RCOEM

Shri Ramdeobaba College of Engineering and Management, Nagpur

# SHRI RAMDEOBABA COLLEGE OF ENGINEERING AND MANAGEMENT,

# NAGPUR – 440013

## PROGRAMME SCHEME & SYLLABI

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# BATCH 2023–2024

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# B. Tech. CSE

# Artificial Intelligence and Machine Learning (AI&ML)

# B. Tech. Computer Science and Engineering
# (Artificial Intelligence and Machine Learning) [2023-24]
# Teaching & Evaluation Scheme and Syllabus [B. Tech CSE-AIML]

## Semester – I

| S. N. | Category | Course Code | Course Name | Hours/ week | | | Credits | Maximum Marks | | | ESE Duration (Hrs) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | L | T | P | | Continuous Evaluation | End Sem Exam | Total | |
| 1. | BSC | CHT1001 | Chemistry of Smart Materials | 2 | 0 | 0 | 2 | 50 | 50 | 100 | 2 |
| 2. | BSC | CHP1001 | Chemistry of Smart Materials Lab | 0 | 0 | 2 | 1 | 50 | - | 50 | - |
| 3. | BSC | MAT1002 | Calculus | 3 | 0 | 0 | 3 | 50 | 50 | 100 | 3 |
| 4. | ESC | CAT1001 | Digital Electronics | 3 | 0 | 0 | 3 | 50 | 50 | 100 | 3 |
| 5. | ESC | CAP1001 | Digital Electronics Lab | 0 | 0 | 2 | 1 | 50 | - | 50 | - |
| 6. | ESC | CAT1002 | Programming for Problem Solving | 3 | 0 | 0 | 3 | 50 | 50 | 100 | 3 |
| 7. | ESC | CAP1002 | Programming for Problem Solving Lab | 0 | 0 | 2 | 1 | 50 | - | 50 | - |
| 8. | VSEC | CAT1003 | Computer Workshop – I | 1 | 0 | 0 | 1 | 50 | - | 50 | - |
| 9. | VSEC | CAP1003 | Computer Workshop – I Lab | 0 | 0 | 2 | 1 | 50 | - | 50 | - |
| 10. | HSSM-IKS | HUT1001 | Foundational Literature of Indian Civilization | 2 | 0 | 0 | 2 | 50 | 50 | 100 | 2 |
| 11. | CCA | PET1001 | Sports-Yoga-Recreation | 1 | 0 | 0 | 1 | 50 | - | 50 | - |
| 12. | CCA | PEP1001 | Sports-Yoga-Recreation | 0 | 0 | 2 | 1 | 50 | - | 50 | - |
| | | | **TOTAL** | **15** | **0** | **10** | **20** | | | **850** | **-** |

## Semester – II

| Sr. No. | Category | Course Code | Course Name | Hours/ week | | | Credits | Maximum Marks | | | ESE Duration (Hrs) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | L | T | P | | Continuous Evaluation | End Sem Exam | Total | |
| 1. | BSC | PHT2001 | Introduction to Quantum Computing | 2 | 1 | 0 | 3 | 50 | 50 | 100 | 3 |
| 2. | BSC | PHP2001 | Quantum Computing Lab | 0 | 0 | 2 | 1 | 50 | - | 50 | - |
| 3. | BSC | MAT2002 | Discrete Mathematics | 3 | 0 | 0 | 3 | 50 | 50 | 100 | 3 |
| 4. | BSC | MAP2001 | Computational Mathematics Lab | 0 | 0 | 2 | 1 | 50 | - | 50 | - |
| 5. | BSC | CHT2007 | Bioinformatics | 2 | 0 | 0 | 2 | 50 | 50 | 100 | 2 |
| 6. | ESC | CAT2001 | Object Oriented Programming | 3 | 0 | 0 | 3 | 50 | 50 | 100 | 3 |
| 7. | ESC | CAP2001 | Object Oriented Programming Lab | 0 | 0 | 2 | 1 | 50 | - | 50 | - |
| 8. | PCC | CAT2002 | Computer Architecture | 2 | 0 | 0 | 2 | 50 | 50 | 100 | 2 |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 9. | VSEC | CAT2003 | Computer Workshop - II | 1 | 0 | 0 | 1 | 50 | - | 50 | - |
| 10. | VSEC | CAP2003 | Computer Workshop – II Lab | 0 | 0 | 2 | 1 | 50 | - | 50 | - |
| 11. | AEC | HUT2002 | English for Professional Communication | 2 | 0 | 0 | 2 | 50 | 50 | 100 | 2 |
| 12. | AEC | HUP2002 | English for Professional Communication Lab | 0 | 0 | 2 | 1 | 50 | - | 50 | - |
| 13. | CCA | HUP0001 | Liberal/Performing Art | 0 | 0 | 2 | 1 | 50 | - | 50 | - |
| 14. | VEC | HUT2004 | Foundational Course in Universal Human Values | 1 | 0 | 0 | 1 | 50 | - | 50 | - |
| | | | **TOTAL** | **16** | **1** | **12** | **23** | | | **1000** | **-** |

## Scheme for Liberal/Performing Arts basket

| Sr. No. | Course Code | Course Name | Hours/ week | Credits | Maximum Marks |
|---|---|---|---|---|---|
| 1. | HUP0001-1 | Fundamentals of Indian Classical Dance: Bharatnatayam | 2 | 1 | 50 |
| 2. | HUP0001-2 | Fundamentals of Indian Classical Dance: Kathak | 2 | 1 | 50 |
| 3. | HUP0001-3 | Introduction to Digital Photography | 2 | 1 | 50 |
| 4. | HUP0001-4 | Introduction to Japanese Language and Culture | 2 | 1 | 50 |
| 5. | HUP0001-5 | Art of Theatre | 2 | 1 | 50 |
| 6. | HUP0001-6 | Introduction to French Language | 2 | 1 | 50 |
| 7. | HUP0001-7 | Introduction to Spanish Language | 2 | 1 | 50 |
| 8. | HUP0001-8 | Art of Painting | 2 | 1 | 50 |
| 9. | HUP0001-9 | Art of Drawing | 2 | 1 | 50 |
| 10. | HUP0001-10 | Nature camp | 2 | 1 | 50 |
| 11. | PEP0001-21 | Disaster Management Through Adventure Sports | 2 | 1 | 50 |
| 12. | PEP0001-22 | Self-Defense Essentials and Basics Knowledge of Defense Forces | 2 | 1 | 50 |
| 13. | CHP0001-31 | Art of Indian Traditional Cuisine | 2 | 1 | 50 |
| 14. | CHP0001-32 | Introduction to Remedies by Ayurveda | 2 | 1 | 50 |

| **Exit option: Award of UG Certificate in Major with 43 credits and an additional 8 credits.** | | | |
|---|---|---|---|
| **Exit Courses** | | | |
| 1. | **Web Designer** | **Online/offline certification Course** | **8** |
| 2. | **IT Support Engineer** | | **8** |
| 3. | **Certified Programmer (language learned in Sem-1 and/or Sem-2 [C,C++,Java, Python ] )** | | **8** |

## Semester – III

| Sr. No. | Category | Course Code | Course Name | Hours/ week | | | Credits | Maximum Marks | | | ESE Duration (Hrs) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | L | T | P | | Continuous Evaluation | End Sem Exam | Total | |
| 1 | PCC | CAT3001 | Data Structures | 3 | 1 | 0 | 4 | 50 | 50 | 100 | 3 |
| 2 | PCC | CAP3001 | Data Structures Lab | 0 | 0 | 2 | 1 | 50 | - | 50 | - |
| 3 | PCC | CAT3002 | Operating Systems | 3 | 0 | 0 | 3 | 50 | 50 | 100 | 3 |
| 4 | PCC | CAP3002 | Operating Systems Lab | 0 | 0 | 2 | 1 | 50 | - | 50 | - |
| 5 | VSEC | CAP3003 | Software Lab-I | 0 | 0 | 4 | 2 | 50 | - | 50 | - |
| 6 | MDM | MAT3002 | Probability and Statistics | 3 | 0 | 0 | 3 | 50 | 50 | 100 | 3 |
| 7 | OE | Open Elective | Open Elective I | 2 | 0 | 0 | 2 | 50 | 50 | 100 | 2 |
| 8 | EEM | CAP3004 | Idea Lab | 0 | 0 | 4 | 2 | 50 | - | 50 | - |
| 9 | VEC | CAT3005 | Cyber Law and Ethics | 2 | 0 | 0 | 2 | 50 | 50 | 100 | 2 |
| 10 | AEC | HUT3001 | Business Communication | 2 | 0 | 0 | 2 | 50 | 50 | 100 | 2 |
| | | | **TOTAL** | **15** | **1** | **12** | **22** | | | **800** | **-** |

## Semester – IV

| Sr. No. | Category | Course Code | Course Name | Hours/ week | | | Credits | Maximum Marks | | | ESE Duration (Hrs) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | L | T | P | | Continuous Evaluation | End Sem Exam | Total | |
| 1 | PCC | CAT4001 | Artificial Intelligence | 3 | 0 | 0 | 3 | 50 | 50 | 100 | 3 |
| 2 | PCC | CAP4001 | Artificial Intelligence Lab | 0 | 0 | 2 | 1 | 50 | - | 50 | - |
| 3 | PCC | CAT4002 | Design and Analysis of Algorithms | 3 | 0 | 0 | 3 | 50 | 50 | 100 | 3 |
| 4 | PCC | CAT4003 | Theory of Computation | 3 | 0 | 0 | 3 | 50 | 50 | 100 | 3 |
| 5 | MDM | MAT4001 | Linear Algebra | 3 | 0 | 0 | 3 | 50 | 50 | 100 | 3 |
| 6 | OE | Open Elective | Open Elective II | 3 | 0 | 0 | 3 | 50 | 50 | 100 | 3 |
| 7 | VSEC | CAP4004 | Software Lab-II | 0 | 0 | 2 | 1 | 50 | - | 50 | - |
| 8 | VSEC | CAP4005 | Software Lab-III | 0 | 0 | 2 | 1 | 50 | - | 50 | - |
| 9 | CEP | CAP4006 | Community Engagement Project | 0 | 0 | 4 | 2 | 50 | - | 50 | - |
| 10 | VEC | HUT4002 | Environment Education | 2 | 0 | 0 | 2 | 50 | 50 | 100 | 2 |
| 11 | EEM | HUT4003 | Managerial Economics | 2 | 0 | 0 | 2 | 50 | 50 | 100 | 2 |
| | | | **TOTAL** | **19** | **0** | **10** | **24** | | | **900** | **-** |

| **Exit option : Award of UG Diploma in Major with 90 credits and an additional 8 credits** | | | |
|---|---|---|---|
| **Exit Courses** | | | |
| **1** | **Application Development (Android)** | **Online/offline certification Course** | **8** |
| **2** | **Certified software Engineer (Devop)** | | **8** |

