Master of Technology (Computer Engineering)
Department of Computer Engineering
Curriculum Structure
(With effect from year 2024-25)

(Approved by the Board of Studies and Academic Council)
SCTR’S PUNE INSTITUTE OF COMPUTER TECHNOLOGY, PUNE-43
M. Tech. (Computer Engineering) Curriculum Structure
With effect from the A.Y. 2024-25

Semester - I

<table>
<thead>
<tr>
<th>Broad category of Course</th>
<th>Subject code</th>
<th>Name of subjects</th>
<th>Teaching Scheme (Hours/Week)</th>
<th>Credits/ Grades</th>
<th>Examination Scheme and Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>L</td>
<td>P</td>
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</tr>
<tr>
<td>PCC</td>
<td>MCE1-001</td>
<td>Mathematical Foundations for Computing</td>
<td>2</td>
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<tr>
<td>PCC</td>
<td>MCE1-002</td>
<td>Advanced Algorithms</td>
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<tr>
<td>PCC</td>
<td>MCE1-003</td>
<td>Information Security</td>
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<td>AEC</td>
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<td>Research Methodology</td>
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<tr>
<td>PEC</td>
<td>MCE1-005</td>
<td>Program Elective - I</td>
<td>3</td>
<td>3</td>
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<tr>
<td>VSEC</td>
<td>MCE-006</td>
<td>Laboratory Proficiency-I</td>
<td>-</td>
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<td>-</td>
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<tr>
<td>AAC</td>
<td>MCE1-007</td>
<td>Research and Technical Communication Lab</td>
<td>-</td>
<td>2</td>
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</tr>
<tr>
<td>VSEC</td>
<td>MCE1-008</td>
<td>Programming Proficiency Lab</td>
<td>-</td>
<td>2</td>
<td>-</td>
</tr>
</tbody>
</table>

### Total

|               | 15 | 8  | 1  | 24 | 15 | 4  | 1  | 20 | 100 | 150 | 250 | 75  | 25  | 600 |

**MCE1-005: Program Elective - I**

- MCE1-005A: IoT Architecture and Protocols
- MCE1-005B: Machine Learning
- MCE1-005C: Natural Language Processing
- MCE1-005D: Distributed Operating Systems

**MCE1-006: Lab Proficiency – I**

Laboratory Assignments will be based on Program Core and Program Elective Courses.
## Semester – II

<table>
<thead>
<tr>
<th>Broad Category of Course</th>
<th>Subject code</th>
<th>Name of subjects</th>
<th>Teaching Scheme (Hours/Week)</th>
<th>Credits/ Grades</th>
<th>Examination Scheme and Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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<tr>
<td>PCC</td>
<td>MCE2-009</td>
<td><strong>Cloud Computing</strong></td>
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<tr>
<td>PCC</td>
<td>MCE2-010</td>
<td><strong>Applied Deep Learning</strong></td>
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<tr>
<td>PEC</td>
<td>MCE2-011</td>
<td><strong>Program Elective - II</strong></td>
<td>3</td>
<td>-</td>
<td>-</td>
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<tr>
<td>OE</td>
<td>MCE2-012</td>
<td><strong>Open Elective - I</strong></td>
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<td>-</td>
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<tr>
<td>VSEC</td>
<td>MCE2-013</td>
<td><strong>Laboratory Proficiency - II</strong></td>
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<td>VSEC</td>
<td>MCE2-014</td>
<td><strong>Skills Enhancement Lab</strong></td>
<td>2</td>
<td>2</td>
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<tr>
<td>AEC</td>
<td>MCE2-015</td>
<td><strong>Seminar-I</strong></td>
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<td>12</td>
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</table>

### MCE2-011: Program Elective - II

- **MCE2-011A:** Edge Computing and IoT Applications
- **MCE2-011B:** Information Retrieval and Web mining
- **MCE2-011C:** Multimodal Computing
- **MCE2-011D:** Advanced Compilers
- **MCE2-011E:** Applied Security

### MCE2-012: Open Elective - I (MOOCs)

<table>
<thead>
<tr>
<th>Subject code</th>
<th>Name of subjects</th>
<th>MOOC link</th>
</tr>
</thead>
<tbody>
<tr>
<td>MCE2-012A</td>
<td>Computer Vision</td>
<td><a href="https://onlinecourses.nptel.ac.in/noc19_cs58/preview">https://onlinecourses.nptel.ac.in/noc19_cs58/preview</a></td>
</tr>
<tr>
<td>MCE2-012B</td>
<td>Mobile Computing</td>
<td><a href="https://nptel.ac.in/course/106106147">https://nptel.ac.in/course/106106147</a></td>
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<tr>
<td>MCE2-012C</td>
<td>Software Architecture</td>
<td><a href="https://onlinecourses.nptel.ac.in/noc22_cs39/preview">https://onlinecourses.nptel.ac.in/noc22_cs39/preview</a></td>
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## Semester – III

<table>
<thead>
<tr>
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<th>Credits/ Grades</th>
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<tr>
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<td>L  P  T Total</td>
<td>Theory</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>ISE  CIE  ESE  CIE/ TW</td>
<td>ESE (P/OR)</td>
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<td>PEC</td>
<td>MCE3-016</td>
<td>Program Elective Course - III</td>
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<td>4 - - 4</td>
<td>20 30 50 - -</td>
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<td>OE</td>
<td>MCE3-017</td>
<td>Open Elective Course - II</td>
<td>4 - - 4</td>
<td>4 - - 4</td>
<td>20 30 50 - -</td>
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<tr>
<td>IKS</td>
<td>MCE3-018</td>
<td>Indian Knowledge System and Human Values</td>
<td>1 2 - 3</td>
<td>1 1 - 2</td>
<td>- 30 - 20 -</td>
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<td>AEC</td>
<td>MCE3-019</td>
<td>Internship/Field Study</td>
<td>- 8 - 8</td>
<td>- 4 - 4</td>
<td>- - - 50 50</td>
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<tr>
<td>AEC</td>
<td>MCE3-020</td>
<td>Seminar – II</td>
<td>- 4 - 4</td>
<td>- 2 - 2</td>
<td>- - - 50 50</td>
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<tr>
<td>AEC</td>
<td>MCE3-021</td>
<td>Dissertation Stage -I</td>
<td>- 8 - 8</td>
<td>- 4 - 4</td>
<td>- - - 50 50</td>
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<td>9 22 0 31</td>
<td>9 1 1</td>
<td>20 40 90 100 170 150</td>
</tr>
</tbody>
</table>

### MCE3-016: Program Elective - III (MOOCs)

- **MCE3-016A**: Digital Forensic
- **MCE3-016B**: Pattern Recognition
- **MCE3-016C**: Big Data Analytics
- **MCE3-016D**: Business Intelligence
<table>
<thead>
<tr>
<th>MOOC Code</th>
<th>Elective - II (MOOCs)</th>
<th>MOOC link</th>
</tr>
</thead>
</table>
| MCE3-017A | Industrial IoT | **Introduction to Industry 4.0 and Industrial Internet of Things**  
By Prof. Sudip Misra  | IIT Kharagpur  
[https://onlinecourses.nptel.ac.in/noc20.cs69/preview](https://onlinecourses.nptel.ac.in/noc20.cs69/preview) |
| MCE3-017B | Bioinformatics | **BioInformatics: Algorithms and Applications**  
By Prof. Michael Gromiha  
IIT Madras  
[https://onlinecourses.nptel.ac.in/noc21.bt06/preview](https://onlinecourses.nptel.ac.in/noc21.bt06/preview) |
| MCE3-017C | AI in Healthcare | **Coursera-AI in Healthcare Specialization [5 courses] (Stanford) | Coursera  
**NPTEL-Applied Accelerated Artificial Intelligence**  
Prof. Satyajit Das, Prof. Satyadhyaan Chickerur, Prof. Bharatkumar Sharma, Prof. Adesuyi Tosin, Prof.Ashrut Ambastha, IIT Palakkad, KLE Technological University, NVIDIA, NVIDIA  
[https://onlinecourses.nptel.ac.in/noc22_cs132/preview](https://onlinecourses.nptel.ac.in/noc22_cs132/preview) |
| MCE3-017D | AI for Investments | **Artificial Intelligence (AI) for Investments**  
By Prof. Abhinava Tripathi, IIT Kanpur  
[https://onlinecourses.nptel.ac.in/noc23.mg63/preview](https://onlinecourses.nptel.ac.in/noc23.mg63/preview) |
| MCE3-017E | Responsible and Safe AI | **Responsible & Safe AI Systems**  
By Prof. Ponnurangam Kumaraguru, Prof. Balaraman Ravindran, Prof. Arun Rajkumar, IIT Hyderabad, IIT Madras  
[https://onlinecourses.nptel.ac.in/noc24.cs132preview](https://onlinecourses.nptel.ac.in/noc24.cs132preview) |
| MCE3-017F | AI for Economics | **Artificial Intelligence for Economics**  
Prof. Adway Mitra, Prof. Dripto Bakshi, Prof. Palash Dey, IIT Kharagpur  
[https://onlinecourses.nptel.ac.in/noc24.cs76preview](https://onlinecourses.nptel.ac.in/noc24.cs76preview) |
| MCE3-017G | ML for Soil and Crop Management | **Machine Learning For Soil And Crop Management**  
Prof. Somsubhra Chakraborty, IIT Kharagpur  
[https://onlinecourses.nptel.ac.in/noc22.ag05preview](https://onlinecourses.nptel.ac.in/noc22.ag05preview) |
| MCE3-017H | Robotics | **Robotics**  
Prof. Dilip Kumar Pratihar, IIT Kharagpur  
[https://onlinecourses.nptel.ac.in/noc21.me76preview](https://onlinecourses.nptel.ac.in/noc21.me76preview) |
| MCE3-017I | Ethical Hacking | **Ethical Hacking**  
Prof. Indranil Sen Gupta, IIT Kharagpur  
[https://onlinecourses.nptel.ac.in/noc22.cs13preview](https://onlinecourses.nptel.ac.in/noc22.cs13preview) |
| MCE3-017J | AR/VR | **Introduction to Virtual Reality**  
Ramesh C Sharma, Dr B R Ambedkar University Delhi, New Delhi  
[onlinecourses.swayam2.ac.in/nou23_ge34preview](http://onlinecourses.swayam2.ac.in/nou23_ge34preview) |
### Semester – IV

<table>
<thead>
<tr>
<th>Broad Category of Course</th>
<th>Subject code</th>
<th>Name of subjects</th>
<th>Teaching Scheme (Hours/Week)</th>
<th>Credits/Grades</th>
<th>Examination Scheme and Marks</th>
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<tbody>
<tr>
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<td></td>
<td>L  P  T</td>
<td>L  P  T</td>
<td>ISE  CIE  ESE  CIE/TW  ESE (P/OR)  Total</td>
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<td>AEC</td>
<td>MCE4-022</td>
<td>Seminar – III</td>
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<td>- 4 - 4</td>
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<td>AEC</td>
<td>MCE4-023</td>
<td>Dissertation Stage – II</td>
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<td>- 16 - 16</td>
<td>100  50  150</td>
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<td>Total</td>
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<td></td>
<td>- 40 - 40</td>
<td>- 20 - 20</td>
<td>150  100  250</td>
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</tbody>
</table>

**Guidelines**

**Program Elective Course**
- Students may select any one of the courses or NPTEL MOOCs course from the list recommended by the department. The total credits earned through MOOCs should be equivalent to the allocated credits for the respective Elective. (One credit will be awarded for a four-week MOOCs course). MOOCs course list will be updated at the beginning of the academic year.

**Open Elective Course**
- Students may select any one of the courses of 4 credits offered by any department in the Institute or Industry supported Course or MOOCs. The total credits earned through MOOCs should be equivalent to the allocated credits for the respective Open Elective Course. (One credit will be awarded for a four week MOOCs). MOOCs list will be updated at the beginning of the academic year.

