr>
<th>Course Code</th>
<th>CSPE71</th>
</tr>
</thead>
<tbody>
<tr>
<td>Course Title</td>
<td>Advanced Cryptography</td>
</tr>
<tr>
<td>Number of Credits</td>
<td>3-0-0-3</td>
</tr>
<tr>
<td>Pre-requisites (Course Code)</td>
<td>CSPC63</td>
</tr>
<tr>
<td>Course Type</td>
<td>PE</td>
</tr>
</tbody>
</table>

Course Objectives
- To study the concepts of applied cryptography
- To understand the application of cryptographic techniques in real world applications
- To comprehend the notion of provable security and its implication with improved security guarantees
- To introduce the concept of block chain technology

Course Contents

UNIT I
Review of number theory - group - ring and finite fields - quadratic residues - Legendre symbol - Jacobi symbol - Probability - Probability - Discrete random variable - Continuous random variable - Markov’s inequality - Chebyshev’s inequality - normal distribution - the geometric and binomial distributions.*

UNIT II

UNIT III
Public key cryptography - RSA cryptosystem - probabilistic encryption - homomorphic encryption - Elliptic curve cryptosystems - Digital signatures and the notion of existential unforgerability under chosen message attacks - ElGamal digital signature scheme - Schnorr signature scheme - blind signature.*

UNIT IV

UNIT V
Blockchain technology - Consensus algorithm - Incentives and proof of work - Smart contract - Bitcoin.*

*Programming assignments are mandatory.

Course Outcomes
Upon completion of this course, the students will be able to:
- Break cryptosystems that are not provably secure
- Derive simple provable security proofs for cryptographic schemes
- Design and implement cryptographic protocols
- Understand blockchain technology

Text Books
Reference Books


Mapping of Course Outcomes with Programme Outcomes

<table>
<thead>
<tr>
<th></th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>CO2</td>
<td>✓</td>
<td></td>
<td></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>CO3</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>CO4</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>
Course Objectives

- To introduce building blocks of deep neural network architecture
- To learn deep learning algorithms and its problem settings
- To understand representation and transfer of knowledge using deep learning
- To learn to use deep learning tools and framework for solving real-life problems
- To use Python for Deep Learning

Course Contents

**UNIT I  Deep Networks**

**UNIT II  Convolutional Networks**
Convolution operation - Motivation - Pooling - Convolution and Pooling as strong prior - Efficient convolution algorithms - Unsupervised features - Sequence Modeling: Recurrent and Recursive Nets - LSTM Networks - Applications - Computer Vision - Speech Recognition - Natural Language Processing.

**UNIT III  Linear factor Models**

**UNIT IV  Representation Learning**

**UNIT V  Deep Learning with Python**

Course Outcomes

Upon completion of this course, the students will be able to:

- Identify the deep learning algorithms which are more appropriate for various types of learning tasks in various domains
- Incorporate transfer of knowledge in machine learning algorithms
- Implement deep learning algorithms and solve real-world problems
- Develop Deep Learning techniques using Python
- Represent learning Models

Text Book

Reference Books


Mapping of Course Outcomes with Programme Outcomes

<table>
<thead>
<tr>
<th></th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO5</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Course Code: CSPE73
Course Title: Natural Language Processing
Number of Credits: 3-0-0-3
Pre-requisites (Course Code): CSPC62
Course Type: PE

Course Objectives
- To understand the steps involved in Natural language processing
- To learn about the lexical, syntactic and semantic analysis of natural language processing
- To explore the various parsing techniques for natural languages
- To understand the statistical models for natural language processing
- To learn about the various applications involved in Natural language processing

Course Contents

UNIT I  Lexical Analysis

UNIT II  Speech Processing

UNIT III  Parsing

UNIT IV  Lexical Knowledge Networks

UNIT V  Applications
Applications: Sentiment Analysis - Text Entailment - Machine Translation - Question Answering System - Information Retrieval - Information Extraction - Cross Lingual Information Retrieval (CLIR).*

*Programming Assignments are mandatory.

Course Outcomes
Upon completion of the course, the students will be able to:
- Justify the various steps necessary for processing natural language
- Suggest appropriate lexical and parsing techniques for a given natural language
- Apply appropriate statistical models for a given natural language application
- Modify existing algorithms to suit any natural language for processing
- Suggest appropriate pre-processing steps essential for the various applications involving natural language processing
**Text Books**


**Reference Books**


**Mapping of Course Outcomes with Programme Outcomes**

<table>
<thead>
<tr>
<th></th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td>✓</td>
<td></td>
<td></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO5</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Course Code : CSPE74  
Course Title : Image Processing and Applications  
Number of Credits : 3-0-0-3  
Pre-requisites (Course Code) : -  
Course Type : PE

Course Objectives

- To learn the fundamentals of image processing and various transformation applied in an image
- To learn image enhancement techniques
- To understand image restoration
- To impart knowledge on different compression techniques
- To discuss on image segmentation and feature representations

Course Contents

UNIT I Introduction

UNIT II Image Enhancement Techniques

UNIT III Image Restoration
Model of Image Degradation/restoration process - Noise models - Spatial and Frequency Filters - Inverse filtering & Wiener Filtering - Least mean square filtering - Constrained least mean square filtering.

UNIT IV Image Compression Fundamentals

UNIT V Image Segmentation & Analysis

Course Outcomes

Upon completion of this course, the students will be able to:
- Differentiate and interpret various image enhancement techniques
- Reconstruct the image from the degraded image
- Analyze and use appropriate image compression techniques
- Suggest proper image feature for classification problems
- Build image processing applications for real world problems

Text Book


Reference Books

CSE Dept. Flexible Curriculum NITTUGCSE20 117

Mapping of Course Outcomes with Programme Outcomes

<table>
<thead>
<tr>
<th></th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO5</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Course Code: CSPE75
Course Title : Network Security
Number of Credits : 3-0-3
Pre-requisites (Course Code) : CSPC63
Course Type : PE

Course Objectives

- To understand the network security, services, attacks, mechanisms, types of attacks
- To comprehend and apply authentication services
- To apply authentication algorithms
- To comprehend and apply network layer security protocols, Transport layer security protocols, Web security protocols

Course Contents

UNIT I  Overview of Network

UNIT II  Message Authentication Code

UNIT III  IP Security

UNIT IV  Viruses
Intruders - Viruses - Worms - Trojan horses - Distributed Denial-Of-Service (DDoS) - Firewalls - IDS - Honey nets - Honey pots.*

UNIT V  Introduction to Wireless Network Security
Introduction to wireless network security - Risks and Threats of Wireless networks - Wireless LAN Security (WEP - WPA).*

*Programming assignments are mandatory.

Course Outcomes

Upon completion of this course, the students will be able to:

- Determine appropriate mechanisms for protecting the network
- Design and develop security solutions for a given application or system
- Apply Authentication algorithms for Security
- Ability to develop a secure network stack

Text Books

Reference Books


Mapping of Course Outcomes with Programme Outcomes

<table>
<thead>
<tr>
<th></th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>CO2</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>CO3</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>CO4</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
</tr>
</tbody>
</table>
Course Code: CSPE76
Course Title: Wireless Network Systems
Number of Credits: 3-0-0-3
Pre-requisites (Course Code): CSPC53
Course Type: PE

Course Objectives

- Describe fundamentals of wireless communication
- Categorize architecture of different Wireless Networks
- Formulate significance of MAC and Network layers in Wireless Network System
- Differentiate Adhoc networks
- Relate MAC layer concepts

Course Contents

UNIT I  Wireless Communications & Cellular System Fundamentals
Introduction to wireless communications systems - examples - comparisons and trends - Cellular systems - Frequency Management and Channel Assignment - types of handoff and their characteristics - dropped call rates & their evaluation - MAC techniques for Wireless Communication: FDMA - TDMA - MA (FHMA/ CDMA/ Hybrid techniques) - SDMA techniques.*

UNIT II  Wireless WAN

UNIT III  Wireless LAN Architecture
Wireless LAN: Introduction to wireless LANs - IEEE 802.11 WLAN - Architecture and Services - Physical Layer - MAC sub layer - MAC Management Sub layer - Other IEEE 802.11 standards -HIPERLAN -WiMAX standard.*

UNIT IV  AdHoc Networks

UNIT V  MAC Layer

*Programming assignments are mandatory.