## Semester – V

| Sr. No. | Category | Course Code | Course Name | Hours/ week | | | Credits | Maximum Marks | | | ESE Duration (Hrs) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | L | T | P | | Continuous Evaluation | End Sem Exam | Total | |
| 1. | PCC | CAT5001 | Machine Learning | 3 | 0 | 0 | 3 | 50 | 50 | 100 | 3 |
| 2. | PCC | CAP5001 | Machine Learning Lab | 0 | 0 | 2 | 1 | 50 | - | 50 | - |
| 3. | PCC | CAT5002 | Computer Networks | 3 | 0 | 0 | 3 | 50 | 50 | 100 | 3 |
| 4. | PCC | CAP5002 | Computer Networks Lab | 0 | 0 | 2 | 1 | 50 | - | 50 | - |
| 5. | PCC | CAT5003 | Database Management Systems | 3 | 0 | 0 | 3 | 50 | 50 | 100 | 3 |
| 6. | PCC | CAP5003 | Database Management Systems Lab | 0 | 0 | 2 | 1 | 50 | - | 50 | - |
| 7. | PEC | CAT5004 | Program Elective-1 | 3 | 0 | 0 | 3 | 50 | 50 | 100 | 3 |
| 8. | PCC | CAT5005 | Microcontroller Design | 3 | 0 | 0 | 3 | 50 | 50 | 100 | 3 |
| 9. | PCC | CAP5005 | Microcontroller Design Lab | 0 | 0 | 2 | 1 | 50 | - | 50 | - |
| 10. | OE | Open Elective | Open Elective III | 3 | 0 | 0 | 3 | 50 | 50 | 100 | 3 |
| | | | **TOTAL** | **18** | **0** | **8** | **22** | | | **800** | **-** |

## Semester – VI

| Sr. No. | Category | Course Code | Course Name | Hours/ week | | | Credits | Maximum Marks | | | ESE Duration (Hrs) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | L | T | P | | Continuous Evaluation | End Sem Exam | Total | |
| 1. | PCC | CAT6001 | Deep Learning-I | 3 | 0 | 0 | 3 | 50 | 50 | 100 | 3 |
| 2. | PCC | CAP6001 | Deep Learning-I Lab | 0 | 0 | 2 | 1 | 50 | - | 50 | - |
| 3. | PCC | CAT6002 | Computer Vision | 3 | 0 | 0 | 3 | 50 | 50 | 100 | 3 |
| 4. | PCC | CAP6002 | Computer Vision Lab | 0 | 0 | 2 | 1 | 50 | - | 50 | - |
| 5. | PEC | CAT6003 | Program Elective-2 | 3 | 0 | 0 | 3 | 50 | 50 | 100 | 3 |
| 6. | PEC | CAP6003 | Program Elective-2 Lab | 0 | 0 | 2 | 1 | 50 | - | 50 | - |
| 7. | PEC | CAT6004 | Program Elective-3 | 3 | 0 | 0 | 3 | 50 | 50 | 100 | 3 |
| 8. | PEC | CAP6004 | Program Elective-3 Lab | 0 | 0 | 2 | 1 | 50 | - | 50 | - |
| 9. | PCC | CAT6005 | Internet of Things | 2 | 0 | 0 | 2 | 50 | 50 | 100 | 2 |
| 10. | PRJ | CAP6006 | Mini Project | 0 | 0 | 4 | 2 | 25 | 25 | 50 | - |
| | | | **TOTAL** | **14** | **0** | **12** | **20** | | | **750** | |

| **Exit option : Award of UG Degree in Major with 131 credits and an additional 8 credits** | | | |
|---|---|---|---|
| **Exit Courses** | | | |
| **1** | **Certified Network Engineer (CCNA,CISCO)** | **Online/offline certification Course** | **8** |
| **2** | **Certified Database Engineer (Oracle, DB2)** | | **8** |
| **3** | **Certified Cloud Engineer (AWS, AZURE)** | | **8** |
| **4** | **Certified AIML Engineer** | | **8** |
| **5** | **Certified Data Science Engineer** | | **8** |

| **List of Open Electives** | | |
|---|---|---|
| **Sr. No.** | **Subject Code** | **Name of Subject** |
| **Open Elective-I** | **CAT2980** | **Statistical Computing with R** |
| **Open Elective-II** | **CAT2990** | **Fundamentals of Machine Learning** |
| **Open Elective-III** | **CAT3980** | **Big Data Analytics** |

## Semester – VII

| Sr. No. | Category | Course Code | Course Name | Hours/ week | | | Credits | Maximum Marks | | | ESE Duration (Hrs) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | L | T | P | | Continuous Evaluation | End Sem Exam | Total | |
| 1. | PCC | CAT7001 | Deep Learning-II | 3 | 0 | 0 | 3 | 50 | 50 | 100 | 3 |
| 2. | PCC | CAP7001 | Deep Learning-II Lab | 0 | 0 | 2 | 1 | 50 | - | 50 | - |
| 3. | PCC | CAT7002 | Cloud Computing | 3 | 0 | 0 | 3 | 50 | 50 | 100 | 3 |
| 4. | PCC | CAP7002 | Cloud Computing Lab | 0 | 0 | 2 | 1 | 50 | - | 50 | - |
| 5. | PCC | CAT7003 | Data Analytics & Visualization | 1 | 0 | 0 | 1 | 50 | - | 50 | - |
| 6. | PCC | CAP7003 | Data Analytics & Visualization Lab | 0 | 0 | 2 | 1 | 50 | - | 50 | - |
| 7. | PEC | CAT7004 | Program Elective-4 | 3 | 0 | 0 | 3 | 50 | 50 | 100 | 3 |
| 8. | PCC | CAT7005 | Robotics and Intelligent Systems | 2 | 0 | 0 | 2 | 50 | 50 | 100 | 2 |
| 9. | PRJ | CAP7006 | Major Project-1 | 0 | 0 | 8 | 4 | 50 | 50 | 100 | - |
| | | | **TOTAL** | **12** | **0** | **14** | **19** | | | **700** | **-** |

## Semester – VIII

| Sr. No. | Category | Course Code | Course Name | Hours/ week | | | Credits | Maximum Marks | | | ESE Duration (Hrs) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | L | T | P | | Continuous Evaluation | End Sem Exam | Total | |
| 1. | PEC | CAT8001 | Program Elective-5 | 3 | 0 | 0 | 3 | 50 | 50 | 100 | 3 |
| 2. | PEC | CAT8002 | Program Elective-6 | 3 | 0 | 0 | 3 | 50 | 50 | 100 | 3 |
| 3. | PRJ | CAP8003 | Major Project-2 | 0 | 0 | 12 | 6 | 50 | 50 | 100 | - |
| **OR** | | | | | | | | | | | |
| 1. | Internship | CAP8006 | Industry / TBI / Research Internship | 0 | 0 | 24 | 12 | 200 | 100 | 300 | - |
| | | | **TOTAL** | | | | **12** | | | **300** | |

## Electives Basket

| Elective-I | Elective-II | Elective-III | Elective-IV | Elective-V | Elective-VI |
|---|---|---|---|---|---|
| Software Engineering | Natural Language Processing | Customer Relationship Management | Big Data Analytics | Human Computer Interaction | Financial Analysis |
| Design Pattern | Data Mining and Warehousing | Software Testing | Reinforcement Learning | Generative Adversarial Network | Time Series Analysis |
| Robotic Process Automation | Compiler Design | Blockchain Technology | System Design | Information Retrieval | Edge Computing |

# Syllabus for Semester III, B. Tech - Computer Science & Engineering (Artificial Intelligence and Machine Learning)

**Course Code: CAT3001** **Course: Data Structures**
**L: 3 Hrs, T: 1 Hr, P: 0 Hrs, Per Week** **Total Credits: 4**

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**Course Prerequisite**
Basic knowledge of computer programming and common programming concepts.

**Course Outcomes**

On successful completion, of course student will able to:
1. Identify different ADTs, their operations and specify their complexities.
2. Apply linear data structures to address practical challenges and analyze their complexity.
3. Implement different sorting, searching, and hashing methods and analyze their time and space requirements.
4. Analyse non-linear data structures to develop solutions for real-world applications.

**Syllabus:**

**UNIT I: Data Structures and Algorithms Basics**

**Introduction:** Basic terminologies, elementary data organizations, data structure operations; abstract data types (ADT) and their characteristics.
**Algorithms**: Definition, characteristics, analysis of an algorithm, asymptotic notations, time and space trade-offs.
**Array ADT**: Definition, operations and representations – row-major and column- major.

**UNIT II: Sorting, Searching and Hashing**

**Sorting:** Different approaches to sorting, properties of different sorting algorithms (insertion, Shell, quick, merge, heap, counting), performance analysis and comparison.
**Searching:** Necessity of a robust search mechanism, searching linear lists (linear search, binary search) and complexity analysis of search methods.
**Hashing:** Hash functions and hash tables, closed and open hashing, randomization methods (division method, mid-square method, folding), collision resolution techniques.

**UNIT III: Stacks and Queues**

**Stack ADT:** Allowable operations, algorithms and their complexity analysis, applications of stacks–expression conversion and evaluation (algorithmic analysis), multiple stacks.
**Queue ADT:** Allowable operations, algorithms and their complexity analysis for simple queue and circular queue, introduction to double-ended queues and priority queues.