**Exit Criteria:**
- Post graduate diploma will be awarded if a student completes 40 credits and wishes to exit after the first year of PG. A student will be allowed to enter/re-enter only at the odd semester and can only exit after the even semester.
Abbreviations:

<table>
<thead>
<tr>
<th>PCC</th>
<th>Program Core Course</th>
<th>L</th>
<th>Lecture</th>
<th>ISE</th>
<th>In Semester Examination</th>
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<tbody>
<tr>
<td>PEC</td>
<td>Program Elective Course</td>
<td>P</td>
<td>Practical</td>
<td>ESE</td>
<td>End Semester Examination</td>
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<td>OEC</td>
<td>Open Elective Course</td>
<td>CIE</td>
<td>Continuous Internal Evaluation</td>
<td>AEC</td>
<td>Ability Enhancement Course</td>
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<tr>
<td>VSEC</td>
<td>Vocational Skill Enhancement Course</td>
<td>TW</td>
<td>Term Work</td>
<td>MOOC</td>
<td>Massive Open Online Course</td>
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<td>HSS</td>
<td>Humanities/IKS/Research</td>
<td>OR</td>
<td>Oral</td>
<td>T</td>
<td>Tutorial</td>
</tr>
</tbody>
</table>

CIE [30] **Continuous Internal Evaluation:** (Activity Based Learning Evaluation) The department shall declare the set of all applicable activities such as Problem Based Learning, Quizzes, field work, group discussion, but not limited to etc. The course coordinator, in consultation with course teachers, shall select any of three to four activities suitable for the course from the list declared by the department and get the selected activities approved from HoD. The Course teacher shall get the activities carried out by students, evaluate the student performance based on the prescribed rubrics. Department shall prepare the rubrics for all the activities and display the same before the commencement of academics.

ISE [20] **In-Semester Examination:** Written examination shall be conducted for one hour duration on First Module for 20 marks.

ESE [50] **End-Semester Examination:** Written examination shall be conducted for three hours duration on Modules II, III, IV for 50 marks.
Semester I
## Semester I

### MCE1-001 Mathematical Foundations for Computing

<table>
<thead>
<tr>
<th>Teaching Scheme:</th>
<th>Examination Scheme:</th>
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</thead>
<tbody>
<tr>
<td>L: 02 Hrs/week</td>
<td>ISE: 20 Marks</td>
</tr>
<tr>
<td>T: 01 Hr/week</td>
<td>CIE:30 Marks</td>
</tr>
<tr>
<td></td>
<td>ESE:50 Marks</td>
</tr>
</tbody>
</table>

**Credits:** 03

**Prerequisite:** Fundamental of Mathematics

**Course Objectives:**

Course intends to prepare the students

1. To explore basics of discrete mathematics for computing in computer science/Data Science applications.
2. To explore various data structures and algorithmic solutions for storage and retrieval of data computational problems.
3. To explore statistical measures and hypotheses for computing.
4. To understand the use of probability for solving computer science/Data Science problems.
5. To understand the use of linear algebra and calculus for solving computational problems.

**Course Outcomes:**

At the end of the Course Students will be able to

1. Solve the given computing problem using discrete mathematics principles.
2. Use relevant statistical tools to solve given problems.
3. Apply probability theory principles to solve the given problem.
4. Use relevant principles of linear algebra and vector calculus to solve the given data science problems.

### Course Contents

**Discrete Mathematics for Computing**

<table>
<thead>
<tr>
<th>Module I</th>
<th>8 Hrs</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Set Theory:</strong> Elementary Theory of Sets, Set Rules &amp; Sets Combinations.</td>
<td></td>
</tr>
<tr>
<td><strong>Relations:</strong> Binary Relation, Equivalence Relation, Composite Relation, Partial Ordering Relation.</td>
<td></td>
</tr>
<tr>
<td><strong>Fundamentals of Graph Theory:</strong> Types, graph representation methods, Traveling-salesman problem, applications.</td>
<td></td>
</tr>
<tr>
<td><strong>Trees &amp; Search Trees:</strong> balanced search trees, Multiway balanced search trees, splay tree, Trie, KD Tree</td>
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</tr>
<tr>
<td>Heaps: Binomial Heaps, Fibonacci Heap.</td>
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</tr>
<tr>
<td><strong>Case Study:</strong> Mathematical modeling for applications of Graph Electrical network problem/ Flow graph notation/ Test case generation using graphs/Trie for spell checker/autocomplete string/ KD Tree for geographic information systems (GIS)</td>
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</table>

<table>
<thead>
<tr>
<th>Module II</th>
<th>8 Hrs</th>
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</thead>
<tbody>
<tr>
<td><strong>Statistical Inference</strong></td>
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</tr>
</tbody>
</table>
### Module III
- **Probability Theory**

### Module IV
- **Linear Algebra & Vector Calculus**
  - Matrix and vector algebra, systems of linear equations using matrices, linear independence, Matrix factorization concept/LU decomposition, Eigenvalues and eigenvectors. Understanding of calculus: concept of function and derivative, Multivariate calculus: concept, Partial Derivatives, chain rule. **Case Study:** System of linear equations for Electrical Networks/Eigen values & Eigen vector for PageRank and PCA algorithm/ Gradient Descent

### Text Books
### Reference Books


### Paper References:


### Relevant MOOCs Course

1. Introduction to Probability Theory and Statistics By Prof. S Dharmaraja, IIT Delhi [https://onlinecourses.nptel.ac.in/noc22_ma81/preview](https://onlinecourses.nptel.ac.in/noc22_ma81/preview)
3. Graph Theory By Prof. S.A. Choudum Department of Mathematics, IIT Madras [https://archive.nptel.ac.in/courses/111/106/111106050/](https://archive.nptel.ac.in/courses/111/106/111106050/)

### Other Resources/Links

## MCE1-002 Advanced Algorithms

<table>
<thead>
<tr>
<th>Teaching Scheme:</th>
<th>Examination Scheme:</th>
</tr>
</thead>
<tbody>
<tr>
<td>L: 04 Hrs/week</td>
<td>ISE: 20 Marks</td>
</tr>
<tr>
<td></td>
<td>CIE: 30 Marks</td>
</tr>
<tr>
<td></td>
<td>ESE: 50 Marks</td>
</tr>
</tbody>
</table>

### Prerequisite:
Foundation in data structures and algorithms, Proficiency in programming, Understanding of discrete mathematics, probability, and linear algebra.

### Course Objectives:
**Course intends to prepare the students**
1. To understand different algorithm design techniques.
2. To analyze performance of different algorithmic strategies in terms of time and space.
3. To apply algorithmic strategies while solving problems.
4. To understand Multithreaded and Distributed Algorithms.

### Course Outcomes:
**At the end of the Course Students will be able to**
1. Evaluate and contrast the efficiency of polynomial time algorithms by examining their performance across worst, best, and average case scenarios.
2. Utilize appropriate algorithmic techniques to address problems involving binomial coefficients, chain matrix multiplication, and longest common subsequence.
3. Develop and apply problem-solving skills to address real-world business challenges and decision-making scenarios.
4. Evaluate the effectiveness and accuracy of randomized algorithms, considering both their efficiency and correctness.
5. Apply problem-solving techniques tailored for multi-core, distributed, or concurrent environments to effectively address complex computational challenges.

<table>
<thead>
<tr>
<th>Module I</th>
<th>Introduction</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Module II</th>
<th>Dynamic programming and Linear Programming</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dynamic programming: Control abstraction for dynamic programming, elements of dynamic programming, use of dynamic programming method to solve the problems: binomial coefficients, chain matrix multiplication, longest common subsequence. Linear programming: Its use, problem formulation as linear programming model, simplex method, duality.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Module III</th>
<th>Randomized and Distributed Algorithms</th>
</tr>
</thead>
</table>
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<table>
<thead>
<tr>
<th>Module IV</th>
<th>Complexity Theory</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Case Studies of industry relevance/recent trends</td>
</tr>
<tr>
<td></td>
<td>8 Hrs</td>
</tr>
</tbody>
</table>

**Text Books**


**Reference Books**


**Paper References:**


**Relevant MOOCs Course**

Design and Analysis of Algorithms, By Prof. Madhavan Mukund, Chennai Mathematical Institute

https://onlinecourses.nptel.ac.in/noc19_cs47/preview
# MCE1-003 Information Security

**Teaching Scheme:**
L: 03 Hrs/week

**Credits:** 03

**Examination Scheme:**
- ISE: 20 Marks
- CIE: 30 Marks
- ESE: 50 Marks

**Prerequisite:** Basic Mathematics, Matrix inverse, Networking Protocols, Sniffing tools

## Course Objectives

**Course intends to prepare the students**
1. To classify threats to assess damages to information systems.
2. To acquire the knowledge of mathematics for cryptography, understand the concepts of cryptography.
3. To examine firewalls in the context of intrusion detection systems.
4. To learn the strengths & weaknesses of the Indian IT Act along with the amendment to the Act.

## Course Outcomes:

**At the end of the Course Students will be able to:**
1. **Apply** the Euclidean algorithm, Fermat’s theorem and Euler’s theorem.
2. **Apply** appropriate cryptographic techniques by learning symmetric and asymmetric key cryptography.
3. **Evaluate** information security threats, vulnerabilities in information systems and security measures.
4. **Comprehend** the authentication services Kerberos & X.509 directory services

## Course Contents

### Mathematical Foundation for Cryptography

**Module I**

### Elementary Cryptography

**Module II**

### Security to Authenticity and Integrity

**Module III**

### Cybercrimes & Cybersecurity: The Legal Perspective

**Module IV**

<table>
<thead>
<tr>
<th>Credits: 03</th>
<th>8 Hrs</th>
<th>8 Hrs</th>
<th>8 Hrs</th>
<th>8 Hrs</th>
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<tr>
<td>L: 03 Hrs/week</td>
<td>Modular Arithmetic</td>
<td>Elementary Cryptography</td>
<td>Security to Authenticity and Integrity</td>
<td>Cybercrimes &amp; Cybersecurity: The Legal Perspective</td>
</tr>
</tbody>
</table>

Case Studies of industry relevance/recent trends 5 Hrs

Text Books


Reference Books


Paper References:

1. Springer Nature, Published: 03 May 2022 Volume 9, pp 3759–3786, 2023 DOI
   https://doi.org/10.1007/s40747-022-00756-z
   https://doi.org/10.48550/arXiv.2301.07041

Relevant MOOCs

2. Forensic Linguistics Prof. Deepak Mashru National Forensic Sciences University (NI) https://onlinecourses.nptel.ac.in/noc24_hs88/preview

Other Resources/Links

3. https://ocw.mit.edu/courses/
| Teaching Scheme: |
| L: 03 Hrs/week | Credits: 03 |

| Examination Scheme: |
| ISE: 20 Marks | CIE:30 Marks |
| ESE:50 Marks |

| Prerequisite: | Mathematical foundations |

**Course Objectives:**

**Course intends to prepare the students**

1. To understand the philosophy of research in general.
2. To understand diverse aspects of research methodologies.
3. To enhance proficiency in both verbal and written presentation abilities.
4. To get familiar with Intellectual Property Rights (IPR) and plagiarism.

**Course Outcomes:**

At the end of the Course Students will be able to

1. **Understand** the significance of research and **develop** methodologies for collecting and analyzing data.
2. **Formulate** and **assess** hypotheses through experimentation.
3. **Design** and **write** a comprehensive research report.
4. **Identify** and **compare** various forms of intellectual property.

**Course Content**

<table>
<thead>
<tr>
<th>Module I</th>
<th>Introduction to RM, defining the research problem and research design</th>
</tr>
</thead>
</table>

- Why do research? Meaning, objectives, Research types: computer science and engineering applications specific to nature of research in system building, research process, Criteria of good research.
- Formulating a research problem: Selecting a research problem, Writing research Objectives.
- Conceptualizing a research design: Meaning, Need and Basic principles of research design.

<table>
<thead>
<tr>
<th>Module II</th>
<th>Literature survey, Data Collection and Sampling methods</th>
</tr>
</thead>
</table>

- Literature Survey: Importance, planning, locating relevant literature, managing information, and writing a review.
- Methods for primary and secondary data collection, data processing operations, measures for analyzing data, basics of sampling theory, concept of standard error, estimations on populations, determining sample size.

<table>
<thead>
<tr>
<th>Module III</th>
<th>Technical Content Writing</th>
</tr>
</thead>
</table>

- Report writing significance and steps.
- Types of technical content publishing: White paper, journal, conference, poster, short paper etc.
- Writing various technical papers: survey paper, journal paper, indexing agencies, COPE.