Course Outcomes

Upon completion of this course, the students will be able to:

- Make critical assessment of wireless networks
- Comprehend the fundamentals of wireless networks
- Apply the knowledge gained in the development of MAC, network layer protocols of wireless network
- Categorize wireless sensor networks
- Collect the simulation tools for adhoc network

Text Books

Reference Books


Mapping of Course Outcomes with Programme Outcomes

<table>
<thead>
<tr>
<th></th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td></td>
<td>✓</td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>CO3</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>CO5</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Course Code: CSPE77
Course Title: Parallel Architectures and Programming
Number of Credits: 3-0-0-3
Pre-requisites (Course Code): CSPC51
Course Type: PE

Course Objectives

- To understand the fundamental principles involved in designing modern parallel computers
- To gain knowledge about key issues in parallel programming and architecture
- To understand the operation of parallel hardware including cache coherence and distributed memory machines
- To understand the necessity of efficient parallel program design to minimize overhead
- To gain knowledge about various parallel programming strategies
- To develop practical programming skills using MPI and CUDA

Course Contents

UNIT I Introduction
Introduction: The need for parallelism - Forms of parallelism (SISD - SIMD - MISD - MIMD) - Moore's Law and Multi-cores - Fundamentals of Parallel Computers - Communication architecture - Message passing architecture - Data parallel architecture - Dataflow architecture - Systolic architecture - Performance Issues.*

UNIT II Cache Design
Large Cache Design: Shared vs. Private Caches - Centralized vs. Distributed Shared Caches - Snooping-based cache coherence protocol - directory-based cache coherence protocol - Uniform Cache Access - Non-Uniform Cache Access - D-NUCA - S-NUCA - Inclusion - Exclusion - Difference between transaction and transactional memory - STM - HTM.*

UNIT III Graphics Processing Unit

UNIT IV Parallel Programming

UNIT V Parallel Programming Languages

*Programming assignments are mandatory.

Course Outcomes

Upon completion of this course, the students will be able to:

- Comprehend parallel architecture and its importance in solving engineering problems
- Summarize and differentiate the different parallel programming strategies
- Design parallel programs to enhance machine performance in parallel hardware environment
- Design and write programs that can make efficient use of multiple cores, multiple networked processors and GPU Processing power
- Design and implement parallel programs in modern environments such as CUDA, OpenMP, etc.

Text Books

Reference Books

Mapping of Course Outcomes with Programme Outcomes

<table>
<thead>
<tr>
<th></th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
<td>✓</td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO5</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Course Objectives

- To understand the basics of Information Security
- To know the legal, ethical and professional issues in Information Security
- To know the aspects of risk management
- To become aware of various standards in this area
- To know the technological aspects of Information Security

Course Contents

UNIT I Introduction

UNIT II Security Investigation

UNIT III Security Analysis

UNIT IV Logical Design

UNIT V Physical Design

Course Outcomes

Upon completion of this course, the students will be able to:

- Discuss the basics of information security
- Illustrate the legal, ethical and professional issues in information security
- Demonstrate the aspects of risk management
- Become aware of various standards in the Information Security System
- Design and implementation of Security Techniques

Text Book


Reference Books


### Mapping of Course Outcomes with Programme Outcomes

<table>
<thead>
<tr>
<th></th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO5</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

CSE Dept. Flexible Curriculum

NITTU GCSE 20

126
Course Code : CSPE79
Course Title : Human Computer Interaction
Number of Credits : 3-0-0-3
Pre-requisites (Course Code) : -
Course Type : PE

Course Objectives

- To provide an overview of the concepts relating to the design of human-computer interfaces
- To understand the theoretical dimensions of human factors involved in the acceptance of computer interfaces
- To understand the important aspects of implementation of human-computer interfaces
- To identify the various tools and techniques for interface analysis, design and evaluation

Course Contents

UNIT I

UNIT II
Designing - Programming Interactive systems - Models of interaction - Frameworks and HCI - Ergonomics - Interaction styles - Elements of the WIMP interface - The context of the interaction - Experience - engagement and fun - Paradigms for interaction.
Cantered Design and testing - Interaction design basics - The process of design - User focus - Scenarios - Navigation design - Screen design and layout, Iteration and prototyping.

UNIT III
HCI in the software process - Iterative design and prototyping - Design rules - Principles to support usability - Standards and Guidelines - Golden rules and heuristics - HCI patterns.
Implementation support - Elements of windowing systems - Programming the application - Using toolkits - User interface management systems.

UNIT IV
Evaluation techniques - Evaluation through expert analysis - Evaluation through user participation - Universal design - User support.
Models and Theories - Cognitive models - Goal and task hierarchies - Linguistic models - The challenge of display-based systems - Physical and device models - Cognitive architectures.

UNIT V
Collaboration and communication - Face-to-face communication - Conversation - Text-based communication - Group working - Dialog design notations - Diagrammatic notations - Textual dialog notations - Dialog semantics - Dialog analysis and design Human factors and security - Groupware - Meeting and decision support systems - Shared applications and artifacts - Frameworks for groupware - Implementing synchronous groupware - Mixed - Augmented and Virtual Reality.

Course Outcomes

Upon completion of the course, the students will be able to:
- Design and Develop processes and life cycle of Human Computer Interaction
- Analyze product usability evaluations and testing methods
- Apply the interface design standards/guidelines for cross cultural and disabled users
• Categorize, Design and Develop Human Computer Interaction in proper architectural structures

Text Books


Mapping of Course Outcomes with Programme Outcomes

<table>
<thead>
<tr>
<th></th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td></td>
<td></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
VIII SEMESTER

<table>
<thead>
<tr>
<th>Course Code</th>
<th>:</th>
<th>CSPE81</th>
</tr>
</thead>
<tbody>
<tr>
<td>Course Title</td>
<td>:</td>
<td>Data Science</td>
</tr>
<tr>
<td>Number of Credits</td>
<td>:</td>
<td>3-0-0-3</td>
</tr>
<tr>
<td>Pre-requisites (Course Code)</td>
<td>:</td>
<td>-</td>
</tr>
<tr>
<td>Course Type</td>
<td>:</td>
<td>PE</td>
</tr>
</tbody>
</table>

Course Objectives

- To understand the data science process and exploration
- To learn Machine learning algorithms
- To get a knowledge on types of learning, processes, techniques and models
- To know about the research that requires the integration of large amounts of data

Course Contents

UNIT I

UNIT II

UNIT III

UNIT IV

UNIT V
Course Outcomes

Upon completion of this course, the students will be able to:

- Understand the data science concepts, techniques and models
- Forecast the time series data
- Build recommendation systems
- Learn and apply different mining algorithms and recommendation systems for large volumes of data
- Perform analytics on data streams

Text Books


Reference Books


Mapping of Course Outcomes with Programme Outcomes

<table>
<thead>
<tr>
<th></th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td>✓</td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO5</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Course Code : CSPE82
Course Title : GPU Computing
Number of Credits : 3-0-0-3
Pre-requisites (Course Code) : CSPC51
Course Type : PE

Course Objectives

- To learn the architecture of GPU and basics of parallelism
- To learn about the evolution of GPU computing
- To learn GPU programming using CUDA
- To study the methods of performance improvement in GPU

Course Contents

UNIT I Introduction

UNIT II Parallel Programming
Goals of Parallel Programming - Problem Decomposition - Algorithm Selection - Computational Thinking - Introduction to OPENCL: Background - Data Parallelism Model - Device Architecture - Kernel Functions - Device Management & Kernel Launch.

UNIT III Introduction to CUDA

UNIT IV Performance considerations
Thread execution - Global memory bandwidth - Dynamic partitioning of SM resources - Data prefetching - Instruction mix - Thread Granularity - Floating Point considerations: FP format - Representable numbers - Special bit patterns and precision - Arithmetic accuracy and rounding - Algorithm considerations - Debugging and Profiling: Debugging CUDA programs - Profiling CUDA programs - CUDA and MPI.

UNIT V Parallel Programming
Parallel Programming and Computational Thinking - Goals of Parallel Programming - Problem Decomposition - Algorithm Selection - Computational Thinking - OpenCL - Introduction.

Course Outcomes

Upon completion of this course, the students will be able to:

- Understand the basics of GPUs and GPU architecture
- Write programs for GPUs using CUDA and OpenCL
- Develop parallel applications targeting GPUs
- Develop Debugging tool

Text Book

Reference Book


Mapping of Course Outcomes with Programme Outcomes

<table>
<thead>
<tr>
<th></th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>CO2</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>CO3</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>CO4</td>
<td>✓</td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
</tr>
</tbody>
</table>
Course Objectives

- To understand Smart Objects and IoT Architectures
- To learn about various IOT-related protocols
- To build simple IoT Systems using Arduino and Raspberry Pi.
- To understand data analytics and cloud in the context of IoT
- To develop IoT infrastructure for popular applications

Course Contents

UNIT I  Fundamentals of IoT

UNIT II  IoT Protocols
IoT Access Technologies: Physical and MAC layers - topology and Security of IEEE 802.15.4 - 802.15.4g - 802.15.4e - 1901.2a - 802.11ah and LoRaWAN - Network Layer: IP versions - Constrained Nodes and Constrained Networks – Optimizing IP for IoT: From 6LoWPAN to 6Lo - Routing over Low Power and Lossy Networks - Application Transport Methods: Supervisory Control and Data Acquisition - Application Layer Protocols: CoAP and MQTT.