**UNIT IV: Linked Lists**

**Singly Linked Lists:** Representation in memory, algorithms of several operations: traversing, searching, insertion, deletion, reversal, ordering, etc.
**Doubly and Circular Linked Lists**: Operations and algorithmic analysis.
**Linked representation of stacks and queues**.

**UNIT V: Trees and Graphs**

**Trees:** Basic tree terminologies, binary tree and operations, binary search tree (BST) and operations with time analysis of algorithms, threaded binary trees.
**Self-balancing Search Trees:** Tree rotations, AVL tree and operations,
**Graphs:** Basic terminologies, representation of graphs, traversals (DFS, BFS) with complexity analysis, path finding (Dijkstra's SSSP, Floyd's APSP), and spanning tree (Prim's and Kruskal's algorithms).

**Text Books**


1. G.A.V. Pai, Data Structures and Algorithms: Concepts, Techniques and Application, First Edition, McGraw Hill, 2017.
2. Ellis Horowitz, Sartaj Sahni and Susan Anderson-Freed, Fundamentals of Data Structures in C, Second Edition, Universities Press, 2008.
3. Mark Allen Weiss, Data Structures and Algorithm Analysis in C, Third Edition, Pearson Education, 2007.
4. Thomas H Cormen, Algorithms Unlocked, MIT Press, 2013


**Reference Books**


1. Reema Thareja, Data Structures using C, Third Edition, Oxford University Press, 2023
2. Narasimha Karumanchi, Data Structures and Algorithms Made Easy: Data Structures and Algorithmic Puzzles Fifth Edition, CareerMonk Publications, 2016.
3. Aditya Bhargava, Grokking Algorithms: An Illustrated Guide for Programmers and Other Curious People, First Edition, Manning Publications, 2016.
4. K. R. Venugopal and Sudeep R. Prasad, Mastering C, Second Edition, McGraw Hill, 2015.
5. A. K. Sharma, Data Structures using C, Second Edition, Pearson Education, 2013.

# Syllabus for Semester III, B. Tech - Computer Science & Engineering (Artificial Intelligence and Machine Learning)

**Course Code: CAP3001** **Course: Data Structures Lab**
**L: 0 Hrs, T: 0 Hr, P: 2 Hrs, Per Week** **Total Credits: 1**

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**Course Prerequisite**
Basic knowledge of computer programming and common programming concepts.

**Course Outcomes**

On successful completion, of course student will able to:
1. Identify different ADTs, their operations and specify their complexities.
2. Apply linear data structures to address practical challenges and analyze their complexity.
3. Implement different sorting, searching, and hashing methods and analyze their time and space requirements.
4. Analyse non-linear data structures to develop solutions for real-world applications.

**Syllabus:**

Experiments based on **CAT3001** Syllabus in C, C++, Java.

Few lab sessions shall be conducted using virtual lab platforms to enhance learning experiences and accessibility.

**Text Books**


1. G.A.V. Pai, Data Structures and Algorithms: Concepts, Techniques and Application, First Edition, McGraw Hill, 2017.
2. Ellis Horowitz, Sartaj Sahni and Susan Anderson-Freed, Fundamentals of Data Structures in C, Second Edition, Universities Press, 2008.
3. Mark Allen Weiss, Data Structures and Algorithm Analysis in C, Third Edition, Pearson Education, 2007.
4. Thomas H Cormen, Algorithms Unlocked, MIT Press, 2013


**Reference Books**


1. Reema Thareja, Data Structures using C, Third Edition, Oxford University Press, 2023
2. Narasimha Karumanchi, Data Structures and Algorithms Made Easy: Data Structures and Algorithmic Puzzles Fifth Edition, CareerMonk Publications, 2016.
3. Aditya Bhargava, Grokking Algorithms: An Illustrated Guide for Programmers and Other Curious People, First Edition, Manning Publications, 2016.
4. K. R. Venugopal and Sudeep R. Prasad, Mastering C, Second Edition, McGraw Hill, 2015.
5. A. K. Sharma, Data Structures using C, Second Edition, Pearson Education, 2013.

# Syllabus for Semester III, B. Tech - Computer Science & Engineering (Artificial Intelligence and Machine Learning)

**Course Code: CAT3002** **Course: Operating Systems**
**L: 3 Hrs, T: 0 Hr, P: 0 Hrs, Per Week** **Total Credits: 3**

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**Course Prerequisite**
Basic knowledge of the Computer Architecture

**Course Outcomes:**
On successful completion of the course, students will be able to:
1. Demonstrate LINUX system calls and implement system commands.
2. Implement processes and process schedulers.
3. Design and implement solution to handle synchronization and deadlock
4. Implement Memory management and File management solutions.

**Syllabus:**

**UNIT I: Introduction:** Concept of Operating Systems, Generations of Operating systems, Types of Operating Systems, OS Services, System Calls, Structure of an OS - Layered, Monolithic, Microkernel Operating Systems, Concept of Virtual Machine.
**File Management**: File System structure, Allocation methods, Free-space management, and case study on File Systems in LINUX operating System.
**Disk Management**: Disk structure, Disk scheduling - FCFS, SSTF, SCAN, C-SCAN, LOOK, C-LOOK,

**UNIT II:** Processes: Definition, Process Relationship, Different states of a Process, Process State transitions, Process Control Block (PCB), Context switching. Threads: Definition, Various states, Benefits of threads, Types of threads, Concept of multi threads. Process Scheduling: Foundation and Scheduling objectives, Types of Schedulers, Scheduling criteria: CPU utilization, Throughput, Turnaround Time, Waiting Time, Response Time; Scheduling algorithms: Pre-emptive and Non-pre-emptive, FCFS, SRTF, Priority, RR, Case study on Process Management in LINUX Operating System.

**UNIT III: Inter-process Communication**: Critical Section, Race Conditions, Mutual Exclusion, Peterson's solution, Hardware Solution, Semaphores, Monitors, Message Passing, Classical IPC Problems: Producer- Consumer Problem, Reader-Writer Problem, Dining Philosopher Problem etc.

**UNIT IV:** Deadlocks: Definition, Necessary and sufficient conditions for Deadlock, Deadlock Prevention, Deadlock Avoidance: Banker's algorithm, Deadlock Detection and Recovery.

**UNIT V:** Memory Management: Basic concept, Logical and Physical address mapping, Memory allocation: Contiguous Memory allocation – Fixed and variable partition, Internal and External fragmentation and Compaction, Paging: Principle of operation – Page allocation, Hardware support for paging, Protection and sharing, Advantages and Disadvantages of paging. Virtual Memory: Basics of Virtual Memory, Hardware and control structures, Locality of reference, Page fault, Dirty page/ Dirty bit, Demand paging; Page Replacement, algorithms: First in First Out (FIFO), Least Recently used (LRU), and Optimal.

**Text Books**

1. Operating System Concepts, 8th Editionby A. Silberschatz, P.Galvin, G. Gagne, Wiley India.
2. Modern Operating Systems, 2nd Edition by Andrew Tanenbaum, PHI.

**Reference Books:**

1. Operating Systems: Internals and Design Principles, 5th Edition, William Stallings, Prentice Hall of India.
2. Understanding the Linux Kernel, 3rd Edition, Daniel P. Bovet, Marco Cesati, O'Reilly

# Syllabus for Semester III, B. Tech - Computer Science & Engineering (Artificial Intelligence and Machine Learning)

**Course Code: CAP3002** **Course: Operating System Lab**
**L: 0 Hrs, T: 0 Hr, P: 2 Hrs, Per Week** **Total Credits: 1**

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**Course Outcomes**

On successful completion of the course, students will be able to:

1. Demonstrate LINUX system calls and implement system commands.
2. Implement processes and process schedulers.
3. Design and implement solution to handle synchronization and deadlock
4. Implement Memory management and File management solutions.

**Syllabus:**

Experiments based on **CAT3002** Syllabus in C/C++/Java, etc.

**Text Books**

1. Operating System Concepts, 8th Edition by A. Silberschatz, P.Galvin, G. Gagne, Wiley India.
2. Modern Operating Systems, 2nd Edition by Andrew Tanenbaum, PHI.

Reference Books:

1. Operating Systems: Internals and Design Principles, 5th Edition, William Stallings, Prentice Hall of India.
2. Understanding the Linux Kernel, 3rd Edition, Daniel P. Bovet, Marco Cesati, O'Reilly

# Syllabus for Semester III, B. Tech - Computer Science & Engineering (Artificial Intelligence and Machine Learning)

**Course Code: CAP3003** **Course: Software Lab - I**
**L: 0 Hrs, T: 0 Hr, P: 4 Hrs, Per Week** **Total Credits: 2**

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**Course Outcomes**
On successful completion, of course student will able to:

1. Use Python libraries for data manipulation, visualization, and statistical analysis.
2. Create and manage virtual machines using VMWare and VirtualBox.
3. Write shell scripts using TCL for automating tasks and creating user interfaces.
4. Design and simulate VHDL models using Modelsim.

**Syllabus:**

**Python Basic Libraries**

- **NumPy:** A library for scientific computing with Python. It provides a high-performance multidimensional array object, and tools for working with these arrays.
- **Pandas:** A library for data analysis and manipulation. It provides data structures and operations for manipulating numerical tables and time series.
- **Seaborn:** A library for data visualization. It provides a high-level interface for drawing statistical graphics.
- **Matplotlib:** A library for creating static, animated, and interactive visualizations in Python.
- **Scipy:** A library for scientific computing with Python. It provides modules for optimization, linear algebra, statistics, and signal processing.
- **EDA:** A library for exploratory data analysis. It provides tools for visualizing and summarizing data.

**Virtual Machine**

- **VMWare:** A software for creating and running virtual machines. It allows you to run multiple operating systems on a single computer.
- **VirtualBox:** A software for creating and running virtual machines. It is free and open-source.
- **Jira:** A software for project management and issue tracking. It is used to plan, track, and release software.

**Shell Scripting (TCL)**

- **TCL:** A scripting language for Unix-like operating systems. It is used for automating tasks and creating user interfaces.

**VHDL**

- **VHDL:** A hardware description language used to describe the behavior of electronic circuits. It is used in the design and verification of integrated circuits.