<table>
<thead>
<tr>
<th>Module IV</th>
<th>Intellectual Property Rights</th>
</tr>
</thead>
</table>

- Intellectual property: types of IP, IPR in India and abroad.
Steps in patenting: Searching prior art, preparing the patent application, claims, filing, prosecution, objections, appeal, issuance or rejection of patent. Plagiarism and Research ethics.
Research Tools: Plagiarism checking tools, Grammar checker tools

Discussion on research by eminent researchers and their research work with citation analysis and related patents and IPR

Case Studies of industry relevance/recent trends

Text Books

Reference Books

Paper References

Relevant MOOCs
1. Research Methodology : Prof. Edamana Prasad, Prof. Prathap Haridoss, IIT Madras https://onlinecourses.nptel.ac.in/noc24_ge21/preview
Research Methodology : Prof. Soumitro Banerjee, IISER Kolkata https://onlinecourses.nptel.ac.in/noc22_ge08/preview
2. Introduction to Statistical Hypothesis Testing: Dr. Arun Tangirala IIT Madras https://nptel.ac.in/courses/103106120
3. Roadmap for patent creation: Dr. Gouri Gargate IIT Kharagpur https://nptel.ac.in/courses/127105008

Other Resources/Links
2. IP India: http://www.ipindia.nic.in/
3. Cell For IPR Promotion and Management : http://cipam.gov.in/

MCE1-005 Program Elective Courses: I

<table>
<thead>
<tr>
<th>Teaching Scheme:</th>
<th>Examination Scheme:</th>
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<tbody>
<tr>
<td>L: 03 Hrs/week</td>
<td>ISE: 20 Marks</td>
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<td></td>
<td>CIE: 30 Marks</td>
</tr>
<tr>
<td></td>
<td>ESE: 50 Marks</td>
</tr>
<tr>
<td>Credits: 03</td>
<td></td>
</tr>
</tbody>
</table>

**Prerequisite:** Computer Networks, Data Communication, Wireless Sensor Network

**Course Objectives:**

Course intended to prepare the students:

1. To understand the fundamentals of embedded systems and IoT.
2. To learn methodologies for IoT application development.
3. To study architecture and protocol standards of IoT systems.
4. To learn real world application scenarios of IoT using real time example case studies.

**Course Outcomes:**

At the end of the Course Students will be able to:

1. **Summarize** the need of IoT and embedded systems.
2. **Illustrate** integration of sensors with embedded devices like Raspberry Pi/BBB/Arduino.
3. **Illustrate** and **compare** different IoT application layer protocols.
4. **Design** cloud based IoT applications using embedded devices.

**Course Contents**

**Module I**

<table>
<thead>
<tr>
<th><strong>Introduction to embedded systems and IoT</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Introduction to Embedded systems:</strong> Introduction to Embedded systems, Sensors and actuators, Challenges.</td>
</tr>
<tr>
<td><strong>IoT:</strong> Introduction, characteristics, application areas, Structure of IoT Applications and Functional blocks of IoT</td>
</tr>
<tr>
<td><strong>IoT enabling technologies:</strong> Cloud computing, Big data analytics, WSN, advantages and disadvantages of IoT with challenges.</td>
</tr>
</tbody>
</table>

8 Hrs

**Module II**

<table>
<thead>
<tr>
<th><strong>IoT Architectures and Components</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>IoT Architectures:</strong> Introduction, Functional View, Information View, Deployment and Operational View, Other Relevant architectural views.</td>
</tr>
<tr>
<td><strong>Hardware and software Components of IoT:</strong> Introduction to Arduino, Raspberry pi, NodeMCU, BBB and interfacing. Designing IoT applications using embedded devices.</td>
</tr>
</tbody>
</table>

8 Hrs

**Module III**

<table>
<thead>
<tr>
<th><strong>IoT Data Link Layer and Network Layer protocols</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>IoT reference model, IoT Levels and Deployment templates. Physical/Link Layer, IEEE802.15.4 and ZigBee, Low-power Wi-Fi, Bluetooth and BLE. Network Layer IP Based Protocols, The 6LoWPAN Adaptation Layer and RPL.</td>
</tr>
</tbody>
</table>

8 Hrs

**Module IV**

<table>
<thead>
<tr>
<th><strong>IoT application layer protocols</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Case Study:</strong> Home Automation system/Smart Irrigation system/remote health monitoring using IoT.</td>
</tr>
</tbody>
</table>

8 Hrs

**Case Study:** of industry relevance/recent trends

5 Hrs
# Text Books


# Reference Books


# Paper References


# Relevant MOOCs

2. Udemy: A Complete Course on an IOT system - Design and Development.
MCE1-005B Advanced Machine Learning

<table>
<thead>
<tr>
<th>Teaching Scheme:</th>
<th>Credits: 03</th>
<th>Examination Scheme:</th>
</tr>
</thead>
<tbody>
<tr>
<td>L: 03 Hrs./week</td>
<td></td>
<td>ISE: 20 Marks</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CIE: 30 Marks</td>
</tr>
<tr>
<td>Prerequisite:</td>
<td></td>
<td>ESE: 50 Marks</td>
</tr>
<tr>
<td>Mathematics, Data Mining.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Course Objectives:
Course intends to prepare the students
1. To understand basic concepts and possible applications of machine learning.
2. To study and illustrate various data preprocessing methods and Supervised, Unsupervised machine learning techniques.
3. To study the basic principles of reinforcement learning.
4. To understand the basic principles of optimization and its importance in machine learning.

Course Outcomes:
At the end of the Course Students will be able to:
1. Describe the basic concepts and possible applications of machine learning.
2. Apply classification, regression and clustering methods for real world applications for specified data.
3. Apply reinforcement algorithms to real world problems.

Course Contents

<table>
<thead>
<tr>
<th>Basics of Machine Learning and Regression</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Module I</strong></td>
</tr>
<tr>
<td><strong>Models of Machine learning</strong>: Geometric model, Probabilistic Models, Logical Models, Grouping and grading models, Parametric and non-parametric models</td>
</tr>
<tr>
<td><strong>Features</strong>: Concept of Feature, Feature Extraction, Feature Selection</td>
</tr>
<tr>
<td>Data Preprocessing and Dimensionality Reduction.</td>
</tr>
<tr>
<td><strong>Regression</strong>: Introduction, Multivariate Linear regression, Logistic regression, Lasso and Ridge Regression</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Classification and Clustering algorithms</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Module II</strong></td>
</tr>
<tr>
<td><strong>Classification</strong>: Classification concepts, Binary and multi-class classification, K nearest neighbor, Decision Tree Representation, Alternative measures for selecting attributes, ID3 algorithm, Naïve Bayes, Support Vector Machines as a linear and non-linear classifier.</td>
</tr>
<tr>
<td><strong>Ensemble methods</strong> – Introduction, Bagging, Boosting and Adaboost, Random Forest.</td>
</tr>
<tr>
<td><strong>Clustering</strong>: Introduction, Distance based clustering- K-means algorithm, Hierarchical Clustering-Agglomerative and Hierarchical, Expectation Maximization methods, Choosing number of clusters- silhouettes.</td>
</tr>
</tbody>
</table>

8 Hrs
8 Hrs
### Performance measure metric:
Mean Square Error, R-squared, Precision, Recall, F1-score, Accuracy.

<table>
<thead>
<tr>
<th>Module III</th>
<th>Reinforcement Learning</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Elements of Reinforcement Learning, Model-Based Learning, Dynamic programming, Monte Carlo, Temporal Difference Learning, Generalization. Bandit algorithms: Upper Confidence Bound algorithm.</td>
</tr>
<tr>
<td></td>
<td>Case Study: Incremental Document Classification</td>
</tr>
<tr>
<td>Module IV</td>
<td>Optimization Algorithms</td>
</tr>
<tr>
<td></td>
<td>Case Study: Stochastic Gradient Descent for Employee Attrition</td>
</tr>
</tbody>
</table>

### Module III
- **Reinforcement Learning**
  - Elements of Reinforcement Learning, Model-Based Learning, Dynamic programming, Monte Carlo, Temporal Difference Learning, Generalization. Bandit algorithms: Upper Confidence Bound algorithm.
  - Case Study: Incremental Document Classification

### Module IV
- **Optimization Algorithms**
  - Case Study: Stochastic Gradient Descent for Employee Attrition

### Text Books

### Reference Books

### Paper References
3. Taye, Mohammad Mustafa, “Theoretical Understanding of Convolutional Neural...

<table>
<thead>
<tr>
<th>Relevant MOOCs</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Introduction to Machine Learning by Sudeshna Sarkar IIT Kharagpur.</td>
</tr>
<tr>
<td>[<a href="https://nptel.ac.in/courses/106105152">https://nptel.ac.in/courses/106105152</a>]</td>
</tr>
<tr>
<td>2. Introduction to Machine Learning by Dr. Balaraman Ravindran, IIT Madras.</td>
</tr>
<tr>
<td>[<a href="https://nptel.ac.in/courses/106106139">https://nptel.ac.in/courses/106106139</a>]</td>
</tr>
<tr>
<td>3. Machine Learning with Python by IBM.</td>
</tr>
<tr>
<td>[<a href="https://cognitiveclass.ai/courses/machine-learning-with-python">https://cognitiveclass.ai/courses/machine-learning-with-python</a>]</td>
</tr>
<tr>
<td>[<a href="https://onlinecourses.nptel.ac.in/noc20_cs62/preview">https://onlinecourses.nptel.ac.in/noc20_cs62/preview</a>]</td>
</tr>
</tbody>
</table>
### MCE1-005C Natural Language Processing

<table>
<thead>
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<th>Teaching Scheme:</th>
<th>Credits: 03</th>
<th>Examination Scheme:</th>
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</thead>
<tbody>
<tr>
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<td>ISE: 20 Marks</td>
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<tr>
<td></td>
<td></td>
<td>CIE:30 Marks</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ESE:50 Marks</td>
</tr>
</tbody>
</table>

#### Prerequisite:

#### Course Objectives:

**Course intends to prepare the students**

1. To be familiar with fundamental concepts of Computational Linguistics.
2. To understand various text pre-processing methods like tagging, parsing and semantic analysis.
3. To study neural network models for processing of natural language.
4. To get acquainted with modern approaches and applications in Computational Linguistics.

#### Course Outcomes

**At the end of the course students will be able to**

1. **Apply** text processing techniques in NLP.
2. **Analyze** syntax and semantics of natural language data.
3. **Design** word embedding for neural language modeling.
4. **Design** machine translation and dialogue system.

#### Course Contents

<table>
<thead>
<tr>
<th>Module I</th>
<th>8 Hrs</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Introduction</strong></td>
<td></td>
</tr>
<tr>
<td>Introduction: Computing, Natural Language Processing and Linguistics, Stages of NLP</td>
<td></td>
</tr>
<tr>
<td>Text Pre-processing: sentence segmentation, Tokenization, feature extraction, issues in tokenization for different languages, word segmentation, text segmentation, normalization, case folding, Morphology, Stemming: Porters Algorithm, lemmatization.</td>
<td></td>
</tr>
<tr>
<td>Spelling correction - dynamic programming approach for finding edit distance, N-gram Language Modeling- context sensitive spelling correction probabilistic language model, auto completion prediction.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Module II</th>
<th>8 Hrs</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Tagging, Syntax and Semantics</strong></td>
<td></td>
</tr>
<tr>
<td>Sequence Labeling for Parts of Speech, HMM for speech tagging, Viterbi Algorithm, Conditional Random Fields.</td>
<td></td>
</tr>
<tr>
<td>Syntax: Constituency and dependency parsing, Constituency parser - Syntactic structure, Parsing methodology, Different parsing algorithms, Parsing in case of ambiguity, Probabilistic parsing, CKY algorithm, Issues in parsing, Dependency parsing- Syntactic structure, Parsing methodology, Transition-Based Dependency Parsing, Graph-Based dependency parsing, Evaluation, Co-reference resolution.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Module III</th>
<th>8 Hrs</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Neural Language Models, Large Language Models</strong></td>
<td></td>
</tr>
<tr>
<td>Overview of Machine Learning- Basics of Neural Networks, Feedforward neural</td>
<td></td>
</tr>
</tbody>
</table>
Network for NLP classification task, word embeddings, Recurrent Neural Networks (RNNs) as language model, Long short-term memory (LSTMs) network

Transformers-Self attention network, Large Language Models: with transformers, Generation by sampling, training transformer.

Fine-tuning and Masked language models: Bidirectional transformer encoders, training bidirectional encoders, fine tuning language models

**Applications - Machine Translation and Dialogue System**

- Language Divergences and Typology, Machine Translation using encoder decoder, Back-Translation, MT Evaluation
- Chatbots and Dialogue System: Properties of Human Conversation, Frame-Based Dialogue system, Chatbot, Dialogue system design
- Transfer learning via Prompting, Chain of Thought Prompting, Tree of Thought Prompting and Instruction Tuning, Retrieval Augmented Generation (RAG) techniques, Using vector datastore for RAG.