UNIT III  Design and Development
Design Methodology - Embedded computing logic - Microcontroller - System on Chips - IoT system building blocks - Arduino Board details - IDE programming - Raspberry Pi - Interfaces and Raspberry Pi with Python Programming.

UNIT IV  Data Analytics and Supporting Services
Structured Vs Unstructured Data and Data in Motion Vs Data in Rest - Role of Machine Learning - No SQL Databases - Hadoop Ecosystem - Apache Kafka - Apache Spark - Edge Streaming Analytics and Network Analytics - Xively Cloud for IoT - Python Web Application Framework - Django AWS for IoT - System Management with NETCONF-YANG.

UNIT V  Case Studies / Industrial Applications
Cisco IoT system - IBM Watson IoT platform – Manufacturing - Converged Plantwide Ethernet Model (CPwE) - Power Utility Industry - GridBlocks Reference Model - Smart and Connected Cities: Layered architecture - Smart Lighting - Smart Parking Architecture and Smart Traffic Control.

Course Outcomes

Upon completion of the course, the student should be able to:
- Explain the concept of IoT
- Analyze various protocols for IoT
- Design a PoC of an IoT system using Raspberry Pi/Arduino
- Apply data analytics and use cloud offerings related to IoT
- Analyze applications of IoT in real time scenario

Text Book
CSE Dept. Flexible Curriculum NITTUGCSE20 133

Reference Books


Mapping of Course Outcomes with Programme Outcomes

<table>
<thead>
<tr>
<th></th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO5</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Course Code: CSPE84
Course Title: Social Network Analysis
Number of Credits: 3-0-0-3
Pre-requisites (Course Code): -
Course Type: PE

Course Objectives
- Recognize the concept of semantic web and related applications
- Employ learn knowledge representation using ontology
- Recognize human behavior in social web and related communities
- Sketch and learn visualization of social networks
- Investigate variety of descriptive measures for networks and software to calculate them, and have the ability to interpret the results

Course Contents

UNIT I Introduction

UNIT II Modelling, Aggregating and Knowledge Presentation

UNIT III Extraction and Mining Communities in Web Social Networks

UNIT IV Predicting Human Behavior and Privacy Issues

UNIT V Visualization and Applications of Social Networks

Course Outcomes
Upon completion of this course, the students will be able to:
- Develop semantic web related applications.
- Describe and Represent knowledge using ontology.
• Inspect and Predict human behavior in social web and related communities
• Organize and Visualize social networks
• Analyze tools for detecting communities social network infrastructures

Text Books

Reference Books

Mapping of Course Outcomes with Programme Outcomes

<table>
<thead>
<tr>
<th></th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td>✓</td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO5</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Course Code : CSPE85
Course Title : Speech Processing Techniques
Number of Credits : 3-0-0-3
Pre-requisites (Course Code) : -
Course Type : PE

Course Objectives

• To learn about the source of sound and its representation from a signal perspective
• To understand the features necessary for Speech processing
• To have an insight on the steps involved in Speech Recognition and Synthesis
• To learn about the mapping and features for identifying and extracting in music signal processing

Course Contents

UNIT I  Speech Source and Representation

UNIT II  Speech Features

UNIT III  Speech Recognition

UNIT IV  Speech Synthesis

UNIT V  Applications

Course Outcomes

Upon completion of the course, the students will be able to:

• Appreciate the Time, Spectral and Cepstral features’ influence in recognizing and synthesising speech
• Decide and design the appropriate combination of features for applications involving speech processing and recognition
• Propose new strategies and approaches for language independent speech synthesis and recognition
• Decide on combination of signal features for music processing

Text Books

Reference Books


Mapping of Course Outcomes with Programme Outcomes

<table>
<thead>
<tr>
<th></th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
MINORS

<table>
<thead>
<tr>
<th>Course Code</th>
<th>CSMI11</th>
</tr>
</thead>
<tbody>
<tr>
<td>Course Title</td>
<td>Data Structures and Algorithms</td>
</tr>
<tr>
<td>Number of Credits</td>
<td>3-0-0-3</td>
</tr>
<tr>
<td>Pre-requisites (Course Code)</td>
<td>-</td>
</tr>
<tr>
<td>Course Type</td>
<td>MI</td>
</tr>
</tbody>
</table>

Course Objectives

- To understand the various techniques of sorting and searching
- To design and implement arrays, stacks, queues, and linked lists
- To understand the complex data structures such as trees and graphs
- To design and implement various programming paradigms and its complexity

Course Contents

UNIT I  Development of Algorithms
Notations and analysis - Storage structures for arrays - Sparse matrices - Stacks and Queues: Representations and applications - linked lists - Doubly linked lists - Circular linked lists.

UNIT II  Trees

UNIT III  Graphs

Unit IV  Algorithmic Paradigms

UNIT V  Searching and Sorting Techniques
Selection - Bubble - Insertion - Merge - Quick - Radix sort - Address calculation - Linear search - Binary search.

Course Outcomes

Upon completion of this course, the students will be able to:
- Develop programs to implement linear data structures such as stacks, queues, linked lists, etc.
- Apply the concept of trees and graph data structures in real world scenarios
- Comprehend the implementation of sorting and searching algorithms
- Handle data in different algorithms

Text Book


Reference Books


### Mapping of Course Outcomes with Programme Outcomes

<table>
<thead>
<tr>
<th></th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>CO2</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
</tr>
</tbody>
</table>
Course Code : CSMI12  
Course Title : Computer Organization  
Number of Credits : 3-0-3  
Pre-requisites (Course Code) : -  
Course Type : MI

Course Objectives

- To understand the basic hardware and software issues of computer organization
- To understand how computations are performed at machine level
- To understand how data storage is happening at machine level
- To understand the memory hierarchies, cache memories and virtual memories
- To learn the different ways of communication with I/O devices

Course Contents

UNIT I

UNIT II

UNIT III
Logic Design Conventions - Building a Datapath - A Simple Implementation Scheme - overview of Pipelining - Pipelined Datapath - Data Hazards: Forwarding versus Stalling - Control Hazards - Exceptions - Parallelism via Instructions.

UNIT IV
Memory Technologies - Basics of Caches - Measuring and Improving Cache Performance - Dependable memory hierarchy - Virtual Machines - Virtual Memory - Using FSM to Control a Simple Cache - Parallelism and Memory Hierarchy: Redundant Arrays of Inexpensive Disks.

UNIT V
Disk Storage and Dependability - Parallelism and Memory Hierarchy: RAID levels - Performance of storage systems - Introduction to multithreading clusters - message passing multiprocessors.

Course Outcomes

Upon completion of the course, the students will be able to:

- Analyze the abstraction of various components of a computer
- Analyze the hardware and software issues and the interfacing
- Work out the tradeoffs involved in designing a modern computer system
- Understand the various memory systems and I/O communication

Text Books

Reference Books


Mapping of Course Outcomes with Programme Outcomes

<table>
<thead>
<tr>
<th></th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td></td>
<td></td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Course Objectives

• To provide basic knowledge about the services rendered by operating systems
• To explain the various issues related to process management
• To provide a detailed discussion of the various memory management techniques
• To discuss the various file-system design and implementation issues
• To discuss how the protection domains, help to achieve security in a system

Course Contents

UNIT I
Basic OS Concepts - User's view of the OS - Architectural support - OS services - OS structures - System calls - Building and Booting OS - Process - Threads - Multithreading.

UNIT II
Thread and process scheduling - Types of schedulers - Scheduling Policies – Inter-process synchronization - Critical Section problem - Hardware and Software solutions.

UNIT III
Semaphores - Monitors – Inter-process communication - Deadlocks: Characterization - Handling of deadlocks - Prevention - Avoidance - detection and recovery.

UNIT IV
Memory Management - Contiguous allocation - Static and dynamic partitioned memory allocation - Non-contiguous allocation - Paging - Segmentation - Virtual Memory - Demand Paging.

UNIT V
Need for files - File abstraction - File naming - File system organization - File system optimization - Reliability - Security and protection - I/O management and disk scheduling - Recent trends and development.
Case Study: Linux and Windows OS

Course Outcomes

Upon completion of the course, the students will be able to:
• Comprehend the techniques used to implement the process manager
• Comprehend virtual memory abstractions in operating systems
• Design and develop file system interfaces
• Design protection mechanisms for securing the system
• Design and manage storage systems

Text Book

References Books
## Mapping of Course Outcomes with Programme Outcomes

<table>
<thead>
<tr>
<th></th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO5</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Course Objectives

- To learn data models, conceptualize and depict a database system using ER diagram
- To understand the internal storage structures in a physical DB design
- To know the fundamental concepts of transaction processing techniques
- To understand the concept of Database Design in Normalization techniques
- To know the manipulation of SQL Queries

Course Contents

UNIT I Introduction
Purpose of Database System - Views of data - Data Models - Database Languages - Database System Architecture - components of DBMS - Entity - Relationship model (E-R model ) - E-R Diagram notation - Examples.