**Modelsim**

- **Modelsim:** A software for simulating VHDL designs. It allows you to verify the behavior of electronic circuits before they are manufactured.

**Text/Reference Books**


1. "Python Data Science Handbook" by Jake VanderPlas
2. "The Elements of Statistical Learning" by Trevor Hastie, Robert Tibshirani, and Jerome Friedman
3. "Data Visualization with Seaborn" by Michael Waskom
4. "VHDL: A Tutorial and Practical Guide" by William J. Dally and John W. Poulton
5. "ModelSim User's Guide" by Mentor Graphics Corporation
6. "TCL Programming for System Administration" by Brent B. Welch

# Syllabus for Semester III, B. Tech - Computer Science & Engineering (Artificial Intelligence and Machine Learning)

**Course Code: MAT3002** **Course: Probability and Statistics**
**L: 3 Hrs, T: 0 Hr, P: 0 Hrs, Per Week** **Total Credits: 3**

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**Course Pre-requisite:** Basics of Probability and Statistics**.**

**Course Objective:**

The objective of this course is to expose student to understand the basic importance fundamental principles of probability, including probability distributions, random variables, basic statistical methods used for data analysis, inferential statistics, hypothesis testing, confidence intervals, and regression analysis in computer science and Information technology.

**Course Outcomes**

On successful completion of the course, student shall be able to

1. Grasp the meaning of discrete and continuous random variables, probability distribution. Interpret the meaning of probabilities derived from distributions. This involves understanding what the calculated probabilities represent in practical terms and drawing conclusions from the results.
2. To analyze and interpret stochastic models, including calculating probabilities, transition probabilities, and steady-state probabilities within stochastic systems.
3. Grasp the fundamental concepts of curve fitting like regression techniques, model selection, and the use of different types of curves or functions to approximate data.
4. Understand the fundamental concept of hypothesis testing, including the null hypothesis (H0) and alternative hypothesis (H1), significance levels, p-values, and the basic logic behind hypothesis testing.
5. To apply MLE to various statistical models, such as linear regression, exponential distribution, etc. They should understand how to formulate likelihood functions and derive estimators for unknown parameters.

**Syllabus**

**Module 1: (8 hours)**

Probability spaces, conditional probability, independence; Discrete random variables, Binomial distribution, Poisson distribution, Normal distribution. Relation between binomial, Poisson and Normal distributions.

**Module 2: (8 Lectures)**

Joint probability function, Introduction to stochastic process, random walk, stationary and auto regressive process, transition probability Matrix, Discrete time Markov chain.

**Module 3: (8 hours)**

Curve fitting by the method of least squares- fitting of straight lines, second degree parabolas and more general curves, correlation and regression – Rank correlation, Multiple regression and correlation.

**Module 4: (8 Lectures)**

Sampling Distributions, Point and Interval Estimations, Testing of Hypothesis for single mean and proportion.

**Module 5: (7 Lectures):**
Testing of Hypothesis for difference of mean and proportion, Test for ratio of variances - Chi-square test for goodness of fit and independence of attributes, maximum likelihood estimation

**Text Books:**

1. M R. Spiegal , Theory and Problems of probability and statistics :,2nded :,Schaum series
2. S. Ross, A First Course in Probability, 6th Ed., Pearson Education India, 2002.

**Reference Books:**

1. Maurtis Kaptein, Statistics for data science, An introduction to probability, statistics and Data Analysis, Springer 2022.
2. Jay L Devore,Probability and Statistics for Engineering and sciences, 8th edition, Cenage learning.

# Syllabus for Semester III, B. Tech - Computer Science & Engineering (Artificial Intelligence and Machine Learning)

**Course Code: CAP3004** **Course: Idea Lab**
**L: 0 Hrs, T: 0 Hr, P: 4 Hrs, Per Week** **Total Credits: 2**

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**Course Outcomes**
On successful completion, of course student will able to:

1. Identify problems across various domains and effectively frame them that facilitates creative solution generation.
2. Understand business models, pricing strategies, and ethical considerations in innovations.
3. Apply for patents/copyrights under IPR activities.
4. Design prototypes or proof-of-concepts to test and validate their ideas.
5. Enhance their presentation and communication skills as they pitch ideas, articulate concepts, and engage with stakeholders.

**Syllabus:**

1. Introduction of idea generation techniques and methodologies based on case studies of successful innovations.
2. Conducting market research, such as surveys, interviews, focus groups, and observational studies.
3. Brainstorming exercises and group discussions on problem framing and the solutions.
4. Hands-on activities for developing prototypes and refining ideas through user feedback.
5. Technical report writing and research proposals that match technology readiness levels (TRLs).
6. Practice sessions for pitching ideas and receiving constructive feedback.
7. Discussion on concepts such as business models, value proposition, pricing strategies and ethical implications for scalable innovations.

**Text Books**


1. Jacob Goldenberg and David Mazursky, Creativity in Product Innovation, Cambridge University Press, 2022.
2. Jessica Livingston, Founders at Work: Stories of Startups' Early Days", Fourth Edition, Apress, 2008.
3. Bill McGowan, Pitch Perfect: How to Say It Right the First Time, Every Time, Reprint Edition, Harper Business, 2016.


**Reference Books**


1. Bjarki Hallgrimsson**,** Prototyping and Modelmaking for Product Design**,** Laurence King Publishing Ltd**,** 2012.
2. David Bornstein and Susan Davis**,** Social Entrepreneurship: What Everyone Needs to Know**,** Oxford University Press**,** 2010.

# Syllabus for Semester III, B. Tech - Computer Science & Engineering (Artificial Intelligence and Machine Learning)

**Course Code: CAT3005** **Course: Cyber Law and Ethics**
**L: 2 Hrs, T: 0 Hr, P: 0 Hrs, Per Week** **Total Credits: 2**

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**Prerequisites:** Basic Knowledge of Internet

**Course Outcomes**
On successful completion, of course student will able to learn:

1. Analyse the role of ethics in IT organization.
2. Identify various cyber laws with respect to legal dilemmas in the Information Technology field.
3. Interpret various intellectual property rights, Privacy, Protection issues in Information Technology field.
4. Describe the ways of precaution and prevention of Cyber Crime as well as Human Rights.

**Syllabus:**

**UNIT I:** Ethics in business world & IT professional malpractices, Introduction to firewalls, IDS System, Distortion and fabrication of information

**UNIT II:** Ethics of IT Organization: Contingent Workers H- IB Workers, Whistle- blowing, Protection for Whistle- Blowers, Handling Whistle- blowing situation, Digital divide.

**UNIT III:** Intellectual Property: Copyrights, Patents, Trade Secret Laws, Key Intellectual property issues, Plagiarism, Privacy: The right of Privacy, Protection, Key Privacy and K-Anonymity issues, Identity Theft, Consumer Profiling,

**UNIT IV:** Cyber laws and rights in today's digital age, Emergence of Cyberspace, Cyber Jurisprudence, Cyber Crimes against Individuals, Institution and State, Hacking, Digital Forgery, Cyber Stalking/Harassment, Cyber terrorism, cyber tort, Cyber Defamation & hate speech, Competitive Intelligence, Cybersquatting, The Indian information technology act 2000 IT Act.

**Text Books:**

1. George Reynolds, “Ethics in information Technology”,5th edition, Cengage Learning
2. Hon C Graff, Cryptography and E-Commerce - A Wiley Tech Brief, Wiley Computer Publisher, 2001.

**Reference Books:**
1. Michael Cross, Norris L Johnson, Tony Piltzecker, Security, Shroff Publishers and Distributors Ltd.
2. Debora Johnson,” Computer Ethic s”,3/e Pearson Education.
3. Sara Baase, “A Gift of Fire: Social, Legal and Ethical Issues, for Computing and the Internet,” PHI Publications.
4. Chris Reed & John Angel, Computer Law, OUP, New York, (2007).
5. Dr Pramod Kr. Singh, “Laws on Cyber Crimes [Along with IT Act and Relevant Rules]” Book Enclave Jaipur India.

# Syllabus for Semester IV, B. Tech - Computer Science & Engineering (Artificial Intelligence and Machine Learning)

**Course Code: HUT3001** **Course: Business Communication**
**L: 2 Hrs, T: 0 Hr, P: 0 Hrs, Per Week** **Total Credits: 2**

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**Course Objective**
The course aims to develop the skills of students to proficiently craft compelling business documents and employ strategic verbal communication techniques. By honing these skills, students will gain the ability to convey ideas persuasively and interact confidently in diverse business contexts.

**Course Outcomes**
On successful completion of the course the students will be able to achieve the following:
CO1: Understand the fundamentals of business communication.
CO2: Apply tools and techniques to create effective workplace correspondence.
CO3: Analyse and apply visual design principles to create business documents.
CO4: Understand and evaluate information to draft reports.
CO5: Apply and evaluate strategies for effective communication for employment.

**Syllabus:**

**UNIT 1: Fundamentals of Business Communication**
Definition of communication, Emergence of communication as a key concept in the Corporate and Global world, Types- Internet, Blogs, E-mails, social media, Channels- Formal and Informal: Vertical, Horizontal, Diagonal, Grapevine, Persuasive Communication- Negotiation Skills, PAC concept

**UNIT 2: Business Correspondence**
Planning, Writing, and Completing Business Messages
**Personnel Correspondence:** Job Application Letter, Letter of Acceptance of Job Offer, Letter of Resignation, Letter of Appointment, Promotion and Termination, Letter of Recommendation
**Trade Correspondence:** Inquiry, Order, Credit and Status Enquiry, Complaints, Claims, Adjustments, Consumer Grievance Letters

**UNIT 3: Visual and Content Creation**
Visual design principles, Ethics of visual communication, selecting visuals for presenting data, Content Creation: Website, Help file, User Guides, Promotional leaflets and fliers

**UNIT 4: Reports**
Basic formats and types of reports - Feasibility, Progress, Project, Case Study Evaluation, Agenda, Notices, Minutes of Meeting, Organizational announcements, Statement of Purpose.

**UNIT 5: Communication for Employment**
Pre-interview technique- NOISE Analysis, Job Description and Resume, Creating LinkedIn Profile, Effective use of job portals, Business etiquette.