**Module IV**

**Text Books**


**Reference Books**


**Paper References**

M. Tech. (Computer Engineering) Curriculum Structure

With effect from the A.Y. 2024-25

(ICON), pages 11–16, Patna, India. NLP Association of India (NLPAI).


<table>
<thead>
<tr>
<th>Relevant MOOCs</th>
</tr>
</thead>
</table>
| 1. Course Title: Natural Language Processing Specialization offered by Kaiser, Coursera.  
  Link: [https://www.coursera.org/specializations/natural-language-processing](https://www.coursera.org/specializations/natural-language-processing)  |
| 2. Course Title: Applied Natural Language Processing offered by Swayam, NPTEL  
  Link: [https://onlinecourses.nptel.ac.in/noc20_cs87/preview](https://onlinecourses.nptel.ac.in/noc20_cs87/preview)  |

<table>
<thead>
<tr>
<th>Other Resources/Links</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. <a href="https://www.ibm.com/topics/instruction-tuning">https://www.ibm.com/topics/instruction-tuning</a></td>
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<tr>
<td>Teaching Scheme:</td>
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<tr>
<td>Credits:03</td>
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</tbody>
</table>

**Prerequisite:** Fundamentals of Operating System

**Course Objectives:**

Course intends to prepare the students

1. To understand Characteristics and Challenges of distributed systems.
2. To learn process management in distributed operating systems.
3. To study various strategies of Shared Memory and Inter process Communication.
4. To understand Design Principles of Distributed File Management.

**Course Outcomes:**

At the end of the Course Students will be able to:

1. **Analyze** the challenges in distributed OS.
2. **Demonstrate** the process of communication and synchronization.
3. **Design** application to retrieve the data stored in distributed Memory.
4. **Compare** different File Systems.

**Course Contents**

<table>
<thead>
<tr>
<th>Module I</th>
<th>Introduction to Distributed Operating System</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Fundamentals: Characteristics and challenges of distributed systems. Design issues in distributed operating systems; Architectural models, Desirable features of good global scheduling algorithms, Task Assignment Approach, Load-Balancing Approach, Load-Sharing Approach</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Module II</th>
<th>Process Management and Synchronization</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Threads and Process, Process States, Scheduling in DOS, Process Migration, Synchronization: Clock Synchronization, Event Ordering, Mutual Exclusion, Deadlock, Election Algorithms</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Module III</th>
<th>Distributed Shared Memory</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Module IV</th>
<th>Distributed File System and Naming</th>
</tr>
</thead>
<tbody>
<tr>
<td>Case Study:</td>
<td>File Management in Linux/Windows/Android (EoS)/Andrew File System File Handling System Call implementation in Rust. Real Time Linux(RT Linux).</td>
</tr>
<tr>
<td></td>
<td>Case study of industry relevant /recent trends</td>
</tr>
</tbody>
</table>

8 Hrs

8 Hrs

8 Hrs

8 Hrs

5 Hrs
## Text Books

## Reference Books

## Paper References

## Relevant MOOCs
1. Cloud Computing and Distributed Systems, Dr. Rajiv Mishra IIT Patna [https://nptel.ac.in/courses/106104182](https://nptel.ac.in/courses/106104182)
2. Distributed Systems Dr. Rajiv Mishra IIT Patna [https://nptel.ac.in/courses/106106168](https://nptel.ac.in/courses/106106168)

## Other Resources/Links
[https://www.rust-lang.org/](https://www.rust-lang.org/)
### MCE1- 006 Laboratory Proficiency - I

<table>
<thead>
<tr>
<th>Teaching Scheme:</th>
<th>Credits: 02</th>
<th>Examination Scheme:</th>
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<tr>
<td>P: 04 Hrs/week</td>
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<td>CIE/TW: - 25</td>
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<tr>
<td></td>
<td></td>
<td>ESE(OR):-25</td>
</tr>
</tbody>
</table>

#### Prerequisite Courses:
Knowledge of programming languages, Basics of Python/R

#### Course Objectives:
**Course intends to prepare the students**

1. To explore graph theory in computational problem-solving.
2. To use descriptive statistical measures for conducting statistical inference.
3. To choose appropriate algorithmic strategies while solving problems.
4. To explore Multithreaded and Distributed Algorithms.
5. To learn various data storage methods on cloud.
6. To develop IoT applications utilizing embedded devices.
7. To study supervised machine learning techniques.
8. To explore methods for representing and retrieving text documents.
9. To gain insight into the behavioral patterns and profiles of web users.
10. To explore different approaches to Shared Memory and Inter-process Communication.
11. To comprehend the fundamental principles behind designing Distributed File Management systems.
12. To engineer security solutions tailored for real-world applications.

#### Course Outcomes:
**At the end of the Course Students will be able to**

1. **Apply** Graph theory for problem modeling and resolution.
2. **Analyze** population characteristics through central tendency, dispersion, and relationships.
3. **Apply** problem-solving skills to address real-world business challenges and decision-making scenarios.
4. **Implement** Multithreaded and Distributed Algorithms to solve given problems.
5. **Use** appropriate data storage techniques on Cloud, based on Cloud application.
6. **Implement** IoT applications leveraging embedded devices.
7. **Apply** classification and regression methods for real world applications.
8. **Evaluate** methods for representing and retrieving text documents.
9. **Design** web user behavioral patterns and profiles through the analysis of web transactions.
11. **Develop** an application for accessing data stored across distributed environments.
12. **Apply** cryptographic techniques and tools for problem-solving applications.

All assignments are compulsory. Each student should implement the assignment individually. Laboratory teachers should make sure that the dataset/code/write up is not the same.

#### Mathematical foundations for Computing

1.  
   a. Write a program to represent users’ information in social networks using graphs. Find the number of associations of each user.
   
   OR
   
   b. Design an algorithm to organize the sequence of courses within engineering programs, leveraging graph theory to account for the prerequisite dependencies among courses.

2. Write a program in the language of your choice to calculate measures of central tendency.
### M. Tech. (Computer Engineering) Curriculum Structure

With effect from the A.Y. 2024-25

<table>
<thead>
<tr>
<th>Advanced Algorithm</th>
</tr>
</thead>
</table>
| 1. a) Write a program to find the longest common subsequence using dynamic programming.  
    OR  
    b) Design an algorithm for randomized quicksort to mitigate the worst-case time complexity of conventional Quicksort. |
| 2 a) Design and implement a multithreaded merge-sort algorithm.  
    OR  
    b) Given a social network represented as a graph, where nodes are users, and edges represent connections (friendship). Write a program to find the shortest path between two users using appropriate algorithms. |

<table>
<thead>
<tr>
<th>IoT Architecture &amp; Protocols</th>
</tr>
</thead>
</table>
| 1. Design and develop a home automation security system using embedded devices.  
  2. Design and develop a remote health monitoring system using IoT devices and ThingSpeak cloud. |

<table>
<thead>
<tr>
<th>Information security</th>
</tr>
</thead>
</table>
| 1. Implement the Diffie-Hellman Key Exchange mechanism using HTML & JavaScript. Consider the end user as one of the parties (Alice) & the JavaScript application as another party (bob). Also demonstrate MITM (man in the middle attack) on it  
   1. a) Write a program for Elliptic curve cryptography.  
      OR  
      b) Write a program to apply Advanced Encryption Standard (AES) Algorithm for a practical application like URL Encryption |

<table>
<thead>
<tr>
<th>Machine Learning</th>
</tr>
</thead>
</table>
| 1. Download Email spam classification dataset from Kaggle [https://www.kaggle.com/datasets/balaka18/email-spam-classification-dataset-csv](https://www.kaggle.com/datasets/balaka18/email-spam-classification-dataset-csv)  
  Email Spam detection has two states: a) Normal State – Not Spam, b) Abnormal State – Spam. Use K-Nearest Neighbors and Support Vector Machine to classify the email. Extract confusion matrix from the test results and compare the performance of both.  
  2. Download Housing Rent Prediction Dataset from Kaggle and predict the house rent using regression. [https://www.kaggle.com/datasets/jamsouravbanerjee/house-rent-prediction-dataset/](https://www.kaggle.com/datasets/jamsouravbanerjee/house-rent-prediction-dataset/) |

<table>
<thead>
<tr>
<th>Natural Language Processing</th>
</tr>
</thead>
</table>
| 1. Implement complete natural language processing pipeline for Indic language text input.  
  2. Implement Conversational interface (chatbot) using python. |

<table>
<thead>
<tr>
<th>Distributed Operating System</th>
</tr>
</thead>
</table>
| 1. Develop a program in C or Rust to implement Process Management System Calls, which enable the creation, manipulation, and control of processes within an operating system environment.  
  2. Design and implement a Distributed File System (DFS) like Hadoop Distributed File System (HDFS), capable of storing and managing large volumes of data across multiple nodes in a distributed environment.  
  3. Mini Project (Based on Core and Elective) |
MCE1- 007 Research and Technical Communication Lab

<table>
<thead>
<tr>
<th>Teaching Scheme:</th>
<th>Credits: 01</th>
<th>Examination Scheme: CIE/TW:- 25</th>
</tr>
</thead>
</table>

Prerequisite Courses: Basic statistics

Course Objectives:
Course intends to prepare the students
1. To understand research papers.
2. To formulate research questions and hypotheses and derive research objectives.
3. To enhance proficiency in both verbal and written presentation abilities.
4. To get familiar with research proposals and patent writing.

Course Outcomes:
At the end of the Course Students will be able to
1. Analyse the published research paper.
2. Analyse research data using relevant statistical techniques.
3. Interpret the research findings.
4. Apply research findings through written reports and oral presentations.

1. Reviewing Research papers
   a. Write a set of research questions for the case study of your interested topic. Construct the set of research objectives from the set of questions.
   b. Utilize academic search tools to extract pertinent journal papers. Engage in comprehensive reading of the paper, focusing on the following aspects: major contribution, datasets utilized, methodology employed, analysis and outcomes, conclusions drawn, and any limitations identified. Post-review, articulate the research question believed to have been addressed by the author. Evaluate whether the paper effectively substantiates its conclusions in addressing the question.

2. Literature Review Quality and research proposal
   a. Select a journal paper within your engineering discipline and provide a detailed summary of its literature review section, comprising 400 to 500 words. Evaluate the quality and relevance of the papers cited within the review, assessing the commentary on their contributions to the broader field. Additionally, analyze any notable omissions of papers that hold significant importance within the field.
   b. Craft a new research proposal based on insights gleaned from a chosen published journal paper. Focus specifically on scrutinizing the discussion and conclusion sections of the paper to identify suggestions for future research endeavors.

3. Data modeling and statistical review
   a) Download a set of weather data from the Internet covering the temperature and atmospheric pressure over a five days period. Present the data using 2D and 3D plots, and so deduce if the weather conditions are trending either higher or lower over these five days period.
   b) Numerical modeling: Find a research paper that employs numerical modeling to validate experimental findings. Compare and contrast the differences observed between the experimental and modeling results. Evaluate whether the authors have provided insights into the accuracy of both the experimental and modeling methodologies. Provide recommendations for enhancing the quality of the modeling techniques presented in the paper.
   c) Statistical review: Within your engineering domain, examine a published paper incorporating statistical analysis. Draft a concise report delineating the statistical methods employed. Proposed enhancements to the statistical analysis. Recommend additional parameters that
could have been captured during data acquisition and elucidate how to analyze the comprehensive dataset to ascertain the influence and statistical significance of these supplementary measurements.

4. Research Paper analysis
   1. Note the keywords and type them into one of the web-based academic search engines (e.g. googlescholar.com).
      i. Does the original article appear in the search results?
      ii. Compare the citations of this paper with those from the most highly cited paper in the search results?
      iii. If this paper was published before your original article, is it cited in your article? Do you think this high-cited paper should have been listed as a reference in your original article? Give reasons for your decision.
   2. How many citations does this article have?
   3. Have the same authors published further work in this field?
      i. How many citations does this highly cited article have?