UNIT II Relational Model
Relational Data Model - Concept of relations - schema-instance distinction - keys - integrity rules - relational algebra operators - SQL: data definition - data manipulation - aggregate function - Null Values - nested sub queries - Joined relations - Work with MySQL Workbench.

UNIT III Database Design
Dependencies and Normal forms - dependency theory - functional dependencies - Armstrong's axioms for FD's - closure of a set of FD's - minimal covers - definitions of 1NF - 2NF - 3NF and BCNF - 4NF - 5NF, decompositions and desirable properties of them.

UNIT IV Transaction management
ACID properties - serializability and concurrency control - Lock based concurrency control (2PL - Deadlocks) - database recovery management.

UNIT V Implementation Techniques
Overview of Physical Storage Media - Magnetic Disks - RAID - Tertiary storage - Organization of Records in Files - Indexing and Hashing - Ordered Indices - primary - secondary index structures - Static Hashing - Dynamic Hashing.

Course Outcomes
Upon completion of this course, the students will be able to:

- Install, configure, and interact with a relational database management system
- Master the basics of SQL and construct queries using SQL
- Design and develop a large database with optimal query processing
- Develop efficient storage scheme of saving and retrieving Records and Files
- Design the database with normalization techniques

Text Books

Reference Books


Mapping of Course Outcomes with Programme Outcomes

<table>
<thead>
<tr>
<th></th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>CO5</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
</tr>
</tbody>
</table>
Course Code: CSMI15
Course Title: Software Engineering
Number of Credits: 3-0-0-3
Pre-requisites (Course Code): -
Course Type: MI

Course Objectives

- Memorize Software Engineering Practice & Process Models
- Identify requirements prioritization
- Construct data and Architectural Design diagram
- Differentiate software testing methods
- Collect ideas about software project management and Maintenance

Course Contents

UNIT I  Software Engineering Modeling

UNIT II  Requirement analysis

UNIT III  Software Design Concepts
Design Concepts and Principles - Modular design - Design heuristic - S/W architecture - Data design - Architectural design - Transform & Transaction mapping - Introduction to SCM process - Software Configuration Items.

UNIT IV  Software Testing Strategy
Software Testing - Taxonomy of S/W testing - Black box testing - Testing boundary conditions - Structural testing - Regression testing - S/W testing strategies: Unit testing - Integration testing - Validation testing - System testing and debugging.

UNIT V  Project Management and Maintenance
Software Project Management - S/W cost estimation - Function point models - COCOMO model - Project Scheduling - S/W maintenance.

Course Outcomes

Upon completion of this course, the students will be able to:
- Enhance the software project management skills
- Comprehend the systematic methodologies involved in SE
- Design and develop a software product in accordance with SE principles
- Organize all the testing tools and its usage
- Collect Software cost estimation tools

Text Books


Reference Books

CSE Dept. Flexible Curriculum  NITTUGCSE20  147

Mapping of Course Outcomes with Programme Outcomes

<table>
<thead>
<tr>
<th>CO1</th>
<th>CO2</th>
<th>CO3</th>
<th>CO4</th>
<th>CO5</th>
</tr>
</thead>
<tbody>
<tr>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
</tbody>
</table>
Course Objectives

- To provide insight about fundamental concepts and reference models (OSI and TCP/IP) and its functionalists
- To gain comprehensive knowledge about the principles, protocols, and significance of Layers in OSI and TCP/IP
- To know the implementation of various protocols and cryptography techniques
- Learn the flow control and congestion control algorithms

Course Contents

UNIT I  Data Communications

UNIT II  Physical Layer

UNIT III  Network Layer

UNIT IV  Transport Layer
Transport Services - UDP - TCP - Congestion Control - Quality of Services (QOS).

UNIT V  Application Layer
Domain Name Space (DNS) - Electronic Mail - HTTP - WWW.

Course Outcomes

Upon completion of this course, the students will be able to:

- Identify the components required to build different types of networks
- Choose the required functionality at each layer for given application
- Identify solution for each functionality at each layer
- Trace the flow of information from one node to another node in the network

Text Books


Reference Books

## Mapping of Course Outcomes with Programme Outcomes

<table>
<thead>
<tr>
<th></th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td></td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td></td>
<td>✔</td>
<td>✔</td>
<td></td>
<td></td>
<td>✔</td>
<td>✔</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td>✔</td>
<td></td>
<td>✔</td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✔</td>
<td>✔</td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td></td>
<td>✔</td>
<td>✔</td>
<td></td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✔</td>
</tr>
<tr>
<td>Course Code</td>
<td>CSMII7</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-----------------</td>
<td>--------</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Course Title</td>
<td>Artificial Intelligence</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of Credits</td>
<td>3-0-0-3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pre-requisites (Course Code)</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Course Type</td>
<td>MI</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Course Objectives**

- To understand the various characteristics of Intelligent agents
- To learn the different search strategies in AI
- To learn to represent knowledge in solving AI problems
- To understand the ways of planning and acting in the real world
- To know about the models behind the AI application

**Course Contents**

**UNIT I  Introduction**
Introduction - Definition - Future of Artificial Intelligence - Characteristics of Intelligent Agents - Typical Intelligent Agents - Problem Solving Approach to Typical AI problems.

**UNIT II  Problem Solving Methods**

**UNIT III  Knowledge Representation**

**UNIT IV  Planning**
Planning with state-space search - partial-order planning - planning graphs - planning and acting in the real world - Plan generation systems.

**UNIT V  Uncertain Knowledge and Reasoning**

**Course Outcomes**

- Ability to design a plan for the real world problems and mapping it to the digital world
- Ability to identify problems that are amenably solved by AI methods

**Text Book**


**Reference Books**

Mapping of Course Outcomes with Programme Outcomes

<table>
<thead>
<tr>
<th></th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
</tr>
</tbody>
</table>
HONOURS

<table>
<thead>
<tr>
<th>Course Code</th>
<th>CSHO11</th>
</tr>
</thead>
<tbody>
<tr>
<td>Course Title</td>
<td>Software Defined Networking</td>
</tr>
<tr>
<td>Number of Credits</td>
<td>3-0-0-3</td>
</tr>
<tr>
<td>Pre-requisites (Course Code)</td>
<td>-</td>
</tr>
<tr>
<td>Course Type</td>
<td>MI</td>
</tr>
</tbody>
</table>

Course Objectives

- Analyze reduced Complexity of Network Operation
- Describe and understand the concepts of minimize Layer and maximize Network Resources
- Evaluate and understand the Faster Time to Revenue for New Applications
- Memorize Data center and its usage
- Illustrate about Big data

Course Contents

UNIT I Introduction

UNIT II Interface

UNIT III Data Center
Multitenant Data Center - Virtualized Multitenant Data Center - SDN Solutions for Data Center Network - VLANs - EVPN - VXLAN - NVGRE - Virtualization and Data Plane I/O - Services Engineered Path - Service Locations and Chaining - NEV at ETSI - Non-ETSI NEV Work.*

UNIT IV Topology
Network Topology - Traditional Methods - LLDP - BGP-TE/LS - ALTO - 12RS - Build Code First - The Juniper SDN Framework(s) - Open Daylight Controller/Framework - Policy.*

UNIT V Technology

*Programming Assignments are mandatory

Course Outcomes

Upon completion of this course, the students will be able to:

- Comprehend Software Defined Networks
- Compare and analyze the advantages of SDN over traditional network
- Design and implement software defined network
- Design algorithm for virtualization
- Design algorithm for big data analytics
Text Books


Reference Books


Mapping of Course Outcomes with Programme Outcomes

<table>
<thead>
<tr>
<th>CO1</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
</tr>
</thead>
<tbody>
<tr>
<td>⨯</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td></td>
<td>⨯</td>
<td>⨯</td>
<td>⨯</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td>⨯</td>
<td>⨯</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td>⨯</td>
<td>⨯</td>
<td>⨯</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO5</td>
<td>⨯</td>
<td>⨯</td>
<td>⨯</td>
<td>⨯</td>
<td>⨯</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Course Objectives

- To understand fundamentals of Distributed Systems
- To explore the issues in communications in distributed systems
- To understand the various issues in process and thread management
- To discuss the issues in design the distributed file system
- To know security issues in Distributed System

Course Contents

UNIT I Introduction
Parallel and Distributed Systems - multiprocessor versus multicomputer systems - Message-passing systems versus shared memory systems - Primitives for distributed communication - Synchronous versus asynchronous executions - Design issues and challenges - Distributed Computing paradigms.