**Text Books**


1. Sharon Gerson, Steven Gerson, “Technical Communication: Process and Product”, 2018, Pearson
2. Courtland L Bovee, John V Thill and Roshan Lal Raina “Business Communication Today”, 14th edition Pearson
3. P.D. Chaturvedi and Mukesh Chaturvedi, Fundamentals of Business Communication, Pearson Publications, 2012.


**Reference Books**


1. Shalini Verma, Business Communication, Vikas Publishing House Pvt. Ltd., 2015.
2. Sanjay Kumar, Pushpa Lata, Communication Skills, 2nd Edition, Oxford Publication, 2018
3. William Strunk Jr. and E.B. White, The Elements of Style, Allyn & Bacon, A Pearson Education Company, 2000

# Syllabus for Semester IV, B. Tech - Computer Science & Engineering (Artificial Intelligence and Machine Learning)

**Course Code: CAT4001** **Course: Artificial Intelligence**
**L: 3 Hrs, T: 0 Hr, P: 0 Hrs, Per Week** **Total Credits: 3**

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**Course Prerequisite**
Basic knowledge of the data structure and probability.

**Course Outcomes**
On successful completion, of course student will be able to:

1. Apply uninformed and informed search techniques and represent given problem using state space representation.
2. Utilize different AI techniques to solve fully informed two player games and constraint satisfaction problems.
3. Solve the AI problems by using logic programming.
4. Identify the uncertainty theory-based techniques for solving diverse problems.

**Syllabus:**

**UNIT I: Introduction to Artificial Intelligence**
History, applications, task domains, Basics of problem solving, problem characteristics, problem representation (toy problems and real-world problems); Structure of agent, rational agent, specifying task environment, Properties of task environment; measuring problem solving performance.
Uninformed Search: Depth, Breadth, Uniform Cost, Depth Limited, Iterative deepening DFS, Bidirectional Search.
Informed Search: Heuristic Based Search, Greedy Best First Search, A* Search; Local Search algorithms: Hill-climbing, Genetic Algorithms.

**UNIT III: Adversarial Search**
Two player Games, The min-max algorithm, Alpha-Beta pruning. Constraint Satisfaction Problems: Constraint propagation, backtracking search.

**UNIT IV: Knowledge Representation**
Propositional logic, First Order Logic: Syntax and Semantics of FOL, Inference in FOL: Unification Algorithm, Resolution, Forward Chaining, Backward Chaining.

**UNIT V: Uncertain Knowledge and Reasoning**
Probability and Bayes' Theorem, Statistical reasoning: Bayesian networks, Bayes optimal classifier, Naïve bayes algorithm, Fuzzy Logic: properties and operations, Introduction to expert system.

**Text Books**


1. Stuart Russel and Peter Norvig; Artificial Intelligence: A Modern Approach; Fourth Edition; Pearson Education, 2022.
2. E. Rich, K. Knight, S.B. Nair; Artificial Intelligence ,3rd Edition, Tata McGraw Hill, 2009.
3. G. Luger, Artificial Intelligence: Structures and Strategies for complex problem solving, Sixth Edition, Pearson Education, 2009.

**Reference Books**


1. Dan W Patterson, Introduction to Artificial Intelligence & Expert System, Pearson Education India; First Edition, 2015.
2. By Patrick D. Smith, David Dindi, Hands-On Artificial Intelligence for Beginners: An introduction to AI concepts, algorithms, and their implementation, First edition, Packt Publishing Ltd, 2018.
3. Denis Rothman; Artificial Intelligence By Example: Develop machine intelligence from scratch using real artificial intelligence use cases; Kindle Edition, Packt Publishing Ltd, 2018.
4. Richard E. Neapolitan, Xia Jiang, Artificial Intelligence with an Introduction to Machine Learning, Chapman and Hall/CRC; 2nd edition, 2018.

# Syllabus for Semester IV, B. Tech - Computer Science & Engineering (Artificial Intelligence and Machine Learning)

**Course Code: CAP4001** **Course: Artificial Intelligence Lab**
**L: 0 Hrs, T: 0 Hr, P: 2 Hrs, Per Week** **Total Credits: 1**

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**Course Prerequisite**
Basic knowledge of the data structure and probability.

**Course Outcomes**
On successful completion, of course student will be able to:

1. Apply uninformed and informed search techniques and represent given problem using state space representation.
2. Utilize different AI techniques to solve fully informed two player games and constraint satisfaction problems.
3. Solve the AI problems by using logic programming.
4. Identify the uncertainty theory-based techniques for solving diverse problems.

**Syllabus:**

Experiments based on **CAT4001** Syllabus.

**Text Books**


1. Stuart Russel and Peter Norvig; Artificial Intelligence: A Modern Approach; Fourth Edition; Pearson Education, 2022.
2. E. Rich, K. Knight, S.B. Nair; Artificial Intelligence ,3rd Edition, Tata McGraw Hill, 2009.
3. G. Luger, Artificial Intelligence: Structures and Strategies for complex problem solving, Sixth Edition, Pearson Education, 2009.


**Reference Books**


1. Dan W Patterson, Introduction to Artificial Intelligence & Expert System, Pearson Education India; First Edition, 2015.
2. By Patrick D. Smith, David Dindi, Hands-On Artificial Intelligence for Beginners: An introduction to AI concepts, algorithms, and their implementation, First edition, Packt Publishing Ltd, 2018.
3. Denis Rothman; Artificial Intelligence By Example: Develop machine intelligence from scratch using real artificial intelligence use cases; Kindle Edition, Packt Publishing Ltd, 2018.
4. Richard E. Neapolitan, Xia Jiang, Artificial Intelligence with an Introduction to Machine Learning, Chapman and Hall/CRC; 2nd edition, 2018.

# Syllabus for Semester IV, B. Tech - Computer Science & Engineering (Artificial Intelligence and Machine Learning)

**Course Code: CAT4002** **Course: Design and Analysis of Algorithms**
**L: 3 Hrs, T: 0 Hr, P: 0 Hrs, Per Week** **Total Credits: 3**

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**Course Prerequisite**

Basic knowledge of the algorithms and its complexity, computer programming and common programming concepts.

**Course Outcomes**

On successful completion, of course student will be able to:

1. Describe mathematical formulation, complexity analysis and methodologies to solve the recurrence relations for algorithms.
2. Design Greedy and Divide & Conquer algorithms and their usage in real life examples.
3. Apply the principles of dynamic programming for problem-solving and optimization.
4. Utilize the graph theory, traversal, search algorithms, and backtracking techniques in real life usages.
5. Understand the NP class problems and formulate solutions using standard approaches.

**Syllabus:**

**UNIT I:** Recurrence relations and their solutions, Principles of designing algorithms and complexity calculation, Asymptotic notations for analysis of algorithms, worst case and average case analysis, amortized analysis and its applications.

**UNIT II:** Divide and Conquer - basic strategy, Strassen's matrix multiplication, Maximum subarray problem, Closest pair of points problem.
Greedy method – basic strategy, fractional knapsack problem, Huffman Coding, activity selection problem, Find maximum sum possible equal to sum of three stacks.

**UNIT III:** Dynamic Programming -basic strategy, Bellman-Ford algorithm, all pairs shortest path, multistage graphs(backward), optimal binary search trees, traveling salesman problem, Longest Common Subsequence problem and its variations.

**UNIT IV:** Basic Traversal and Search Techniques, breadth first search and depth first search, connected components. Backtracking basic strategy, 8-Queens' problem, graph coloring, Hamiltonian cycles, sum of subset problem.

**UNIT V:** NP-hard and NP-complete problems, basic concepts, non-deterministic algorithms, NP-hard and NP complete, decision and optimization problems, polynomial reduction, graph based problems on NP Principle, vertex cover problem, clique cover problem.

**Text Books:**

1. Thomas H. Cormen et.al; "Introduction to Algorithms": 3 Edition, Prentice Hall, 2009.
2. Horowitz, Sahani and Rajasekaran;"Computer Algorithms", SiliconPress,2008.
3. Brassard and Bratley; "Fundamentals of Algorithms", 1 Edition; Prentice Hall, 1995.
4. Richard Johnsonbaugh, "Algorithms", Pearson Publication, 2003.

**Reference Books**

1. Parag Himanshu Dave, Balchandra Dave, "Design and Analysis of Algorithms", Pearson Education, O'relly Publication.
2. Richard Johnson Baugh, "Algorithms", Pearson Publication, 2003.

# Syllabus for Semester IV, B. Tech - Computer Science & Engineering (Artificial Intelligence and Machine Learning)

**Course Code: CAT4003** **Course: Theory of Computation**
**L: 3 Hrs, T: 0 Hr, P: 0 Hr, Per Week** **Total Credits: 3**

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**Course Prerequisite**

Basic knowledge of the algorithms and its complexity, computer programming and common programming concepts.

**Course Outcomes**

On successful completion of the course, students will be able to:

1. Describe the formal relationships among machines, languages and grammars.
2. Design and Optimize finite automata for given regular languages.
3. Design context free grammar for a given language.
4. Design Pushdown Automata, Turing Machine for given languages.

**SYLLABUS**

**UNIT-I:** Basics of Theory of Computation, Basics of Sets and Relation, Countability and Diagonalization, Principle of mathematical induction, Pigeon- hole principle. Fundamentals of formal languages and grammars, Chomsky hierarchy of languages.

**UNIT-II:** Finite Automata, Deterministic finite automata (DFA), Nondeterministic finite automata (NFA) and equivalence with DFA, Minimization of finite automata, NFA with Epsilon Transitions, Finite Automata with output.

**UNIT-III:** Regular expressions and Regular languages, Regular grammars and equivalence with finite automata, properties of regular languages, pumping lemma for regular languages, Context-free grammars (CFG) and language (CFL), parse trees, ambiguity in CFG, Reduction of CFGs, Chomsky and Greibach normal forms.

**UNIT-IV:** Push Down Automata, Deterministic pushdown automata and Non-Deterministic pushdown automata, Acceptance by two methods: Empty stack and Final State, Equivalence of PDA with CFG, closure properties of CFLs.