5. Research proposal: Generate a novel research proposal based on an existing published journal paper by following these steps:
   a. Begin with an introduction that outlines the research problem and objectives.
   b. Provide background information and rationale to contextualize the proposed research.
   c. Detail the methodology, including research design, data collection methods, and analytical techniques.
   d. Write a research plan and budget requirements.
   e. Summarize the conclusions drawn from the existing paper and propose areas for future research.
   f. Compile a bibliography listing all the references cited in the proposal.

6. Patent claims identification
   Examine a journal article within your field that was published around five years ago. Analyze the paper's key findings and identify significant outcomes. Structure these outcomes in a format akin to patent claims, ensuring they represent novel advancements not readily deduced from prior research.
SCTR’S PUNE INSTITUTE OF COMPUTER TECHNOLOGY, PUNE-43  
M. Tech. (Computer Engineering) Curriculum Structure  
With effect from the A.Y. 2024-25

<table>
<thead>
<tr>
<th>MCE1- 008 Programming Proficiency Lab</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Teaching Scheme:</strong></td>
</tr>
<tr>
<td>P: 02 Hrs/Week</td>
</tr>
</tbody>
</table>

**Prerequisite Courses:** Basic programming

**Course Objectives:**

**Course intends to prepare the students**

1. To study Python/R programming.
2. To study use of Python/R programming in various Applications such as File Handling, Web Scraping, Data Preprocessing, Data Visualization, Natural Language Processing, Machine Learning, Graphical User Interface.
3. To explore functions in Python/R for evaluating performance of the designed model.

**Course Outcomes:**

**At the end of the Course Students will be able to**

1. **Apply** Python/R programming in various domains such as File Handling, Web Scraping, Data Preprocessing, Data Visualization, Natural Language Processing, Machine Learning, Graphical User Interface etc.
2. **Implement** a program for Data Preprocessing and Data visualization.
3. **Develop** GUI in Python/R/Java Programming.
4. **Analyze** the performance of the designed model.

**1.**
A. Write a program to list all regional language names and number of related articles in the order they appear on wikipedia.org.
B. Write a program to download all the images from a given webpage url.

**2.**
A. Write a program to perform various data preprocessing operations such as handling missing values, one hot encoding, label encoding & data normalization on the following dataset. Dataset: https://rb.gy/ppmxxv
B. Write a program to reduce the number of features in the following dataset while preserving most of the important information. Use techniques such Principal Component Analysis (PCA), t-distributed Stochastic Neighbor Embedding (t-SNE), or feature selection methods like Recursive Feature Elimination (RFE) for this purpose. Dataset: https://shorturl.at/aejsM.

**3.**
A. Write a program to visualize educational data such as student performance, attendance, and learning outcomes to identify areas for improvement, track progress over time, and personalize learning experiences.
B. Design a data visualization dashboard to analyze the monthly sales performance of a retail store over the past year. The dashboard should include visualizations of total sales, average sales per day, and sales trends over time. Additionally, it should identify the best and worst performing months and provide insights into factors affecting sales fluctuations.

**4.**
A. Write a program to explore different tokenization techniques such as whitespace tokenization, word tokenization, or sentence tokenization.
B. Write a program to implement the Porter Stemmer algorithm for Stemming.

**5.**
A. Write a program to predict the house price using a regression algorithm in machine
With effect from the A.Y. 2024-25

learning. Evaluate the performance of the model using various performance metrics such as Mean Absolute Error (MAE), Mean Squared Error (MSE), Huber Loss & R2 score. Link to dataset: https://rb.gy/ppmnxv

B. Write a program to split the Iris flower dataset into 80% train data and 20% test data. Fit the data into the Naive Bayes model for training and testing. Plot the Confusion Matrix. Evaluate the performance using various performance metrics such as Accuracy, Precision, Recall & F1 Score

6.

A. Write a program to design a BMI (Body Mass Index) calculator application using tkinter library in Python / shiny library in R where users can input their height and weight, and the application calculates and displays their BMI along with a corresponding interpretation (e.g., underweight, normal weight, overweight).

B. Build a simple calculator application using the tkinter library in Python / shiny library in R that performs basic arithmetic operations such as addition, subtraction, multiplication, and division. The application should have a user interface with buttons for numeric input and operations. (Graphical User Interface)

Text Books


Reference Books


Relevant MOOCs Courses

1. SWAYAM - Programming in Python by Dr. Rizwan Rehman, Dibrugarh University. https://onlinecourses.swayam2.ac.in/cec22_cs20/preview


4. NPTEL - Introduction to R Software by Prof. Shalabh | IIT Kanpur https://onlinecourses.nptel.ac.in/noc19_ma33/preview

5. Getting Started with Competitive Programming,IIT Gandhinagar https://nptel.ac.in/courses/106106231
Semester II
Semester II

<table>
<thead>
<tr>
<th>MCE2-009 Cloud Computing</th>
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<tbody>
<tr>
<td><strong>Teaching Scheme:</strong></td>
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<td>L: 03 Hrs/week</td>
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<tr>
<td><strong>Credits:</strong> 03</td>
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</tbody>
</table>

**Prerequisite:** Knowledge of data structures, networking, and operating systems.

**Course Objectives:**
- To study fundamental concepts of cloud computing.
- To understand the implementation of virtualization in cloud computing.
- To learn the application and security of cloud computing.
- To study risk management in cloud computing.
- To understand the advanced technologies in cloud computing.

**Course Outcomes:**
- Compare private, public and hybrid cloud computing environments.
- Analyze KVM, XEN virtualization technology.
- Analyze security issues in AWS services.
- Evaluate DevOps application using Docker and Container tools.
- Develop reusable, maintainable, and scalable infrastructure Code by Terraform.

**Course Contents**

<table>
<thead>
<tr>
<th>Module I</th>
<th>Fundamentals of Cloud Computing</th>
<th>8 Hrs</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Overview of cloud computing concepts. Types of cloud services: IaaS, PaaS, SaaS</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Advantages and disadvantages of cloud computing. cloud services: IaaS, PaaS, SaaS and basic cloud security.</td>
<td></td>
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<tr>
<td></td>
<td>Public, private, and hybrid cloud community cloud Multi-cloud and Inter-cloud strategies.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>AWS Fundamentals:- Overview of Amazon Web Services (AWS) Setting up an AWS account. Overview of AWS services (EC2, S3, RDS, VPC, IAM)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Module II</th>
<th>AWS Databases and Networking and Security</th>
<th>8 Hrs</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>AWS Databases:- EC2 (Elastic Compute Cloud) for virtual servers, S3 (Simple Storage Service) for object storage, EBS (Elastic Block Store) for block storage, RDS (Relational Database Services), Network and Security:-VPC (Virtual Private Cloud) for networking, IAM (Identity and Access Management) for security, Security Groups and Network ACLs, Auto Scaling and Load balancing.</td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Module III</th>
<th>Mastering DevOps</th>
<th>8 Hrs</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>DevOps Basics and Introduction to Docker:- Understanding DevOps principles and practices: Version Control Systems (e.g., Git)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Introduction to Docker and containerization, Docker architecture and components</td>
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</tr>
<tr>
<td></td>
<td>Implementing Docker, Docker for networking and storage, Docker Compose for multi-container applications.</td>
<td></td>
</tr>
</tbody>
</table>
### Module IV

<table>
<thead>
<tr>
<th><strong>Infrastructure as Code (IaC) and Terraform</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduction to Infrastructure as Code (IaC) with Terraform - Terraform syntax and configuration files- Provisioning and managing infrastructure resources with Terraform - Terraform state management and workspaces- Best practices for using Terraform in production environments.</td>
</tr>
<tr>
<td>Case Study: Implementing Virtual Machine Replication using KVM, Xen.</td>
</tr>
</tbody>
</table>

### Text Books


### Reference Books


### Paper References


### Relevant MOOCs

[https://nptel.ac.in/courses/106104182](https://nptel.ac.in/courses/106104182)

### Other Resources/Links -

**Prerequisite:** Machine Learning.

**Course Objectives:**
Course intends to prepare the students
1. To understand the basics of deep neural networks.
2. To understand the convolution and recurrent neural networks.
3. To get insights into deep generative models.
4. Selection of an effective deep learning model.

**Course Outcomes:**
At the end of the Course Students will be able to:
1. **Develop** deep learning applications using TensorFlow, Keras, PyTorch.
2. **Analyze** the bias variance tradeoff and its impact on model performance.
3. **Apply** Padding, Strides and Local Response Normalization techniques to enhance model performance.
4. **Compare** bidirectional RNN, Encoder and Decoder sequence models.
5. **Develop** GAN application using google TF-GAN Library.

**Course Contents**

<table>
<thead>
<tr>
<th>Module</th>
<th>Content</th>
<th>Hrs</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td><strong>Foundations of Deep learning</strong></td>
<td>8</td>
</tr>
<tr>
<td></td>
<td><strong>Case Study:</strong> TensorFlow, Keras, PyTorch, Caffe, Shogun.</td>
<td></td>
</tr>
<tr>
<td>II</td>
<td><strong>Deep Neural Networks (DNNs)</strong></td>
<td>10</td>
</tr>
<tr>
<td></td>
<td><strong>Case Study:</strong> Applications of Deep Neural Networks.</td>
<td></td>
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<tr>
<td>III</td>
<td><strong>Convolution Neural Network (CNN)</strong></td>
<td>8</td>
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</tbody>
</table>
### Module IV

<table>
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</thead>
<tbody>
<tr>
<td><strong>Recurrent Neural Networks (RNN)</strong></td>
<td>Case Study: Evaluation of Training and Analysis of a Convolutional Network.</td>
</tr>
<tr>
<td>Unfolding Computational Graphs, Recurrent Neural Networks, Bidirectional RNNs, Encoder-Decoder Sequence-to-Sequence Architectures, Recursive Neural Networks, The Challenge of Long-Term Dependencies, Echo State Networks, Leaky Units and Other Strategies for Multiple Time Scales, The Long Short-Term Memory and Other Gated RNNs. Deep Generative Models: Introduction to deep generative model, Boltzmann Machine, Restricted Boltzman Machines, Binary RBM and Gaussian RBM, Deep Belief Networks, Generative adversarial network (GAN), Identify problems that GANs can solve discriminator network, generator network, types of GAN, the advantages and disadvantages of common GAN loss functions.</td>
<td>5 Hrs</td>
</tr>
<tr>
<td><strong>Case studies:</strong> Applications of CNN and RNN models for various computer vision and Natural Language Processing (NLP) problems. Applications of GAN networks using Google TF- GAN Library</td>
<td></td>
</tr>
</tbody>
</table>

### Text Books

### Reference Books

### Paper References


**Relevant MOOCs Course**

<p>| | |</p>
<table>
<thead>
<tr>
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<tbody>
<tr>
<td>2.</td>
<td><a href="https://onlinecourses.nptel.ac.in/noc22_cs22/preview">https://onlinecourses.nptel.ac.in/noc22_cs22/preview</a>.</td>
</tr>
</tbody>
</table>

**Other Resources/Links**

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</table>
MCE2-011 Program Electives II

MCE2-011A Edge Computing and IoT Application

<table>
<thead>
<tr>
<th>Teaching Scheme:</th>
<th>Credits: 03</th>
<th>Examination Scheme:</th>
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</thead>
<tbody>
<tr>
<td>L: 03 Hrs/week</td>
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<td>ISE: 20 Marks</td>
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<td></td>
<td></td>
<td>CIE: 30 Marks</td>
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<td></td>
<td></td>
<td>ESE: 50 Marks</td>
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</tbody>
</table>

**Prerequisite:** Computer Networks, Internet of things (IoT)

**Course Objectives:**
Course intends to prepare the students
1. To understand and compare working principles of cloud, edge and fog computing.
2. To study edge computing architectures and enabling technologies.
3. To study real-world use cases of edge computing in IoT including autonomous vehicles, industrial automation, and smart cities.

**Course Outcomes:**
At the end of the course students will be able to
1. **Differentiate** between edge, fog and cloud computing in the context of IoT applications.
2. **Design** the architecture of edge-enabled systems for IoT applications.
3. **Design** applications in cloud-edge-IoT environments.
4. **Demonstrate** different deployment models, such as fog computing, mobile edge computing.