UNIT II Procedures and Methods

UNIT III Synchronization
Processes and threads - Code migration and distributed scheduling - Naming - Clock Synchronization - Distributed mutual exclusion and distributed deadlocks.

UNIT IV Transaction
Distributed transaction - Consistency models - Replication - Fault tolerance - Distributed commit and failure recovery - Distributed file systems (NFS - AFS & coda).

UNIT V Security
Security in distributed systems - Security: authentication - Distributed middleware: CORBA - Case studies: DCOM and JINI.

Course Outcomes

Upon completion of this course, the students will be able to:
- Apply the middleware technologies in designing a distributed system
- Apply remote method invocation and objects
- Design process and resource management systems
- Handle faults in real time environments
- Handle security related issues in Distributed System

Text Book


Reference Books


Mapping of Course Outcomes with Programme Outcomes

<table>
<thead>
<tr>
<th>CO1</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
</tr>
</thead>
<tbody>
<tr>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>CO2</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>CO3</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>CO4</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>CO5</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>
Course Code : CSHO13  
Course Title : Multi-Core Programming  
Number of Credits : 3-1-0-4  
Pre-requisites (Course Code) : CSPC51  
Course Type : HONOURS

Course Objectives

- To understand the fundamentals of multi-core architecture
- To be able to know the basic concepts of multi core programming using threads
- To be able to understand various programming constructs in multi-core architecture
- To be able to understand Multithreaded applications

Course Contents

UNIT I  Introduction to Multiprocessors and Scalability Issues  
Scalable design principles - Principles of processor design - Instruction Level Parallelism - Thread level parallelism - Parallel computer models - Symmetric and distributed shared memory architectures - Performance Issues - Multi-core Architectures - Software and hardware multithreading - SMT and CMP architectures - Design issues - Case studies - Intel Multi-core architecture - SUN CMP architecture.

UNIT II  Parallel Programming  
Fundamental concepts - Designing for threads - scheduling - Threading and parallel programming constructs - Synchronization - Critical sections - Deadlock - Threading APIs.

UNIT III  OpenMP Programming  
OpenMP - Threading a loop - Thread overheads - Performance issues - Library functions - Solutions to parallel programming problems - Data races - deadlocks and livelocks - Non-blocking algorithms - Memory and cache related issues.

UNIT IV  MPI Programming  
MPI Model - collective communication - data decomposition - communicators and topologies - point-to-point communication - MPI Library.

UNIT V  Multi Threaded Application Development  
Algorithms - program development and performance tuning.

Course Outcomes

Upon completion of this course, the students will be able to:
- Comprehend the programming constructs of multi-core systems
- Exploit the benefit of parallel programming
- Design and develop OpenMP Programming
- Design and develop APIs for Multithreaded Applications

Text Books


Reference Books

## Mapping of Course Outcomes with Programme Outcomes

<table>
<thead>
<tr>
<th></th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✔</td>
</tr>
<tr>
<td>CO2</td>
<td></td>
<td></td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✔</td>
<td></td>
<td></td>
<td>✔</td>
</tr>
<tr>
<td>CO3</td>
<td></td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✔</td>
</tr>
<tr>
<td>CO4</td>
<td>✔</td>
<td>✔</td>
<td></td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✔</td>
</tr>
</tbody>
</table>
Course Code : CSHO14
Course Title : Pervasive and Ubiquitous Computing
Number of Credits : 3-0-0-3
Pre-requisites (Course Code) : CSPC43
Course Type : HO

Course Objectives

- To understand the characteristics and principles of Pervasive computing
- To understand the various components that helps to build pervasive computing system
- To understand the necessity of sensor networks and RFID that capture and disseminate context information
- To understand the principles, challenges, infrastructures and user interface that supports the ubiquitous computing
- To design and implement Pervasive and Ubiquitous applications that are embedded in everyday objects

Course Contents

UNIT I Introduction

UNIT II Technologies

UNIT III Sensor Networks and RFID

UNIT IV Introduction to Ubiquitous Computing
An introduction - overview - challenges to research topics in ubiquitous computing including sensors - ambient displays - tangibles - middleware - mobility - allocation and context awareness - Architecture for ubiquitous computing: new devices and communications - software architectures - Wireless standards & protocols for ubiquitous networks - Near field communication (NFC) - Bluetooth classic - Bluetooth Low Energy (BLE) - WiFi - WiFi Direct.

UNIT V Ubiquitous Computing Applications
Ubiquitous applications: the appropriate design - Weiser's vision of ubiquitous computing - mixed reality and sensible design - Wearable computing - Glass and Augmented Reality - Eye-Tracking-Digital Pen and Paper Mobile social networking & crowd sensing Event based social network.

Course Outcomes
Upon completion of this course, the students will be able to:

- Conclude the enabling technologies that drive the pervasive and ubiquitous computing
- Analyze and compare the performance of different data dissemination techniques
- Formulate the design aspects, that are essential to create the model of pervasive computing
- Develop solutions for problems related to pervasive and ubiquitous computing system through investigation

Text Books
CSE Dept. Flexible Curriculum NITTUGCSE20

Reference Books

Mapping of Course Outcomes with Programme Outcomes

<table>
<thead>
<tr>
<th></th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>CO2</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>CO3</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>CO4</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
</tr>
</tbody>
</table>
Course Title : Middleware Technologies
Number of Credits : 3-0-0-3
Pre-requisites (Course Code) : -
Course Type : HO

Course Objectives

- To understand the essence of client-server and middleware architectures
- To understand the concepts distributed applications
- To learn the basics of CORBA and C#.NET technologies
- To learn the concepts of java bean

Course Contents

Unit I Introduction
Introduction to client server computing - client server models - Benefits of client server computing - pitfalls of client server programming – Middleware - Client/server building blocks - RPC - RMI.*

Unit II Middleware
Middleware - Objects - Elements - Architecture - Middleware distributed applications - middleware types - transaction oriented middleware.*

Unit III Corba
CORBA with Java - Client/Server CORBA-style - CORBA with Java-Static - CORBA ORBlets with Applets - Dynamic CORBA Beans - CORBA initialization protocol - CORBA activation services - CORBA java-toIDL mapping.*

Unit IV EJB
EJBs and CORBA - Object transaction monitors - CORBA OTM’s - EJB and CORBA OTM’s - EJB container framework - Session and Entity Beans - EJB client/server development Process - The EJB container protocol - support for transaction EJB packaging - EJB design Guidelines.*

Unit V Object Oriented Programming
C# and .NET Platform - .NET Assemblies - Object Oriented Programming with C# - Callback Interfaces - Delegates - Events - Type Reflection - Late Binding - Attribute-Based Programming - Object Serialization and the .NET Remoting Layer.*

*Programming assignments are mandatory.

Course Outcomes

Upon completion of this course, the students will be able to:

- Comprehend of Middleware tools
- Build real time applications based on .Net and C#
- Design, develop, and analyze middleware architecture in developing enterprise technologies
- Handle EJB tools

Text Books

Reference Books


Mapping of Course Outcomes with Programme Outcomes

<table>
<thead>
<tr>
<th></th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>✓</td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Course Code: CSHO16
Course Title: Randomized Algorithms
Number of Credits: 3-1-0-4
Pre-requisites (Course Code): CSPC42
Course Type: HO

Course Objectives

- To introduce the concept of randomized algorithms
- To apply the concepts of probabilistic analysis of algorithms
- To derive good upper bounds for the expected running time of simple randomized algorithm
- To analyze the performance of randomized algorithms
- To design simple randomized algorithm that run faster or return correct output with high probability

Course Contents

UNIT I Probability and Computing
Elements of probability theory - Verification of strings - poly identities - matrix multiplication - Las Vegas and Monte Carlo algorithms - Expectations - Jensen's Inequality - Coupon collector's problem - geometric distribution.*

UNIT II Expectations, Moments and Inequalities
Randomized Quick Sort and its expected run-time - Variance and moments - Chebyshev's inequality - Coupon collector's problem - randomized median finding - analysis - moment generating functions.*

UNIT III Chernoff's Bounds and its Applications
Derivation and application of Chernoff's bounds - Sum of Poisson Trials - Coin flips - Set balancing - Packet routing in sparse networks - permutation routing on the hypercube - butterfly.*

UNIT IV Balls, Bins and Random Graphs
Birthday paradox - balls and bins model - application to bucket sort - Poisson distribution - Application to hashing - random graph models - Hamiltonian cycles in random graphs.*

UNIT V Markov Chains and Random Walks
Markov chains - representations - randomized algorithm for 2-satisfiability and 3-satisfiability - classification of states - gambler's ruin - random walks on undirected graphs - s-t connectivity algorithm.*

*Programming assignments are mandatory.