**UNIT-V:** Turing Machines, The basic model for Turing machines (TM), Turing recognizable recursively enumerable) and Turing-decidable (recursive) languages, variants of Turing machines, unrestricted grammars and equivalence with Turing machines, TMs as enumerators.

**Text Books**

1. John E. Hopcroft, Rajeev Motwani and Jeffrey D. Ullman, Introduction to Automata Theory, Languages, and Computation, Pearson Education Asia.

**Reference Books**

1. Harry R. Lewis and Christos H. Papadimitriou, Elements of the Theory of Computation, Pearson Education Asia.
2. Dexter C. Kozen, Automata and Computability, Undergraduate Texts in Computer Science, Springer.
3. Michael Sipser, Introduction to the Theory of Computation, PWS Publishing.
4. John Martin, Introduction to Languages and the Theory of Computation, Tata McGraw Hill

# Syllabus for Semester IV, B. Tech - Computer Science & Engineering (Artificial Intelligence and Machine Learning)

**Course Code: MAT4001** **Course: Linear Algebra**
**L: 3 Hrs, T: 0 Hr, P: 0 Hr, Per Week** **Total Credits: 3**

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**Course Pre-requisite:** Basic knowledge of Matrices and MAT2002 (Discrete Mathematics)

**Course Objective:**
The objective of this course is to provide a foundational understanding and application of linear algebra concepts relevant to various aspects of computer science and related fields

**Course Outcomes**
On successful completion of the course, student shall be able to

1. Check the consistency of system of equations and able to solve systems of linear equations by using Gaussian elimination method.
2. Determine which set is a vector space and able to find the basic elements of vector space.
3. Understand the fundamental concepts of linear transformations including mappings, kernel, image, null space, rank, and linear independence.
4. Find the orthogonal basis elements from given basis elements.
5. To find eigen values, eigen vectors and singular value decomposition of matrix

**Syllabus**
**Module 1**
Row echelon form, Reduced row echelon form of Matrix, rank of matrix, system of Linear Equations.

**Module 2:**
Vector space, subspace, properties of subspaces, spanning set, Linearly independent and dependent vectors, Basis and dimensions of vector space.

**Module 3:**
Linear Transformation, range space and null space of Linear Transformation, Rank-Nullity Theorem, matrix representation of linear transformation.

**Module 4:**
Inner Product Spaces, Norm; Orthonormal Sets, Gram Schmidt orthogonalisation process, projections, positive definite matrices, QR decomposition.

**Module 5:**
Eigen values and eigenvectors, diagonalization, spectral theorem of Matrix, Singular value decomposition, Least square method and introduction to PCA.

**Text Books:**

1. Hoffman and Kunze : Linear Algebra, Prentice Hall of India, New Delhi
2. Gilbert Strang : Linear Algebra And Its Applications (Paperback) , Nelson Engineering (2007)

**Reference Books:**

1. Seymour Lipschutz et al: Linear Algebra, 3rd ed: Schaum series.
2. V. Krishnamoorthy et al : An introduction to linear algebra , Affiliated East West Press, New Delhi P.G. Bhattacharya, S.K. Jain and S.R.

# Syllabus for Semester IV, B. Tech - Computer Science & Engineering (Artificial Intelligence and Machine Learning)

**Course Code: CAP4004** **Course: Software Lab - II**
**L: 0 Hrs, T: 0 Hr, P: 2 Hrs, Per Week** **Total Credits: 1**

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**Course Outcomes**

On successful completion, of course student will able to:

1. Demonstrate proficiency in utilizing popular machine learning tools and libraries such as Scikit-learn, Keras, TensorFlow, and PyTorch
2. Apply natural language processing techniques using NLTK and Spacy libraries to process, analyze, and extract information from textual data
3. Develop skills in web scraping by utilizing tools like Beautiful Soup and Scrapy to extract relevant data from websites and understand the fundamentals
4. Gain hands-on experience in Internet of Things (IoT) development by working with Arduino, Raspberry Pi, and related tools

**Syllabus:**

1. Introduction to Machine Learning Tools
   - Overview of Scikit-learn library
   - Exploring various machine learning algorithms
   - Data preprocessing and feature engineering techniques
2. Deep Learning Frameworks
   - Introduction to Keras, TensorFlow, and PyTorch
   - Neural network architectures and training
   - Transfer learning and fine-tuning pre-trained models
3. Natural Language Processing (NLP) Libraries
   - Introduction to NLTK (Natural Language Toolkit)
   - Text preprocessing and cleaning
   - Text classification and sentiment analysis using NLTK
4. Advanced NLP with Spacy
   - Overview of Spacy library for NLP tasks
   - Named Entity Recognition (NER)
   - Dependency parsing and text processing
5. Web Scraping Techniques
   - Introduction to web scraping
   - Extracting data using Beautiful Soup library
   - Building web spiders with Scrapy
6. Data Visualization and Monitoring
   - Introduction to data visualization with Grafana
   - Monitoring and analyzing data using Grafana dashboards
   - Integrating data sources with Minikube
7. Internet of Things (IoT) Development
   - Introduction to Arduino and Raspberry Pi platforms
   - Building IoT applications using Python
   - Sensor integration and data acquisition
8. Project Work
   - Hands-on project to apply the learned concepts and tools
   - Students will work on a real-world problem using the acquired skills

**Text/Reference Books**


1. Scikit-learn: Machine Learning in Python. Pedregosa, F., et al. (2011). Journal of Machine Learning Research, 12, 2825-2830.
2. Deep Learning with Python. Chollet, F. (2017). Manning Publications.
3. Natural Language Processing with Python: Analyzing Text with the Natural Language Toolkit. Bird, S., et al. (2009). O'Reilly Media.
4. Web Scraping with Python: A Comprehensive Guide. Ryan Mitchell. (2018). O'Reilly Media.

# Syllabus for Semester IV, B. Tech - Computer Science & Engineering (Artificial Intelligence and Machine Learning)

**Course Code: CAP4005** **Course: Software Lab - III**
**L: 0 Hrs, T: 0 Hr, P: 2 Hrs, Per Week** **Total Credits: 1**

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**Course Outcomes**
On successful completion, of course student will able to:

1. Master version control using Git/GitHub for effective collaboration and code management.
2. Containerize applications seamlessly using Docker and Portainer for efficient deployment and scalability.
3. Automate CI/CD pipelines proficiently with Jenkins to enhance software delivery and integration.
4. Develop web applications using Flask/Django and Docker Compose, alongside advanced FPGA development using Xilinx Vivado for comprehensive software engineering skills.

**Syllabus:**

**DevOps**

- **Version Control (Git/GitHub):** Learn the basics of version control using Git and how to use GitHub for collaboration and code sharing.
- **Implementation of Flask application:** Learn how to create and deploy a simple web application using the Flask framework and Python.
- **Containerization (Docker, Portainer):** Understand the concept of containerization and how to use Docker to create and manage containers. Learn how to use Portainer to manage Docker containers.
- **Integration, Development, and Building (Jenkins):** Learn how to use Jenkins for continuous integration and continuous development. Understand how to build and test software projects using Jenkins.
- **Django, Docker Compose:** Learn how to create and deploy a more complex web application using the Django framework and Python. Learn how to use Docker Compose to manage multiple containers for a Django application.

**FPGA**

- **Xilinx, Vivado:** Learn the basics of FPGA (Field-Programmable Gate Array) technology and how to use Xilinx Vivado to design and implement digital circuits on FPGAs.

**Text/Reference Books**


1. "Version Control with Git" by Jon Loeliger
2. "Flask Web Development" by Miguel Grinberg
3. "Docker: Up and Running" by Scott Lowe
4. "Jenkins: The Definitive Guide" by John Ferguson Smart
5. "Django: The Complete Beginner's Guide" by William S. Vincent
6. "Vivado Design Suite User Guide" by Xilinx, Inc.

# Syllabus for Semester IV, B. Tech - Computer Science & Engineering (Artificial Intelligence and Machine Learning)

**Course Code: CAP4006** **Course: Community Engagement Project**
**L: 0 Hrs, T: 0 Hr, P: 4 Hrs, Per Week** **Total Credits: 2**

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**Course Outcomes**
On successful completion, of course student will able to:

1. Gain an understanding of rural life, Indian culture & ethos and social realities
2. Develop a sense of empathy and bonds of mutuality with local community
3. Appreciate significant contributions of local communities to Indian society and economy
4. Learn to value the local knowledge and wisdom of the community
5. Identify opportunities for contributing to community's socioeconomic improvements

**Syllabus:**
**Week 1-2:** Appreciation of Rural Society: Rural lifestyle, rural society, caste and gender relations, rural values with respect to community, nature and resources, elaboration of "soul of India lies in villages' (Gandhi), rural infrastructure.
**Week 3-4:** Understanding rural and local economy & livelihood: Agriculture, farming, land ownership, water management, animal husbandry, non-farm livelihoods and artisans, rural entrepreneurs, rural markets, migrant labour.
**Week 5-7:** Rural and local Institutions: Traditional rural & community organisations, Self-help Groups, Panchayati raj institutions (Gram Sabha, Gram Panchayat, Standing Committees), Nagarpalikas and municipalities, local civil society, local administration.
**Week 8-10:** Rural & National Development Programmes: History of various /development in India, current national programmes: Sarva Shiksha Abhiyan, Beti Bachao, Beti Padhao, Ayushman Bharat, Swatchh Bharat, PM Awaas Yojana, Skill India, Gram Panchayat Decentralised Planning, NRLM, MNREGA, SHRAM, Jal Jeevan Mission, SFURTI, Atma Nirbhar Bharat, etc.