**Course Contents**

<table>
<thead>
<tr>
<th>Module</th>
<th>Fundamentals of Edge Computing</th>
<th>Edge and Fog Computing Architectures</th>
<th>Enabling Technologies for Edge Computing</th>
<th>Advanced Topics in Edge Computing &amp; IoT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Module I</td>
<td>Overview of cloud, edge and fog computing, cloud computing architectures, SaaS, PaaS, EaaS, limitations of cloud supported IoT applications, advantages and applications of edge computing, edge computing architectures, challenges and limitations of edge computing, recent trends in edge computing, Cloud-Edge-Fog comparison.</td>
<td>Evolution of IoT edge computing capabilities, edge-IoT integration, mapping of Edge Computing Architectures (ECA) to IoT layer models, ECA and IoT limitations and challenges, introduction to edge devices, overview of fog computing, fog computing architectures, characteristics of fog computing, applications, limitations, and challenges of fog computing, fog computing platforms.</td>
<td>Introduction to MQTT and Kafka for end-to-end edge pipeline, containerization at the edge, cloudlet, mobile edge computing, machine learning for edge: sensor data in predictive maintenance, image classifier and self-driving cars.</td>
<td>Security concerns in edge computing, lightweight edge clouds, Cloud-Fog-Edge enabled analytics, edge and fog intelligence, cognitive IoT applications using edge and fog computing for vision, speech, text.</td>
</tr>
</tbody>
</table>

Case study: Case study of industry relevance / Recent trend 8 Hrs
Text Books

Reference Books

Paper Reference

Relevant MOOCs
1. Edge Computing, Prof. Rajiv Misra, IIT Patna
   https://onlinecourses.nptel.ac.in/noc24_cs66/preview

Other Resources/Links
1. Edge computing technologies for Internet of Things: a primer - ScienceDirect
2. Edge-Computing Architectures for Internet of Things Applications: A Survey - PMC (nih.gov)
3. Edge computing technologies for Internet of Things: a primer (sciedirectassets.com)
4. Shaping the Future of IoT with Edge Intelligence | How Edge Computing (taylorfrancis.com)
5. Fog computing security challenges and future directions - IEEE Xplore Full-Text PDF
7. Edge-Computing Architectures for Internet of Things Applications: A Survey - PMC (nih.gov)
### MCE2-011B Information Retrieval and Web Mining

<table>
<thead>
<tr>
<th>Teaching Scheme:</th>
<th>Examination Scheme:</th>
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</thead>
<tbody>
<tr>
<td>L: 03 Hrs/week</td>
<td>ISE: 20 Marks</td>
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<td>CIE: 30 Marks</td>
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<tr>
<td></td>
<td>ESE: 50 Marks</td>
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<tr>
<td>Credits: 03</td>
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</tbody>
</table>

**Prerequisite:** Database Management System, Data Structures and Algorithms, Probability and statistics

**Course Objectives:**

**Course intends to prepare the students**

1. To explore various document representation and retrieval methods.
2. To understand query formulation, evaluation and feedback relevance.
3. To study Supervised and Unsupervised learning Method for text analysis and retrieval.
4. To understand behavioral patterns and profiles of web users.

**Course Outcomes:**

**At the end of the Course Students will be able to**

1. **Apply** and **analyze** various document representation and retrieval methods.
2. **Evaluate** language model and query performance for information retrieval.
3. **Apply** classification and clustering methods on text documents and evaluate the performance.
4. **Identify**, **assess**, and **design** behavioral patterns and profiles of the web by studying web user transactions.

### Course Contents

**Module I**

<table>
<thead>
<tr>
<th>Introduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overview of text retrieval systems: Boolean retrieval, the term vocabulary and postings list, Dictionaries and tolerant retrieval, Index construction and compression, Retrieval models and implementation: Vector Space Models, Vector Space Model, TF-IDF Weight. Case Study: Information retrieval and question answering: A case study on COVID-19</td>
</tr>
</tbody>
</table>

**Module II**

<table>
<thead>
<tr>
<th>Language Models, Query Expansion and feedback evaluation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Probabilistic models: statistical language models, Okapi/BM25, Language models for information retrieval, KL-divergence, Smoothing, Query expansion and feedback: Relevance feedback, pseudo relevance feedback, Query Reformulation, Computing scores in a complete search system, Evaluation in information retrieval.</td>
</tr>
</tbody>
</table>

**Module III**

<table>
<thead>
<tr>
<th>Text classification &amp; Text clustering</th>
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</table>

**Module IV**

<table>
<thead>
<tr>
<th>Social Network Analysis &amp; Web usage Mining</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Social Network Analysis:</strong> Centrality, Prestige, Co-Citation and Bibliographic Coupling: Co-Citation, Bibliographic Coupling, Page Ranking: PageRank Algorithm, Strengths and Weaknesses of PageRank, Timed PageRank and Recency Search.</td>
</tr>
</tbody>
</table>

**8 Hrs**
Text Books


Reference Books


Paper References


Relevant MOOCs Course

1. Business Analytics & Text Mining Modeling Using Python by Dr. Gaurav Dixit IIT Roorkee https://onlinecourses.nptel.ac.in/noc19_mg47/preview

2. Natural Language processing : Prof. Pushpak Bhattacharyya IIT Bombay https://nptel.ac.in/courses/106101007

Other Resources/Links

1. C.J. Rijsbergen, "Information Retrieval,” (http://www.dcs.gla.ac.uk/keith/Preface.html)

2. Special interest group on Information retrieval (https://dl.acm.org/sig/sigir)


MCE2-011C Multimodal Computing

<table>
<thead>
<tr>
<th>Teaching Scheme:</th>
<th>Examination Scheme:</th>
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<tbody>
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<td>L: 03 Hrs/week</td>
<td>ISE: 20 Marks</td>
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<td>CIE: 30 Marks</td>
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<td>ESE: 50 Marks</td>
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<td>Credits: 03</td>
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</table>

Prerequisite: Basics of data structure, Algorithms, Programming

Course Objectives:
Course intends to prepare the students
1. To introduce fundamentals of multimodal computing.
2. To elaborate different multimodal learning paradigms.
3. To learn and analyze different multimodal learning strategies.

Course Outcomes:
At the end of the Course Students will be able to:
1. Comprehend complex concepts better when exposed to multiple modalities.
2. Apply knowledge across contexts with deeper understanding.
3. Express themselves using various mediums, improving communication skills.

Course Contents

<table>
<thead>
<tr>
<th>Module I</th>
<th>Introduction to Multimodal computing</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Multimodality introduction, Overview of human communication practices from a multimodal perspective, need of multimodal computing, Need of Multimodal Behaviors &amp; signals, Modes of Multimodal Learning (speech, audio, written and print, illustrations), Multimodal Machine learning and Artificial Intelligence, Applications of MM, Limitations of MM.</td>
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<td>8 Hrs</td>
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<table>
<thead>
<tr>
<th>Module II</th>
<th>Text Processing in Multimodal computing</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Overview of text processing techniques-tokenization, stemming, lemmatization, handling noisy and unstructured text.NLP fundamentals, large language models (BERT, GPT), Multimodal fusion methods, Visual text analysis, transfer learning across modalities, Applications.</td>
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<thead>
<tr>
<th>Module III</th>
<th>Speech Processing in Multimodal computing</th>
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<tbody>
<tr>
<td></td>
<td>Overview of speech processing, Digital Signal processing basics, STFT (Short time Fourier transform). Acoustic Phonetics and Articulatory Phonetics, Speech Prosody, Speech Prosody Modeling (Fujisaki Model) Automatic speech recognition- Hidden Markov models, Speech synthesis -text to speech and speech to text, applications.</td>
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<td>8 Hrs</td>
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<table>
<thead>
<tr>
<th>Module IV</th>
<th>Image &amp; Video processing in Multimodal computing</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Overview of multimodal learning and visual data, Image Representation ways-pixel values, histograms, deep features, Extraction of features from images using CNN activations, texture descriptors, applications, limitations. Overview of video processing in MM, Video compression, motion estimation, temporal modeling, video denoising, stabilization, summarization techniques, applications, case studies.</td>
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<td>8 Hrs</td>
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<table>
<thead>
<tr>
<th>Case Studies of industry relevance/recent trends</th>
</tr>
</thead>
</table>

5 Hrs
Text Books


Reference Books


Paper References


Relevant MOOCs Course

1. Digital Speech Processing - Course (nptel.ac.in) Prof. Shyamal Kumar Das Mandal ,IIT Kharagpur

Other Resources/Links

1. An Introduction to Multimodal Models - Comet
3. Chapter 3 Multimodal architectures | Multimodal Deep Learning (slds-lmu.github.io)
4. Multimodal Learning | SpringerLink
5. Multimodal interaction: A review - ScienceDirect
# MCE2-011D Advanced Compilers

<table>
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<tr>
<th>Teaching Scheme:</th>
<th>Examination Scheme:</th>
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<tbody>
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<td>CIE: 30 Marks</td>
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<tr>
<td></td>
<td>ESE: 50 Marks</td>
</tr>
<tr>
<td>Credits :03</td>
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</tbody>
</table>

**Prerequisite:** Knowledge of Automata Theory and Languages

**Course Objectives:**

Course intends to prepare the students

1. To understand the structure of compilers.
2. To learn different ways of intermediate representation and Code generations.
3. To learn the optimization methods and LLVM framework.

**Course Outcomes:**

At the end of the Course Students will be able to:

1. **Understand** the architecture of advanced compilers, including the various phases of compiler.
2. **Apply** advanced parsing techniques to analyze and transform source code.
3. **Apply** optimization techniques to enhance the performance of generated code.
4. **Analyze** how semantic errors impact program behavior and correctness.
5. **Evaluate** the effectiveness of different compiler optimization strategies in terms of code size, speed, and memory usage.
6. **Design** and **Implement** a compiler for a specific language, incorporating advanced features and optimizations.
7. **Understand** the basic workflows and concepts associated with using LLVM tool.

**Course Contents**

<table>
<thead>
<tr>
<th>Module I</th>
<th>Introduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overview of compilation. Phases of Compiler, Lexical Analysis, Syntax analysis, Different types of Parsers. Predictive Parsing, LR parsing, Using Parser Generators, Parser error recovery. Semantic analysis: Type checking. Type checking Declaration and Expressions. Syntax-directed translation.</td>
<td>8 Hrs</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Module II</th>
<th>Intermediate Representations and Code Generation</th>
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<table>
<thead>
<tr>
<th>Module III</th>
<th>Code Optimization</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intro to code optimization. DFA basics. Program representations for optimization. SSA form. SSA-enabled optimizations: conditional constant propagation, value numbering, partial redundancy elimination. SSA construction and destruction algorithms.</td>
<td>8 Hrs</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Module IV</th>
<th>Types of Compilation and LLVM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Just in-time Compilation, Garbage collection in Compiler, Parallelizing Compilers, Domain Specific Language Compilation. Intro to LLVM framework, Hands on Exercise with LLVM, Custom Compiler development using LLVM. Case study: Recent trends in compiler design for high performance computing and message passing machines and scalable shared</td>
<td>8 Hrs</td>
</tr>
<tr>
<td>memory machines.</td>
<td>Case study: Compiler design for high performance computing and message passing machines and scalable shared memory machines</td>
</tr>
<tr>
<td>-----------------</td>
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</tr>
<tr>
<td>Case Studies of industry relevance/recent trends</td>
<td><strong>5 Hrs</strong></td>
</tr>
</tbody>
</table>

**Text Books**


**Reference Books**


**Paper References:**


**Relevant MOOCs**

1. Compiler design, Prof. Santanu Chattopadhyay, IIT Kharagpur [https://onlinecourses.nptel.ac.in/noc21_cs07/preview](https://onlinecourses.nptel.ac.in/noc21_cs07/preview)
## MCE2-011E Applied Security

<table>
<thead>
<tr>
<th>Teaching Scheme:</th>
<th>Credits: 03</th>
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<tr>
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<table>
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<tr>
<th>Examination Scheme:</th>
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<tr>
<td>ISE: 20 Marks</td>
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<tr>
<td>CIE: 30 Marks</td>
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<tr>
<td>ESE: 50 Marks</td>
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</tbody>
</table>

**Prerequisite:** Basics of computer Network Model, Information Security

### Course Objectives:

**Course intends to prepare the students**

1. To State controls to protect against program flaws in execution– operating system support & administrative control
2. To learn about security threats posed by e–mails.
3. To learn Tools used in Computer Forensics and Cyber Applications.
4. To identify various challenges in real-world applications of Blockchain.