Course Outcomes

Upon completion of this course, the students will be able to:
- Learn the mathematical foundations emphasizing the design and analysis of randomized algorithm
- Apply basics of probability theory in the analysis of algorithms
- Comprehend randomized algorithms and its advantages to traditional algorithm
- Design and implement randomized techniques in solving real world problems
- Design randomized algorithms and analyze their performance

Text Book

## Mapping of Course Outcomes with Programme Outcomes

<table>
<thead>
<tr>
<th></th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>CO1</strong></td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>CO2</strong></td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>CO3</strong></td>
<td>✔</td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>CO4</strong></td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>CO5</strong></td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td></td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Course Code : CSHO17
Course Title : Big Data Mining
Number of Credits : 3-1-0-4
Pre-requisites (Course Code) : -
Course Type : HO

Course Objectives

- To understand big data and data analytics lifecycle
- To learn Basic Data analytic methods using R
- To gain knowledge on advanced analytical methods, technology and tools

Course Contents

UNIT I  Big Data Overview
State of the practice in Analytics - Key roles for new big data ecosystem - Data Analytics Lifecycle - Data analytics lifecycle overview - Discovery - Data Preparation - Model Planning - Model Building - Communicate Results - operationalize.

UNIT II  Introduction to R
Exploratory Data Analytics - Statistical methods for evaluation - Hadoop & Map Reduce framework for R - R with Relational Database Management Systems - R with Non-Relational (NoSQL) DBs.

UNIT III  Clustering

UNIT IV  Classification

UNIT V  Analytics for Unstructured data
The Hadoop Ecosystem – NoSQL - In-Database Analytics - SQL Essentials - In-Database Text Analysis - Advanced SQL.

Course Outcomes

Upon completion of this course, the students will be able to:

- Understand the big data concepts
- Utilize and apply the Analytical methods, Technology and tools in the industry
- Understand hadoop ecosystem and apply to solve real-life problems

Text Books


Reference Books

### Mapping of Course Outcomes with Programme Outcomes

<table>
<thead>
<tr>
<th></th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>
Course Objectives

- To define important terminologies and classify systems/models
- To understand continuous and discrete modelling of computer systems
- To understand the analytical modelling of computer systems
- To enable the students to develop new queueing analysis for both simple and complex systems
- To appreciate the use of smart scheduling and introduce the students to analytical techniques for evaluating scheduling policies

Course Contents

UNIT I Simulation
Inventory Concept: The technique of Simulation - Major application areas - concept of a System - Continuous and discrete systems - Systems modeling - types of models - Progress of a Simulation Study - Monte Carlo Method - Comparison of Simulation and Analytical Methods.

UNIT II Applications
Discrete-Time Markov Chains - Ergodicity Theory - Real World Examples - Google - Aloha - Transition to Continuous-Time Markov Chain - M/M/1 and PASTA.

UNIT III Queueing Analysis
Server Farms: M/M/k and M/M/k/k - Capacity Provisioning for Server Farms - Time Reversibility and Burke’s Theorem - Networks of Queues and Jackson Product Form - Classed and Closed Networks of Queues.

UNIT IV Matrix Analytic Methods
Case Study of Real-world Workloads - Phase-Type Distributions and Matrix-Analytic Methods - Networks with Time-Sharing Servers - M/G/1 Queue and the Inspection Paradox - Task Assignment Policies for Server Farms.

UNIT V Scheduling Policies
Performance Metrics - Scheduling - Non-Preemptive and Preemptive Non-Size-Based Policies - Scheduling Non-Preemptive and Preemptive Size-Based Policies - Scheduling - SRPT and Fairness.

Course Outcomes

Upon completion of this course, the students will be able to:

- Identify the technique for discrete and continuous models
- Discuss open and closed queueing networks
- Apply the operational laws to open and closed systems
- Use discrete-time and continuous-time Markov chains to model real world systems
- Develop analytical techniques for evaluating scheduling policies

Text Books


Reference Books


Mapping of Course Outcomes with Programme Outcomes

<table>
<thead>
<tr>
<th></th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO5</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Course Code : CSHO19
Course Title : Quantum Computing
Number of Credits : 3-1-0-4
Prerequisites(Course code) :
Course Type : HO

COURSE OBJECTIVES

- To understand the principles of quantum computation and mechanics
- To learn about the operators involved in Quantum computing and their applications
- To study the information theory aspects of quantum computing
- To explore the various error corrections available for quantum computing
- To comprehend the applications of quantum computing to information theory and cryptography

COURSE CONTENTS

UNIT I INTRODUCTION TO QUANTUM COMPUTATION


UNIT II QUANTUM COMPUTING OPERATIONS

Quantum circuits - Single qubit operations - Controlled operations - Measurement - Universal quantum gates - Simulation of quantum systems - Quantum Fourier transform and its applications - Phase estimation - Applications: order-finding and factoring - General applications of the quantum Fourier - Quantum search algorithms - Quantum search as a quantum simulation - Quantum counting - Speeding up the solution of NP-complete problems - Quantum search of an unstructured database - Optimality of the search algorithm - Black box algorithm limits

UNIT III QUANTUM INFORMATION

Quantum computers: physical realization - Guiding principles - Conditions for quantum computation- Harmonic oscillator quantum computer - Optical photon quantum computer- Optical cavity quantum electrodynamics - Ion traps - Nuclear magnetic resonance - Other implementation schemes - Quantum information - Quantum noise and quantum operations - Classical noise and Markov processes - Quantum operations - Examples of quantum noise and quantum operations - Applications of quantum operations - Limitations of the quantum operations formalism

UNIT IV - QUANTUM ERROR CORRECTION


UNIT V - QUANTUM INFORMATION THEORY

Entropy and information - Shannon entropy- Basic properties of entropy - Von Neumann entropy- Strong subadditivity - Quantum information theory- Distinguishing quantum states and the accessible information - Data
compression - Classical information over noisy quantum channels - Quantum information over noisy quantum channels - Entanglement as a physical resource - Quantum cryptography

**COURSE OUTCOMES**

Upon completion of this course, students will be able to:

- Apply the operators of quantum computing for different problems
- Suggest quantum operators for any mathematical problem
- Use and modify quantum search algorithms for real-time problems
- Suggest and modify quantum error correction algorithms for any applications
- Apply quantum computing for various security applications

**TEXT BOOKS**


**Mapping of Course Outcomes with Programme Outcomes**

<table>
<thead>
<tr>
<th></th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO5</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
</tr>
</tbody>
</table>
OPEN ELECTIVES

<table>
<thead>
<tr>
<th>Course Code</th>
<th>CSOE11</th>
</tr>
</thead>
<tbody>
<tr>
<td>Course Title</td>
<td>Big Data Analytics</td>
</tr>
<tr>
<td>Number of Credits</td>
<td>3-0-0-3</td>
</tr>
<tr>
<td>Pre-requisites</td>
<td>-</td>
</tr>
<tr>
<td>Course Type</td>
<td>PE</td>
</tr>
</tbody>
</table>

Course Objectives
- To understand the Big Data Platform and its Use cases
- To Provide an overview of Apache Hadoop
- To Provide HDFS Concepts and Interfacing with HDFS
- To understand NoSQL database

Course Contents

UNIT I  Introduction to Big Data
Introduction: Big Data - Characteristics of Big Data - Big data management architecture - Examining Big Data Types - Big Data Technology Components - Big data analytics - Big data analytics examples - Web Data Overview - Web Data in Action.

UNIT II  Hadoop
Introduction: History of Hadoop - Hadoop Ecosystem - Analyzing data with Hadoop - Hadoop Distributed File System - Design - HDFS concepts - Hadoop filesystem - Data flow - Hadoop I/O - Data integrity - Serialization - Setting up a Hadoop cluster - Cluster specification - cluster setup and installation - YARN.

UNIT III  MapReduce
Introduction: Understanding MapReduce functions - Scaling out - Anatomy of a MapReduce Job Run - Failures - Shuffle and sort - MapReduce types and formats - features - counters - sorting - MapReduce Applications – Configuring and setting the environment - Unit test with MR unit - local test.

UNIT IV  Spark

UNIT V  NoSQL Databases
USE CASES: Call detail log analysis - Credit fraud alert - Weather forecast.