**Teaching/ Learning Methodology**

- Classroom discussions, Group discussions, Field visit, Group presentation, Written assignment
- Interaction with self-help groups women members, and study of their functions and challenges; planning for their skill building and livelihood activities
- Conduct Mission Antyodaya surveys to support under Gram Panchayat Development Plan (GPDP)
- Participate in Gram Sabha meetings, and study community participation
- Associate with Social audit exercises at the Gram Panchayat level, and interact with programme beneficiaries
- Visit MGNREGS project sites, interact with beneficiaries and interview functionaries at the site
- Field visit to Swachh Bharat project sites, conduct analysis and initiate problem solving measures
- Visit Rural Schools / mid-day meal centres, study academic and infrastructural resources and gaps
- Visit local Anganwadi Centre and observe the services being provided
- Visit local NGOs, civil society organisations and interact with their staff and beneficiaries,
- Organize awareness programmes, health camps, Disability camps and cleanliness camps
- Organise orientation programmes for farmers regarding organic cultivation, rational use of irrigation and fertilizers and promotion of traditional species of crops and plants
- Formation of committees for common property resource management, village pond maintenance and fishing

**Online Reference Course**

- https://onlinecourses.swayam2.ac.in/ugc23_ge04/preview

# Syllabus for Semester IV, B. Tech - Computer Science & Engineering (Artificial Intelligence and Machine Learning)

**Course Code: HUT4002** **Course: Environment Education**
**L: 2 Hrs, T: 0 Hr, P: 0 Hr, Per Week** **Total Credits: 2**

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**Course Outcomes**
**On successful completion, of course student will able to do the following:**
CO1: Understand and appreciate the historical context of human interactions with the environment.
CO2: Understand the concept of natural resources and their sustainable development
CO3: Develop a critical understanding of the environmental issues of concern
CO4: Understand the concepts of ecosystems, biodiversity and conservation
CO5: Understand broad aspects of environmental management and assessment systems

**Syllabus:**

**UNIT I: Humans and the Environment**
Great ancient civilizations and the environment, Indic Knowledge and Culture of sustainability; Middle Ages and Renaissance; Industrial revolution and its impact on the environment; Population growth and natural resource exploitation; Global environmental change; emergence of environmentalism

**UNIT II: Natural Resources and Sustainable Development**
Definition of resource; Classification of natural resources
Water resources; Soil and mineral resources; Energy resources; Sustainable Development Goals (SDGs)

**UNIT III: Environmental Issues: Local, Regional and Global**
Environmental issues and scales, Pollution, Land use and Land cover change, Global change, case studies/field visit

**UNIT IV: Conservation of Biodiversity and Ecosystems**
Biodiversity and its distribution – India and the world; Ecosystems and ecosystem services, Threats to biodiversity and ecosystems; Major conservation policies and practises, case studies/field visit

**UNIT V: Environmental Management**
Introduction to environmental laws and regulation, Concept of Circular Economy, Life cycle analysis; Cost-benefit analysis; Environmental audit and impact assessment; Concept of 3R (Reduce, Recycle and Reuse) and sustainability; Ecolabeling /Ecomark scheme, case studies/field visit.

**Books**

1. Fisher, Michael H. (2018) An Environmental History of India- From Earliest Times to the Twenty-First Century, Cambridge University Press.
2. Headrick, Daniel R. (2020) Humans versus Nature- A Global Environmental History, Oxford University Press.
3. Simmons, I. G. (2008). Global Environmental History: 10,000 BC to AD 2000. Edinburgh University Press

4. Singh, J.S., Singh, S.P. & Gupta, S.R. 2006. Ecology, Environment and Resource Conservation. Anamaya Publications https://sdgs.un.org/goals
5. Harris, Frances (2012) Global Environmental Issues, 2nd Edition. Wiley- Blackwell.
6. Rajagopalan, R. (2011). Environmental Studies: From Crisis to Cure. India: Oxford University Press.
7. Krishnamurthy, K.V. (2003) Textbook of Biodiversity, Science Publishers, Plymouth, UK
8. Singh, Kartar and Anil Shishodia (2007) 'Environmental Economics: Theory and Applications", Sage,
9. Karpagam. M (2019) Environmental Economics: A textbook, Sterling
10. Jørgensen, Sven Marques, Erik João Carlos and Nielsen, Søren Nors (2016) Integrated Environmental Management, A transdisciplinary Approach. CRC Press.
11. Theodore, M. K. and Theodore, Louis (2021) Introduction to Environmental Management, 2nd Edition. CRC Press.
12. Barrow, C. J. (1999). Environmental management: Principles and practice. Routledge.
13. Tiefenbacher, J (ed.) (2022), Environmental Management - Pollution, Habitat, Ecology, and Sustainability, Intech Open, London. 10.5772/
14. Richard A. Marcantonio, Marc Lame (2022). Environmental Management: Concepts and Practical Skills. Cambridge University Press.
15. N. Mani (2020) Environmental Economics, New NC Century
16. Subhashini Muthukrishnan (2015) Economics of Environment, PHI
17. Rabindra N. Bhattacharya (2001) Environmental Economics: An Indian Perspective, Oxford University press

# Syllabus for Semester IV, B. Tech - Computer Science & Engineering (Artificial Intelligence and Machine Learning)

**Course Code: HUT4003** **Course: Managerial Economics**
**L: 2 Hrs, T: 0 Hr, P: 0 Hr, Per Week** **Total Credits: 2**

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**Course Outcomes**
On successful completion, of course student will able to learn:
CO1: Gain basic knowledge of Economics to take managerial decisions.
CO2: Apply the knowledge of the mechanics of supply and demand to explain working of markets
CO3: To understand the concepts of production, cost, and revenue from a business perspective
CO4: To understand the various market types
CO5: Understand the concepts of macroeconomics for better understanding of the functioning of the economy for taking informed managerial decisions.

**Syllabus:**

**UNIT 1: Introduction to Managerial Economics:**
Nature & scope of Managerial Economics: Concepts of Managerial Economics.
Economic theory & Managerial theory. Role & responsibilities of Managerial Economists

**UNIT 2: Micro Economics:**
Demand Analysis: Individual & market, Law of demand. Elasticity of demand its meaning and importance. Price elasticity, Income elasticity & Cross elasticity Using elasticity in Managerial decisions
Supply Analysis: Supply and Stock, Law of supply, supply function, determinants and elasticity of supply, Equilibrium of Demand and Supply.

**UNIT 3: Theory of Production, Costs, and Revenue:**
Meaning of production, factors of production, laws of variable proportion, Economies and diseconomies of scale, Cost and Revenue concepts

**UNIT 4: Market System:**
Meaning of Market, Types of market - Perfect Competition Market, Monopoly and Monopolistic market, Oligopoly, Duopoly

**Unit 5: Macroeconomics for Management**
**Concepts and Issues:** Consumer Price Index, Wholesale Price Index, BOP, Current and Capital account, GDP, GNP, PI, Inflation, Business cycles, Monetary policy

**Text Books:**

1. Ahuja H.L., (2017) Managerial Economics, Analysis of managerial Decision making, S. Chand and company Limited, New Delhi, 9th ed.
2. Dwivedi D.N., (2015). Managerial Economics, Vikas publishing house Pvt. Ltd, Nodia, 8th ed.


**Reference Books**

1. Mankiw G., (2008) Principles of Economics (Kindle Edition) South Western Cengage Learning, Nodia 6th ed.
2. Salvatore, D., (2007) Managerial Economics. London: Oxford University Press, 6th ed.

**Syllabus for Semester V, B. Tech. Computer Science & Engineering**

**(Artificial Intelligence & Machine Learning)**

**Course Code : CAT5001** **Course : Machine Learning**

**L: 3Hrs, T: 0 Hr, P: 0Hrs, Per Week** **Total Credits: 03**

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**Course Objectives**

1. To introduce the basic concepts and techniques of machine learning.

2. To understand major machine learning algorithms.

3. To identify machine learning techniques suitable for a given problem.

**Syllabus**

**UNIT – I**

Concept Learning: The concept learning task, General-to-specific ordering of hypotheses, Version spaces, Inductive bias, Decision Tree Learning, Rule Learning: Propositional and First-Order, Over-fitting, Cross Validation, Experimental Evaluation of Learning Algorithms.

**UNIT - II**

Instance-Based Learning: K-Nearest neighbor algorithm, Radial basis functions, Case-based learning. Computational Learning Theory: probably approximately correct (PAC) learning, Sample complexity, Computational complexity of training, Vapnik Chervonenkis dimension.

**UNIT - III**

Artificial Neural Networks: Linear threshold units, Perceptron, Multilayer networks and backpropagation, recurrent networks.

**UNIT - IV**

Probabilistic Machine Learning: Maximum Likelihood Estimation, MAP, Bayes Classifiers Naïve Bayes, Bayes optimal classifiers, Minimum description length principle.

Bayesian Networks, Inference in Bayesian Networks.

**UNIT - V**

Expectation Maximization algorithm, preventing over fitting, Gaussian Mixture Models, K- means and Hierarchical Clustering.

Hidden Markov Models, Reinforcement Learning, Support Vector Machines, Ensemble learning: boosting, bagging.

**Course Outcomes:**

**On successful completion of the course, students will be able to:**

1. Solve the problems related to the fundamental concepts in machine learning.
2. Apply machine learning algorithms to solve classification, regression and clustering problems.
3. Analyse the strengths and weaknesses of various machine learning approaches.
4. Apply various machine learning models to efficiently solve real-world problems.

**Text Books**

1. Tom Mitchell; Machine Learning- an Artificial Intelligence Approach, Volume-II; Morgan Kaufmann, 1986.

2. Christopher Bishop, Pattern Recognition and machine learning; Springer Verlag, 2006.

**Reference Books**

1. Soumen Chakrabarti; Mining the Web: Discovering Knowledge from Hypertext Data, Morgan Kaufmann, 2003.

2. A. K. Jain and R. C. Dubes; Algorithms for Clustering Data; Prentice Hall PTR, 1988.

3. Ethem Alpaydin, Introduction to Machine Learning, PHI.

**Syllabus for Semester V, B. Tech. Computer Science & Engineering**

**(Artificial Intelligence & Machine Learning)**

**Course Code : CAP5001** **Course : Machine Learning Lab**

**L: 0Hrs, T: 0 Hr, P: 2Hrs, Per Week** **Total Credits: 01**

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**Course Objectives**

1. To implement basic machine learning algorithm for solving problem.
2. To understand the usage of datasets in implementing machine learning problems.
3. To learn various modern tools, packages and techniques for machine learning.