### Course Outcomes:

**At the end of the Course Students will be able to:**

1. **Summarize** countermeasures to protect from the threats posed by e–mail systems & understand Internet Security
2. **Write** preventive measures by identifying different cyber attacks
3. **Indicate** usage of forensic linguistic in solving cases
4. **Analyze** the need and feasibility of using blockchain technology in real–world applications

### Course Contents

#### Module I

**Securing Computer Network**

- Case studies: Fingerprints & Iris Scans. fail2ban, Snort / design honeypot.

9 Hrs

#### Module II

**Security in Computing**


8 Hrs

#### Module III

**Administering Security**

- Exemplar: Case studies of Ethics.

8 Hrs
### Information Security in AI

**Module IV**

- **Data Security in AI**: Data Security: Protecting data used for AI training and operation from unauthorized access, tampering, and theft.
  - Encryption: Ensuring data is encrypted both in transit and at rest to prevent unauthorized access.
  - Access Control: Implementing strict access controls to limit who can view or manipulate data.
- **Privacy in AI**
  - Privacy: Safeguarding the privacy of individuals whose data is used by AI systems.
  - Data Minimization: Using only the minimum amount of data necessary for AI training and operation.
  - Differential Privacy: Applying techniques to ensure that individual data points cannot be inferred from the output of an AI system.

**Case study on application of Block chain Technology**

*7 Hrs*  

**Text Books**


**Reference Books**


**Paper References**


**Relevant MOOC**

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<tr>
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</thead>
<tbody>
<tr>
<td>1.</td>
<td>Ethical Hacking</td>
<td>Prof. Indranil Sen Gupta, IIT Kharagpur</td>
<td></td>
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</tr>
<tr>
<td></td>
<td></td>
<td><a href="https://onlinecourses.nptel.ac.in/noc19_cs68/preview">https://onlinecourses.nptel.ac.in/noc19_cs68/preview</a></td>
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<tr>
<td>2.</td>
<td>Cyber Security and Privacy</td>
<td>Prof. Saji K Mathew, IIT Madras</td>
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<td><a href="https://onlinecourses.nptel.ac.in/noc23_cs127/preview">https://onlinecourses.nptel.ac.in/noc23_cs127/preview</a></td>
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<tr>
<td>3.</td>
<td>Blockchain and its Applications</td>
<td>Prof. Sandip Chakraborty, Prof. Shamik Sural, IIT Kharagpur</td>
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<td></td>
<td><a href="https://onlinecourses.nptel.ac.in/noc22_cs44/preview">https://onlinecourses.nptel.ac.in/noc22_cs44/preview</a></td>
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**Other Useful Resources/Links**

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<tbody>
<tr>
<td>1.</td>
<td><a href="https://ocw.mit.edu/courses/">https://ocw.mit.edu/courses/</a></td>
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<td></td>
<td></td>
</tr>
</tbody>
</table>
MCE2-013 Laboratory Proficiency – II

Teaching scheme:
P: 6 Hrs/week

Credits: 03

Examination Scheme:
CIE/TW:- 50 Marks
ESE(OR):-50 Marks

Prerequisite: Knowledge of programming languages, Basics of Python/R/Java

All assignments are compulsory. Each student should implement the assignments individually. Laboratory teachers should make sure that the dataset/code/write up is not the same.

Course Objectives:
Course intends to prepare the students
To study various cryptographic techniques for solving real-world problems.
1. To explore cloud-edge-IoT environment and the architecture of edge-enabled systems for IoT applications.
2. To study neural language modeling for analyzing syntax, semantics of natural language data.
3. To design software architecture for a selected software system.
4. To learn different phases of compiler and LLVM framework.
5. To learn preventive measures by identifying different cyber-attacks.
6. To understand the need and feasibility of using blockchain technology in real-world applications.
7. To understand the convolution and recurrent neural networks.
8. To get insights into deep generative models

Course Outcomes:
At the end of the Course Students will be able to:
1. Utilize cryptographic techniques effectively to address real-world challenges.
2. Create applications tailored for the cloud-edge-IoT environment and develop architectural designs for edge-enabled systems in IoT.
3. Examine syntax and semantics of natural language data and implement neural language modeling techniques.
4. Apply acquired knowledge with a deeper understanding across various contexts.
5. Evaluate and incorporate quality attributes into the software architecture design process for a chosen software system.
6. Implement loop restructuring and code optimization techniques compiler.
7. Formulate preventive measures against various cyber-attacks through proactive identification.
8. Assess the necessity and viability of integrating blockchain technology into practical applications.
9. Implement and evaluate deep generative models and CNN/RNN.

Cloud Computing
1. Build your own cloud management system using the libvirt API
2. Build your own container using Linux namespaces and cgroups

Applied Deep Learning
1. Develop an application using Deep GAN for multimedia image processing
2. Hand written digit recognition using CNN/RNN

Edge Computing & IoT Applications
1. a) Setup edge-cloud-IoT environment and develop a data analytics application in the above set-up using open IoT/IoT datasets.

OR
b) Setup edge-cloud-IoT environment and develop an application using lightweight machine learning models for edge enabled IoT systems.
2. Develop an edge-enabled application for real-time monitoring, video analytics, or sensor data processing.

### Information Retrieval and Web Mining
1. Consider 10 documents. Construct a count of each document term and return the top 10 frequently occurring terms in the document collection using the TF-IDF score. Find similarity between documents using different similarity measures. Construct a graph for zips and heaps law. Evaluate the performance of similarity measures using precision, recall and F measure.
2. Develop a program to construct a social network graph and calculate the PageRank scores for each node in a given graph and display the score of each node for each iteration of the PageRank algorithm computation.

### Multi Modal Computing
1. Develop a customer service chatbot using speech recognition and text analysis to provide a more natural and efficient user experience.
2. Design and develop a system that can recognize traffic signs such as speed limit, signals and directional indicators using Convolutional Neural network.

### Advanced Compilers
1. Write a program to demonstrate loop restructuring in C/C++.
2. Write a program to implement code optimization.

### Applied Security
1. Develop data visualization of last few years breach record
   OR
1. Write a program to analyze e-mail header.
2. Develop a decentralized app for real-world application using blockchain.
MCE2-014 Skills Enhancement Lab

<table>
<thead>
<tr>
<th>Teaching Scheme:</th>
<th>Credits:</th>
<th>Examination Scheme:</th>
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<tbody>
<tr>
<td>P: 02 Hrs/week</td>
<td>01</td>
<td>CIE/TW:- 25 Marks</td>
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</table>

**Prerequisite:**

**Course Objectives**
1. To solve and devise solutions to a range of elementary real-world problems.
2. To explore and apply key concepts in logical thinking to business problems.
3. To enable students to critically analyze material (information) to evaluate evidence, construct reasoned arguments, and communicate inferences and conclusions.

**Course Outcomes:**

**At the end of the Course Students will be able to:**
1. Develop problem-solving skills and critical thinking abilities in the context of recruitment aptitude tests.
2. Exhibit advanced skills of interview, debating and discussion or Perform verbal and nonverbal communication behaviors that illustrate self-efficacy

**Guidelines for conduction and evaluation of the laboratory sessions:**

Students will be encouraged to study and prepare for the contents relevant to the modules- Quantitative Aptitude, Logical Reasoning and Technical communication. Evaluation can be in terms of practice tests/ mock tests/ MCQ based tests, Group discussion, Mock interview, and presentation.

<table>
<thead>
<tr>
<th>Module</th>
<th>Quantitative Aptitude</th>
<th>Logical Reasoning</th>
<th>Technical Communication</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Percentage; Profit/ Loss; Simplification and Approximation: Decimal fractions, Square Roots &amp; Cube Roots; Average; Ratio and Proportion: Partnerships; Age; Mixture and alligation; Number Series; Arithmetic: Time and work, Time, Distance and Speed, Boats and streams; Data Interpretation: Pie chart, Bar chart, Table chart.</td>
<td>Distance and direction; Blood relation: Linear inequalities; Ranking arrangement; Coding decoding: Chinese/ Symbolic, Number, Symbolic, Miscellaneous, Letter; Syllogism; Seating arrangement; Puzzle; Input- Output; Alphabetic series; Statements and assumptions; Statements and conclusions</td>
<td>Vocabulary building; Oral Communication and Speaking Techniques; Group Discussions– dynamics of group discussion, Lateral thinking, Brainstorming and Negotiation skills; Meetings– making meeting effective, chairing a meeting, decision making, seeking opinions, interrupting, and handling interruptions, clarifications, closure Agenda, Minute writing; Presentation skills; Interview skills– formal &amp; informal interviews, concept and process, pre-interview planning, opening strategies, answering strategies, interview through tele and video-conferencing.</td>
</tr>
<tr>
<td>II</td>
<td>8 Hrs</td>
<td>8 Hrs</td>
<td>8 Hrs</td>
</tr>
</tbody>
</table>

**Text Books**

1. R. S. Aggarwal, Quantitative Aptitude (Fully solved), Reprint 2016, S. Chand Publishing.

**Reference Books**


### Relevant MOOCs

1. English Language for Competitive Exams, IIT Madras
   [https://nptel.ac.in/courses/109106116](https://nptel.ac.in/courses/109106116)
2. Employment Communication A Lab based course, IIT Kharagpur
   [https://nptel.ac.in/courses/109105144](https://nptel.ac.in/courses/109105144)

### Other Resources/Links
### MCE2-015 Seminar-I

<table>
<thead>
<tr>
<th>Teaching Scheme:</th>
<th>Examination Scheme:</th>
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<tbody>
<tr>
<td>P: 04 Hrs/week</td>
<td>CIE/TW:- 50 Marks</td>
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<tr>
<td></td>
<td>ESE/(OR):-25Marks</td>
</tr>
<tr>
<td>Credit :02</td>
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</tbody>
</table>

#### Course Objectives:
1. To deepen students' understanding of advanced topics, emerging trends, and recent developments in computer engineering.
2. To enhance students' research skills, including literature review, experimental design, data collection and analysis, and interpretation of results, in the context of computer engineering research.
3. To improve students' ability to communicate technical concepts effectively through written reports, oral presentations, and technical documentation, targeting both technical and non-technical audiences.

#### Course Outcomes:

**At the end of the Course Students will be able to:**

1. **Conduct** thorough literature surveys confined to the domain of choice.
2. **Develop** presentation skills to **deliver** the technical contents.
3. **Prepare** the report of the technical research domain.

The student shall have to deliver the seminar I in semester II on a topic approved by guide and authorities. It is recommended to allot a guide to the student since the commencement of semester I. The guide allotment preferably needs to be carried out in synchronization with mutual domains of interest. It is recommended that seminar shall be on the topic relevant to latest trends in the field of concerned branch, preferably on the topic of specialization based on the electives selected or domain of interest.

It is appreciated and strongly recommended that the student will select the domain of his/her dissertation and identify the literature confined to the domain. Thorough literature study based on the broad identified topic has to be carried out. This practice will eventually lead to convergence of the efforts for the dissertation.

The relevant literature then be explored as state-of-the-art, exotic, recent technological advancement, future trend, application and research & innovation. Multidisciplinary topics are encouraged. The student shall submit the duly approved and certified seminar report in standard format, for satisfactory completion of the work by the concerned Guide and head of the department/institute. The student will be assessed based on his/her presentation and preparations by the panel of examiners out of them one has to be an external examiner.

The students are expected to validate their study undertaken by publishing it at standard platforms.

The student has to exhibit the continuous progress through regular reporting and presentations and proper documentation of the frequency of the activities in the sole discretion of the PG coordination.

The continuous assessment of the progress needs to be documented unambiguously. For standardization and documentation, follow the guidelines circulated / as in the seminar logbook approved by the department.
Semester III
MCE3-018 Indian Knowledge System and Human Values

<table>
<thead>
<tr>
<th>Teaching Scheme:</th>
<th>Credits: 02</th>
<th>Examination Scheme:</th>
</tr>
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<tbody>
<tr>
<td>L: 01 Hrs/week</td>
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<td>CIE:30 Marks</td>
</tr>
<tr>
<td>P: 02 Hrs/week</td>
<td></td>
<td>CEI/TW:20 Marks</td>
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</tbody>
</table>

**Prerequisite:**

**Course Objectives:**

**Course intends to prepare the students**

Study/Explore/Understand the significance of IKS for a sustainable environment, love for nature, holistic ways of living, and health conscious that ultimately leads to quality life for everyone in the plane.

1. To preserve and showcase the depth and breadth of Indian knowledge for a sustainable society and future generations.
2. To explore research in the area of Mindfulness for Sustainable Health.
3. To help the students to ensure sustained happiness and prosperity which are the core aspirations of all human beings.
4. To facilitate the development of a Holistic perspective among students towards life and profession as well as towards happiness and prosperity.