Course Outcomes
Upon completion of this course, the students will be able to:
- Understand the characteristics of big data and concepts of Hadoop ecosystem
- Understand the concepts of Scala programming
- Apply Mapreduce programming model to process big data
- Analyze Spark and its uses for big data processing
- Design programs for big data applications using Hadoop components

Text Books

Reference Books


Mapping of Course Outcomes with Programme Outcomes

<table>
<thead>
<tr>
<th></th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO5</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Course Objectives

- To provide comprehensive knowledge of fundamental concepts and of grid and cloud computing
- To demonstrate an understanding of Virtualization, Service models and deployment models of the cloud
- To describe the programming and software environments of grid and cloud
- To shed light on the security issues in the grid and the cloud

Course Contents

UNIT I

UNIT II

UNIT III
Virtual Machines and Virtualization - Implementation levels of Virtualization - Virtualization structures/tools and Mechanisms - Virtualization of CPU - Memory and I/O Devices - Storage Virtualization.

UNIT IV

UNIT V

Course Outcomes

Upon completion of this course, the students will be able to:

- Articulate the Virtualization concepts
- Identify the architecture, service models and deployment models of Cloud
- Master the programming aspects of the Grid and Cloud
- Understand and build secure and reliable Grid and Cloud applications

Text Books


Reference Books


**Mapping of Course Outcomes with Programme Outcomes**

<table>
<thead>
<tr>
<th>CO1</th>
<th>CO2</th>
<th>CO3</th>
<th>CO4</th>
</tr>
</thead>
<tbody>
<tr>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>
Course Code : CSOE13
Course Title : Computer Graphics and Multimedia Systems
Number of Credits : 3-0-0-3
Pre-requisites (Course Code) : -
Course Type : OE

Course Objectives

- To understand the basics of various inputs and output computer graphics hardware devices
- Exploration of fundamental concepts in 2D and 3D computer graphics
- To know 2D raster graphics techniques, 3D modeling, geometric transformations, 3D viewing and rendering
- Exploration of fundamental concepts in multimedia systems, file handling, hypermedia

Course Contents

UNIT I
Basic of Computer Graphics: Applications of computer graphics - Display devices - Random and Raster scan systems - color models - Graphics Primitives: Points - lines - circles and ellipses as primitives - scan conversion algorithms for primitives.*

UNIT II
Two-Dimensional Graphics: Two dimensional geometric transformations - Matrix representations and homogeneous coordinates - composite transformations - Two dimensional viewing - viewing pipeline - viewing coordinate reference frame - window-to-viewport coordinate transformation - Two dimensional viewing functions - clipping operations - point - line - polygon clipping algorithms.*

UNIT III

UNIT IV

UNIT – V

*Programming assignments are mandatory.

Course Outcomes

Upon completion of the course, the students will be able to:

- Understand the various computer graphics hardware and display technologies
- Implement various 2D and 3D objects transformation techniques
- Apply 2D and 3D viewing technologies into the real world applications
• Implement multimedia components efficiently

Text Books


Reference Books


Mapping of Course Outcomes with Programme Outcomes

<table>
<thead>
<tr>
<th></th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Course Title: Distributed Architecture
Number of Credits: 3
Pre-requisites (Course Code): -
Course Type: OE

Course Objectives
- To develop an infrastructure for distributed systems architecture
- To get knowledge about universal and independent of a specific middleware technology
- To obtain knowledge about complete CORBA implementation
- To design the architecture of middleware platforms

Course Contents

UNIT I Introduction

UNIT II ORB
ORB Architecture - Transport Layer - Presentation Layer - Interoperability Layer - Proxies - Object Services - ORB Design - ORB Functionality - Design Of MICO's ORB.

UNIT III Models

UNIT IV Invocation Adapters
Functionality - Static and dynamic Invocation Interface - Design of MICO’s DII-Compiler: Invocation Adapters - Compiler Fundamentals - Abstract Syntax Tree for IDL specifications - MICO’s IDL Compiler.

UNIT V CORBA
CORBA Components - Web Services - Middleware for Ubiquitous Computing - case study for MICO Implementation and Application of MICO.

Course Outcomes
Upon completion of this course, the students will be able to:
- Develop distributed systems architecture
- Gain knowledge about specific middleware technology
- Implement CORBA and MICO
- Design middleware platforms

Text Book

Reference Books
## Mapping of Course Outcomes with Programme Outcomes

<table>
<thead>
<tr>
<th></th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td></td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✔</td>
</tr>
<tr>
<td>CO2</td>
<td>✔</td>
<td></td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✔</td>
</tr>
<tr>
<td>CO3</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td></td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✔</td>
</tr>
<tr>
<td>CO4</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td></td>
<td>✔</td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
<td>✔</td>
</tr>
</tbody>
</table>
Course Code : CSOE15
Course Title : Human Computer Interaction
Number of Credits : 3-0-0-3
Pre-requisites (Course Code) : -
Course Type : OE

Course Objectives

- To provide an overview of the concepts relating to the design of human-computer interfaces
- To understand the theoretical dimensions of human factors involved in the acceptance of computer interfaces
- To understand the important aspects of implementation of human-computer interfaces
- To identify the various tools and techniques for interface analysis, design and evaluation

Course Contents

UNIT I

UNIT II
Designing - Programming Interactive systems - Models of interaction - Frameworks and HCI - Ergonomics - Interaction styles - Elements of the WIMP interface - The context of the interaction - Experience - engagement and fun - Paradigms for interaction. Cantered Design and testing - Interaction design basics - The process of design - User focus - Scenarios - Navigation design - Screen design and layout - Iteration and prototyping.

UNIT III
HCI in the software process - Iterative design and prototyping - Design rules - Principles to support usability - Standards and Guidelines - Golden rules and heuristics - HCI patterns. Implementation support - Elements of windowing systems - Programming the application - Using toolkits - User interface management systems.

UNIT IV

UNIT V
Collaboration and communication - Face-to-face communication - Conversation - Text-based communication - Group working - Dialog design notations - Diagrammatic notations - Textual dialog notations - Dialog semantics - Dialog analysis and design Human factors and security - Groupware - Meeting and decision support systems - Shared applications and artifacts - Frameworks for groupware - Implementing synchronous groupware - Mixed - Augmented and Virtual Reality.

Course Outcomes

Upon completion of the course, the students will be able to:

- Design and Develop processes and life cycle of Human Computer Interaction
- Analyze product usability evaluations and testing methods
- Apply the interface design standards/guidelines for cross cultural and disabled users
- Categorize, Design and Develop Human Computer Interaction in proper architectural structures
Text Books


Mapping of Course Outcomes with Programme Outcomes

<table>
<thead>
<tr>
<th></th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>
Course Code : CSOE16
Course Title : Image Processing
Number of Credits : 3-0-0-3
Pre-requisites (Course Code) : -
Course Type : OE

Course Objectives

- To understand the fundamentals of Digital imaging
- To understand the fundamentals Image Processing techniques
- To under the mathematical transforms applicable for image processing
- To be familiar with image compression and segmentation
- Exploration of image processing algorithms

Course Contents

UNIT I Introduction

UNIT II Image Transformation

UNIT III Image Enhancement and Restoration

UNIT IV Image Segmentation and Compression

UNIT V Recognition of Image Patterns
Introduction - Decision Theoretic Pattern Classification - LDA - Bayesian Decision Theory - Texture and Shape Analysis - Case study - Image mining and Content-Based Retrieval.*

*Programming assignments are mandatory.

Course Outcomes

Upon completion of this course, the students will be able to:
- Process image enhancement and restoration techniques
- Apply image compression and segmentation Techniques
- Apply transforms for processing of images
- Design and develop image processing techniques for assisting digital forensics

Text Books

Reference Books


Mapping of Course Outcomes with Programme Outcomes

<table>
<thead>
<tr>
<th>CO1</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
</tr>
</thead>
<tbody>
<tr>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>✓</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Course Code : CSOE17
Course Title : Internet of Things
Number of Credits : 3-0-0-3
Pre-requisites (Course Code) : -
Course Type : OE

### Course Objectives

- To learn the basic issues, policy and challenges in the Internet
- To get an idea of some of the application areas where Internet of Things can be applied
- To understand the cloud and internet environment
- To understand the various modes of communications with Internet
- To understand about web of things

### Course Contents

#### UNIT I Introduction

#### Unit II IoT Protocols

#### Unit III Resource Management in the Internet of Things
Clustering - Software Agents - Data Synchronization - Clustering Principles in an Internet of Things Architecture - The Role of Context - Design Guidelines - Software Agents for Object Data Synchronization - Types of Network Architectures - Fundamental Concepts of Agility and Autonomy - Enabling Autonomy and Agility by the Internet of Things - The Evolution from the RFID-based EPC Network to an Agent based Internet of Things - Agents for the Behaviour of Objects.*

#### Unit IV Case Study and IoT Application Development

#### Unit V Web of Things

*Programming assignments are mandatory.