**Course Outcomes :**

At the end of the Course Students will be able to

1. **Differentiate** between harmonious and disharmonious living
2. **Contribute** in developing solutions to social problems leading to peaceful life.
3. **Demonstrate** Holistic perspective towards life.

**Course Contents**

**Module I**

**Indian Knowledge System – An Introduction:**

What is IKS? Why do we need IKS? Organization of IKS Historicity of IKS Some salient aspects of IKS.

**Module II**

Students can select any one from A/B/C

A. Introduction to Linguistics, Phonetics, Word generation, Computational aspects, Mnemonics Recursive operations, Rule-based operations, Sentence formation, Verbs and prefixes, Role of Sanskrit in natural language processing.


C. Indian scheme of knowledge, The knowledge triangle, Prameya – A vaiśeṣikan approach to physical reality, Dravyas – the constituents of the physical reality, Attributes – the properties of substances and
### Module III

**Value Education and Harmony in Human being**

Understanding Value Education, Self-exploration as the Process for Value Education, Continuous Happiness and Prosperity – the Basic Human Aspirations, Right Understanding, Relationship and Physical Facility, Happiness and Prosperity – Current Scenario, Method to fulfill the Basic Human Aspirations

Understanding Human being as the Co-existence of the Self and the Body, distinguishing between the Needs of the Self and the Body, The Body as an Instrument of the Self, Understanding Harmony in the Self, Harmony of the Self with the Body, Program to ensure self-regulation and Health.

| 6 Hrs |

### Module IV

**Harmony in the Family, Society and Nature**

The Basic Unit of Human Interaction, Values in Human–to–Human Relationship, Nine universal values in relationships viz. Trust, Respect, Affection, Care, Guidance, Reverence, Glory, Gratitude, Love.


Case Studies of industry relevance/recent trends

| 5 Hrs |

### Text Books

2. Introduction to IKS: Concepts and Applications by Prof. B Mahadevan, IIM Bengaluru

### Reference Books

3. The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi
4. On Education – J Krishnamurthy
5. Rediscovering India – by Dharampal Hind Swaraj or Indian Home Rule – by Mohandas K. Gandhi.
MOOC Courses:

1. Indian Knowledge System (IKS): Concepts and Applications in Engineering By Prof. B. Mahadevan, Dr. Vinayak Rajat Bhat, Dr. R Venkata Raghavan | Indian Institute of Management Bangalore (IIMB), Chanakya University, Bangalore  Link of the Course: https://onlinecourses.swayam2.ac.in/imb23_mg53/preview

2. Indian Knowledge System (IKS): Humanities and Social Sciences By Prof. B. Mahadevan, Dr. Vinayak Rajat Bhat, Dr. R Venkata Raghavan  Indian Institute of Management Bangalore (IIMB), Chanakya University, Bangalore. https://onlinecourses.swayam2.ac.in/imb23_mg55/preview

ACTIVITY BASED LEARNING (SUGGESTED ACTIVITIES IN CLASS)

1. Presentation Participation individually and in teams.
2. Extempore, Impromptu small talks
3. Quizzes/Assignment /Seminars/Group discussions.
SCTR’S PUNE INSTITUTE OF COMPUTER TECHNOLOGY, PUNE-43
M. Tech. (Computer Engineering) Curriculum Structure
With effect from the A.Y. 2024-25

### MCE3-019 Internship/Field Study

<table>
<thead>
<tr>
<th>Teaching Scheme:</th>
<th>Examination Scheme:</th>
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<tbody>
<tr>
<td>P: 08 Hrs/week</td>
<td>CIE/TW:- 50 Marks</td>
</tr>
<tr>
<td>Credit :04</td>
<td>ESE(OR):- 50 Marks</td>
</tr>
</tbody>
</table>

#### Course Objectives:
*Course intends to prepare the students*
1. To identify the problem in the domain of interest.
2. To learn to communicate in a scientific language through collaboration with a guide.
3. To work in a professional environment.

#### Course Outcomes:
*At the end of the Course Students will be able to*
1. **Conduct** literature survey confined to the domain of choice
2. **Develop** presentation skills to deliver the technical contents
3. **Create** report of the technical research domain
4. **Analyze** the findings and work of various authors confined to the chosen domain

#### Conduction guidelines
Industry or research internship should include partial/complete project implementation. The preferences/choices of the domain should be taken from the students. The guide needs to be allocated based on the preference/choices. Students should be allocated to the research guide in the first semester itself and the same guide should be continued for the: Industry Internship-I/ In house Research Project –I. In case of Industry Internship-I, the assigned guide from college has to monitor and evaluate the progress of the student. The student has to exhibit continuous progress through regular reporting and presentations and proper documentation. The continuous assessment of the progress needs to be documented unambiguously.
### MCE3-020 Seminar - II

#### Teaching Scheme:
P: 04 Hrs/week

| Credit | 02 |

#### Examination Scheme:
CIE/TW:- 50 Marks
ESE(OR):-50 Marks

### Course Objectives:
**Course intends to prepare the students**

1. To develop students' ability to critically analyze complex problems in computer engineering and devise innovative solutions by applying theoretical knowledge and practical skills.
2. To enhance students' research skills, including literature review, experimental design, data collection and analysis, and interpretation of results, in the context of computer engineering research.
3. To improve students' ability to communicate technical concepts effectively through written reports, oral presentations, and technical documentation, targeting both technical and non-technical audiences.

### Course Outcomes:
**At the end of the Course Students will be able to:**

1. **Use** multiple thinking strategies to examine multidisciplinary domains.
2. **Identify** research findings of literature survey.
3. **Analyze** and **demonstrate** the findings and work of various authors confined to the chosen domain.
4. **Furnish** the report of the technical research domain.

The student shall have to deliver the seminar II in semester III on a topic approved by guide and authorities. It is appreciated if a student has already selected the domain of his/her dissertation work and identified the literature confined to the domain and thorough literature study based on the identified topic has been carried out. This practice will eventually lead to convergence of the efforts for the dissertation work. The meticulous analyses of the literature can be part of the seminar.

The relevant literature then be explored as state-of-the-art, exotic, recent technological advancements, future trends, applications and research & innovations. The student shall submit the duly approved and certified seminar report in standard format, for satisfactory completion of the work by the concerned Guide and head of the department/institute.

The student will be assessed based on his/her presentation and preparations by the panel of examiners out of them one has to be an external examiner. The students are expected to validate their study undertaken by publishing it at standard platforms. The student has to exhibit the continuous progress through regular reporting and presentations and proper documentation of the frequency of the activities in the sole discretion of the PG coordination.

The continuous assessment of the progress needs to be documented unambiguously. For standardization and documentation, follow the guidelines circulated / as in the seminar logbook approved by the department.
MCE3-021 Dissertation Stage -I

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<th>Teaching Scheme:</th>
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<tr>
<td>P: 08 Hrs/week</td>
<td>CIE/TW:- 50 Marks</td>
</tr>
<tr>
<td></td>
<td>ESE(OR):-50 Marks</td>
</tr>
<tr>
<td>Credit: 04</td>
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</table>

**Course Objectives:**
Course intends to prepare the students
1. To identify the domain of research.
2. To formulate research problems with the help of the guide/mentor elaborating the research.
3. To acquire information and identify scope for the dissertation work.

**Course Outcomes:**
At the end of the Course Students will be able to:
1. **Conduct** thorough literature surveys confined to the domain of choice.
2. **Analyze** the findings, work of various authors confined to the chosen domain and **define** scope of the dissertation work.
3. **Design** the system and **prepare** the technical report of the dissertation work.
4. **Develop** presentation skills to deliver the technical contents.

**Guidelines**
Dissertation Stage – I is an integral part of the Dissertation work. In this, the student shall complete the partial work of the Dissertation which will consist of problem statement, literature review, design, scheme of implementation (Mathematical Model/SRS/UML Diagrams /ERD/block diagram/PERT chart) and Layout & Design of the Set-up.

The student is expected to complete the dissertation at least up to the design phase. As a part of the progress report of Dissertation work Stage-I, the candidate shall deliver a presentation on the advancement in Technology pertaining to the selected dissertation topic. The student shall submit approved and certified Dissertation Stage-I report in standard format for satisfactory completion of the work duly signed by the concerned guide and head of the Department/Institute.

The dissertation stage - I work will be assessed by a panel of examiners of which one is necessarily an external examiner. The assessment will be broadly based on literature study, work undergone, content delivery, presentation skills, documentation and report. The students are expected to validate their study undertaken by publishing it at standard platforms. The investigations and findings need to be validated appropriately at standard platforms – conference and/or peer reviewed journals.

The student has to exhibit the continuous progress through regular reporting and presentations and proper documentation of the frequency of the activities in the sole discretion of the PG coordination. The continuous assessment of the progress needs to be documented unambiguously. For standardization and documentation, it is recommended to follow the formats and guidelines in the dissertation workbook approved by the department.
Semester IV
## MCE4-022 Seminar-III

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<th>Teaching Scheme:</th>
<th>Examination Scheme:</th>
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<tr>
<td>P: 08 Hrs./week</td>
<td>CIE/TW:- 50 Marks</td>
</tr>
<tr>
<td>Credit: 04</td>
<td>ESE(OR):-50 Marks</td>
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</table>

### Course Objectives:
**Course intends to prepare the students**
1. To identify the domain of research
2. To learn to communicate in a scientific language through collaboration with a guide.
3. To categorize the research material confined to the domain of choice
4. To work in professional environment

### Course Outcomes:
**At the end of the Course Students will be able to:**
1. **Conduct** thorough literature surveys confined to the domain of choice.
2. **Develop** presentation skills to deliver the technical contents.
3. **Furnish** the report of the technical research domain.
4. **Analyze** the findings and work of various authors confined to the chosen domain.

### Conduction guidelines

Industry or research internship should include partial/complete project implementation. The preferences/choices of the domain should be taken from the students. The guide needs to be allocated based on the preference/choices. Students should be allocated to the research guide in the first semester itself and the same guide should be continued for the: Industry Internship-I/In house Research Project –I. In case of Industry Internship-I, the assigned guide from college has to monitor and evaluate the progress of the student. The student has to exhibit continuous progress through regular reporting and presentations and proper documentation. The continuous assessment of the progress needs to be documented unambiguously.
### MCE4-023 Dissertation Stage -II

<table>
<thead>
<tr>
<th>Teaching Scheme:</th>
<th>Credit: 16</th>
<th>Examination Scheme:</th>
</tr>
</thead>
<tbody>
<tr>
<td>P: 32 Hrs./week</td>
<td></td>
<td>CIE/TW:- 100 Marks</td>
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<tr>
<td></td>
<td></td>
<td>ESE(OR):-50 Marks</td>
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</tbody>
</table>

#### Course Objectives:

**Course intends to prepare the students**

1. To follow SDLC meticulously and meet the objectives of proposed work.
2. To test rigorously before deployment of the system.
3. To validate the work undertaken.
4. To consolidate the work as a furnished report.

#### Course Outcomes:

**At the end of the Course Students will be able to:**

1. **Demonstrate** a depth knowledge of the domain of choice.
2. **Analyze** findings, **evaluate** and **present** the results and their interpretation.
3. **Prepare** an independent dissertation report, resulting in publication.
4. **Demonstrate** an ability to **present** and **defend** dissertation work to a panel of experts.

#### Guidelines

In Dissertation Stage–II, the student shall consolidate and complete the remaining part of the dissertation which will consist of selection of technology, installations, implementations, testing, results, measuring performance, discussions using data tables as per parameter considered for the improvement with existing/known algorithms/systems, comparative analysis, validation of results and conclusions. The student shall prepare a certified final report of Dissertation in standard format for satisfactory completion of the work duly signed by the concerned guide and head of the Department/Institute.

The dissertation stage - II work will be assessed by a panel of examiners of which one is necessarily an external examiner. The students are expected to validate their study undertaken by publishing it at standard platforms. The investigations and findings need to be validated appropriately at standard platforms – conference and/or peer reviewed journals.

The student has to exhibit the continuous progress through regular reporting, presentations, and proper documentation of the frequency of the activities in the sole discretion of the PG coordination. The continuous assessment of the progress needs to be documented unambiguously. It is recommended to continue with guidelines and formats as mentioned in the Dissertation Workbook approved by the department.