### Course Outcomes

Upon completion of this course, the students will be able to:

- Identify the components of IoT
- Analyze various protocols of IoT
- Design portable IoT using appropriate boards
- Develop schemes for the applications of IOT in real time scenarios
- Design business Intelligence and Information Security for WoT
Text Books

Reference Books

Mapping of Course Outcomes with Programme Outcomes

<table>
<thead>
<tr>
<th></th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO5</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Course Code: CSOE18
Course Title: Machine Learning for Engineering Applications
Number of Credits: 3-0-0-3
Pre-requisites (Course Code): -
Course Type: OE

Course Objectives
- To provide a broad survey of different machine learning approaches and techniques
- To understand the principles and concepts of machine learning
- To understand neural networks concepts
- To learn regression and reinforcement learning
- To develop programming skills that helps to build real world applications based on machine learning

Course Contents

UNIT I Introduction

UNIT II Machine Learning
Types of Machine Learning - Supervised Learning - Classification models - Naïve Bayes Classifier - Decision trees - Support Vector Machines - KNN model - Dimensionality reduction - PCA.

UNIT III Clustering

UNIT IV Neural Networks

UNIT V Applications and Tools

Course Outcomes
Upon completion of this course, the students will be able to:
- Solve typical machine learning problems
- Represent data to facilitate learning
- Design and implement various machine learning algorithms for real-world applications
- Suggest supervised/unsupervised machine learning approaches for any application
- Handle tools of machine learning

Text Books

Reference Books

Mapping of Course Outcomes with Programme Outcomes

<table>
<thead>
<tr>
<th></th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td></td>
<td></td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td></td>
<td></td>
<td></td>
<td>✔</td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td>✔</td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO5</td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✔</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Course Code: CSOE19
Course Title: Security Principles
Number of Credits: 3-0-0-3
Pre-requisites (Course Code): -
Course Type: PE

Course Objectives

• To understand the basics of Information Security
• To know the legal, ethical and professional issues in Information Security
• To know the aspects of risk management
• To become aware of various standards in this area
• To know the technological aspects of Information Security

Course Contents

UNIT I  Introduction

UNIT II  Security Investigation

UNIT III  Security Analysis

UNIT IV  Logical Design

UNIT V  Physical Design

Course Outcomes

Upon completion of this course, the students will be able to:

• Discuss the basics of information security
• Illustrate the legal, ethical and professional issues in information security
• Demonstrate the aspects of risk management
• Become aware of various standards in the Information Security System
• Design and implementation of Security Techniques

Text Book


Reference Books


Mapping of Course Outcomes with Programme Outcomes

<table>
<thead>
<tr>
<th></th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO5</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>
Course Objectives

- Describe and understand the concepts of feed forward & feedback neural networks
- Recognize the concept of fuzziness involved in various systems
- Expose the ideas about genetic algorithm
- Compare about FLC and NN toolbox
- Design algorithm for optimization problem

Course Contents

UNIT I  Introduction

UNIT II  Architecture

UNIT III  Fuzzy Systems

UNIT IV  Optimization Algorithm
Basic concept of Genetic algorithm and detail algorithmic steps - adjustment of free Parameters - Solution of typical control problems using genetic algorithm - Concept on some other search techniques like tabu search and ant colony - search techniques for solving optimization problems.

UNIT V  MATLAB Tool Box for FUZZY Logic and Neural Network

Course Outcomes

Upon completion of this course, the students will be able to:

- Comprehend machine learning and soft computing techniques in solving real world applications
- Design and develop ML techniques with assistance of MATLAB
- Visualize and analyze behavioural pattern to develop evolutionary algorithm
- Use MATLAB toolbox
- Design Algorithm for classification Problems
Text Books

Reference Books

Mapping of Course Outcomes with Programme Outcomes

<table>
<thead>
<tr>
<th></th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td></td>
<td></td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td></td>
<td>✔</td>
<td>✔</td>
<td></td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td></td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
<td>✔</td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO5</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td></td>
<td></td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Course Code : CSOE21
Course Title : Software Project Management
Number of Credits : 3-0-0-3
Pre-requisites (Course Code) : -
Course Type :OE

Course Objectives

- Recognize basic concepts and issues of software project management
- Emphasize successful software projects that support organization's strategic goals
- Comprehend software quality issues
- Comprehend software risk issues
- Analyse SPM tools

Course Contents

UNIT I  SPM Concepts
Definition - components of SPM - challenges and opportunities - tools and techniques - managing human resource and technical resource - costing and pricing of projects - training and development - project management techniques.*

UNIT II  Software Measurements
Monitoring & measurement of SW development - cost - size and time metrics - methods and tools for metrics - issues of metrics in multiple projects.*

UNIT III  Software Quality
Quality in SW development - quality assurance - quality standards and certifications - the process and issues in obtaining certifications - the benefits and implications for the organization and its customers - change management.*

UNIT IV  Risk Issues
The risk issues in SW development and implementation - identification of risks - resolving and avoiding risks - tools and methods for identifying risk management.*

UNIT V  SPM Tools
Software project management using Primavera & Redmine - case study on SPM tools.*

*Programming assignments are mandatory.

Course Outcomes

Upon completion of this course, the students will be able to:
- Maintain software projects and monitor software project process
- Design and develop project modules and assign resources
- Comprehend, assess, and calculate the cost of risk involved in a project management
- Analyse the tools for risk management
- Design a Case study using SPM tools

Text Books


Reference Books

Mapping of Course Outcomes with Programme Outcomes

<table>
<thead>
<tr>
<th>CO1</th>
<th>CO2</th>
<th>CO3</th>
<th>CO4</th>
<th>CO5</th>
</tr>
</thead>
<tbody>
<tr>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>

Course Code : CSOE22
CSE Dept. Flexible Curriculum NITTUGCSE20 192
Course Title: Software Testing And Practices
Number of Credits: 3-0-3
Pre-requisites (Course Code): 
Course Type: OE

Course Objectives

- Summarize to learn the criteria for test cases
- Develop and design test cases
- Analyse test management and test automation techniques
- Assess test metrics and measurements
- Differentiate Test monitoring and controlling

Course Contents

UNIT I Introduction
Software testing - The Role process in Software Quality - Testing as a process - Overview of testing maturity model - software testing definition - Software Testing Principles - Origin of defects - Defect classes - the defect Repository and Test Design.

UNIT II Test Case Design Strategies

UNIT III Levels of Testing

UNIT IV Object Oriented Testing
Testing Object Oriented Software: Unit Testing in OO Context - Integration Testing in OO Context - OO testing methods - Class level testing - Interclass test case design - testing for real time system

UNIT V Test Controlling and Monitoring
Controlling and Monitoring: Measurements and Milestone for Controlling and Monitoring: Status - Productivity - Cost - Error - fault and Failures - Effectiveness - Criteria for Test Completion - Reviews as testing Activity: Inspection Walkthrough - Components of review plan - testing for web application - Component level testing - Clean room tests.

Course Outcomes

Upon completion of this course, the students will be able to:
- Design test cases suitable for a software development for different domains
- Identify suitable tests to be carried out
- Prepare test planning based on the document
- Document test plans and test cases designed
- Use the automated testing tools to check the behaviour of the real time application

Text Book


Reference Books

Mapping of Course Outcomes with Programme Outcomes

<table>
<thead>
<tr>
<th></th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>CO2</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>CO3</td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>CO4</td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>CO5</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
<td>✓</td>
</tr>
</tbody>
</table>

Course Code : CSOE23
Course Title: Web Technology
Number of Credits: 3-0-0-3
Pre-requisites (Course Code): -
Course Type: OE

Course Objectives

- Describe basics of Web Designing using HTML, DHTML, and CSS
- Categories the basics about Client side scripts and Server side scripts
- Classify web applications
- List Regular Expressions
- Create Database connectivity

Course Contents

UNIT I  Web Page Designing

UNIT II  Scripting
Java Script - Control statements - Functions - Arrays - Objects - Events - Dynamic HTML with Java Script - Ajax.*

UNIT III  Web Application

UNIT IV  PHP Programming

UNIT V  JDBC
Database Connectivity with MySQL - Servlets - JSP - PHP,* Case Studies - Student information system - Health Management System.

*Programming assignments are mandatory.

Course Outcomes

Upon completion of this course, the students will be able to:

- Design and develop client side scripting techniques
- Build real world applications using client side and server side scripting languages
- Design and develop an e-governance application using web technology
- Design Database connectivity with JSP
- Design case study for student Information System and Health Management system

Text Books


Reference Books

### Mapping of Course Outcomes with Programme Outcomes

<table>
<thead>
<tr>
<th></th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>CO1</strong></td>
<td></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>CO2</strong></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>CO3</strong></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>CO4</strong></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>CO5</strong></td>
<td>✓</td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>