**Technology: Python.**

**Syllabus**

1. To implement Find-S algorithm to find maximally specific hypothesis on given dataset.
2. To implement Candidate Elimination algorithm on Enjoy Sports dataset and find candidate hypothesis.
3. To implement linear regression algorithm on given dataset.
4. To implement decision tree classifier on given dataset and display generated tree.
5. To Implement KNN algorithm for classification and regression on given datasets.
6. To implement the perceptron algorithm for AND, OR and NOR Boolean functions.
7. To implement the backpropagation algorithm for machine learning using suitable dataset.
8. To implement the Naïve Bayes algorithm on given dataset.
9. To implement the support vector machine algorithm on given dataset.

**Course Outcomes:**

**On successful completion of the course, students will be able to:**

**1.** Implement fundamental concepts used in machine learning algorithms.
2. Implement python programs for various learning algorithms.
3. Apply appropriate machine learning algorithms to various data sets.
4. Apply machine learning algorithms to solve real world problems.

**Text Books**

1. Tom Mitchell; Machine Learning- an Artificial Intelligence Approach, Volume-II; Morgan Kaufmann, 1986.

2. Christopher Bishop, Pattern Recognition and machine learning; Springer Verlag, 2006.

**Reference Books**

1. Soumen Chakrabarti; Mining the Web: Discovering Knowledge from Hypertext Data, Morgan Kaufmann, 2003.

2. A. K. Jain and R. C. Dubes; Algorithms for Clustering Data; Prentice Hall PTR, 1988

3. Ethem Alpaydin, Introduction to Machine Learning, PHI.

**Syllabus for Semester V, B. Tech. Computer Science & Engineering**

**(Artificial Intelligence & Machine Learning)**

**Course Code : CAT5002** **Course : Computer Networks**

**L: 3Hrs, T: 0 Hr, P: 0Hrs, Per Week** **Total Credits: 03**

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**Course Objectives**

1. To Introduce the fundamental concepts of each layer in the OSI and TCP/IP models.
2. To implement, and troubleshoot network topologies and examine network and transport Layer protocol working.
3. To learn about network security, firewalls, and intrusion detection.
4. To Investigate applications of AI in computer network.

**Syllabus**

UNIT - I

Data communication Components: Representation of data and its flow Networks, Various Connection Topology, Protocols and Standards, OSI model, Data Link Layer: Error Detection and Error Correction - Hamming Distance, CRC; Flow Control and Error control protocols - Stop and Wait, Go back – N ARQ, Selective Repeat ARQ. IEEE 802.3.

UNIT – II

Network Layer: Internet Protocol (IP) – Logical Addressing: IPV4, IP addressing and subnetting, IPV6, ARP, RARP, BOOTP and DHCP–Delivery, Routing protocols.

UNIT – III

Transport Layer: Elements of Transport protocols: Addressing, Connection establishment, Connection release, User Datagram Protocol (UDP), Transmission Control Protocol (TCP). TCP congestion control. Traffic shaping Leaky Bucket and token bucket. Algorithm.

UNIT IV

Application Layer: Domain Name Space (DNS), File Transfer Protocol (FTP), WWW, HTTP, Network security principles and threats, Cryptographic techniques (symmetric/asymmetric encryption), SSL/TLS protocols.

UNIT – V

Firewalls, VPNs, and IPS/IDS (Intrusion Detection and Prevention Systems), Bluetooth.

Load Balancing Optimization using AI/ML, AI-based Threat Hunting in Network Security.

**Course Outcomes:**

On successful completion of the course, students will be able to:

1. Implement the computer network protocols with topologies.
2. Apply error detection and correction mechanisms related to data Link Layer and implement Routing algorithm.
3. Analyze TCP protocol related to traffic shaping and routing algorithms.
4. Implement network security mechanisms to protect data and infrastructure.

**Text Books**

1. **"**Computer Networks" by Andrew S. Tanenbaum, David J. Wetherall (5th Edition), Pearson Education
2. "Data and Computer Communications" by William Stallings (10th Edition), Pearson Education
3. Data Communication and networking by Behrouz Forouzan (4th Edition) Mc Graw Hill Publication.
4. Cryptography And Network Security by Behrouz Forouzan (3rd Edition) Mc Graw Hill Publication.

**Reference Books**

1. "Computer Networking: A Top-Down Approach" by James F. Kurose, Keith W. Ross (7th Edition), Pearson Education.
2. "Network Security Essentials" by William Stallings (5th Edition), Pearson Education.

**Syllabus for Semester V, B. Tech. Computer Science & Engineering**

**(Artificial Intelligence & Machine Learning)**

**Course Code : CAP5002** **Course : Computer Networks Lab**

**L: 0Hrs, T: 0 Hr, P: 2Hrs, Per Week** **Total Credits: 01**

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**Course Objectives:**

1. To implement different types of network topologies and configurations, ensuring scalability, reliability, and security.
2. To analyze common network protocols and communication technologies
3. To optimize the allocation of resources in networks and Simulate routing algorithm.

**Experiments may include, but are not limited to the following:**

1. Design of topologies and network troubleshooting:(CISCO PACKET TRACER).
2. Implementation of Packet capture tool: Wireshark.
3. Implementation of Data Link Layer (Error Correction).
4. Design of Virtual LAN.
5. Implementation of IP subnetting
6. Configuring static and dynamic Routing at Network Layer.
7. Implementation on Transport Layer.
8. Setting up SDN network and perform network virtualization

**Tools & Platforms to Use:**

- Cisco Packet Tracer
- GNS3
- Wireshark
- Wi-Fi Analyzers (inSSIDer)
- Python & Netmiko for Network Automation
- VMWare/VirtualBox for Virtualized Labs

**Course outcomes**

1. To design network topologies and perform troubleshooting on the network
2. To Analyze the working of Data link Layer and Routing protocol
3. To Simulate the TCP and UDP protocol working related to congestion control
4. Implement network security mechanisms to protect data and infrastructure.
5. Simulate SDN network for dynamic network control and management.

**Text Books**

1. **"**Computer Networks" by Andrew S. Tanenbaum, David J. Wetherall (5th Edition), Pearson Education
2. "Data and Computer Communications" by William Stallings (10th Edition), Pearson Education
3. Data Communication and networking by Behrouz Forouzan (4th Edition) Mic Graw Hill Publication.

**Reference Books**

1. "Computer Networking: A Top-Down Approach" by James F. Kurose, Keith W. Ross (7th Edition), Pearson Education.
2. "Network Security Essentials" by William Stallings (5th Edition), Pearson Education.
3. "Software-Defined Networking: Design and Deployment" by Patricia A. Morreale, Daniele Ceccarelli, Wiley.

**Syllabus for Semester V, B. Tech. Computer Science & Engineering**

**(Artificial Intelligence & Machine Learning)**

**Course Code : CAT5003** **Course : Databasae Management Systems**

**L: 3Hrs, T: 0 Hr, P: 0Hrs, Per Week** **Total Credits: 03**

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**Course Objectives**

1. To understand the role of a database management system in an organization.
2. To construct simple and advanced database queries using a data language.
3. To understand and apply logical database design principles and database normalization.
4. To recognize the need for transaction management and query processing.

**SYLLABUS**

**UNIT-I Introduction to Database System Concepts and Architecture**

Databases and Database Users, Characteristics of the Database Approach, Advantages of Using the DBMS Approach, When Not to Use a DBMS, Data Models, Schemas, and Instances, Three-Schema Architecture and Data Independence, Database Languages and Interfaces, The Database System Environment.

**UNIT-II The Relational Data Model and SQL**

Relational Model Concepts, Relational Model Constraints and Relational Database Schemas, Update Operations, Transactions, and Dealing with Constraint Violations, SQL Data Definition, Data Types and Constraints, Data Management in SQL, Transforming ER Model into Relational Model.

**UNIT-III Database Design and Normalization**

Functional Dependencies, Inference Rules, Equivalence, and Minimal Cover, Properties of Relational Decomposition, Normal Forms Based on Primary Keys, General Definitions of Second and Third Normal Forms, Boyce-Codd Normal Form, Other Dependencies and Normal Forms.

**UNIT IV Indexing and Hashing**

Ordered Indices, B+-Tree Index Files and its Extensions, Static Hashing and Dynamic Hashing, Comparison of Ordered Indexing and Hashing, Bitmap Indices, Some General Issues Concerning Indexing.

**UNIT V Query Processing and Optimization**

Measures of Query Cost, Query Operation: Selection, Sorting and Join Operation, Transformation of Relational Expressions, Estimating Statistics of Expression Results, Choice of Evaluation Plans.

**UNIT VI Transaction Processing, Concurrency Control and Recovery**

Introduction to Transaction Processing, Characterizing Schedules Based on Recoverability, Characterizing Schedules Based on Serializability, Two-Phase Locking Techniques for Concurrency Control, Deadlock Handling and Multiple Granularity, Database Recovery Techniques.

**Course Outcomes:**

**On completion of the course the student will be able to**

1. Identify the basic concepts and various data model used in database design.
2. Recognize the use of normalization and functional dependency.
3. Understand the purpose of query processing and optimization.
4. Apply and relate the concept of transaction, concurrency control and recovery in database.

**Text Books:**


1. Abraham Silberschatz, Henry F. Korth and S. Sudarshan; "Database System Concepts" Sixth Edition, Tata McGraw Hill, 2011.
2. Ramez Elmasri and Shamkant Navathe; "Fundamentals of Database Systems", Sixth Edition, Addison Wesley 2011.


**Reference Books:**


1. Raghu Ramakrishnan and Johannes Gehrke; "Database Management Systems"; Third Edition; Tata McGraw Hill Publication, 2003.
2. C. J. Date; "Database in Depth – Relational Theory for Practitioners"; O`Reilly Media, 2005.

**Syllabus for Semester III, B. Tech. Computer Science & Engineering**

**(Artificial Intelligence & Machine Learning)**

**Course Code :CAP 5003 Course : Database Management Systems Lab**

**L: 0Hrs, T: 0 Hr, P: 2Hrs, Per Week Total Credits: 01**

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**Course Objectives**

1. To understand the role of a database management system in an organization.
2. To construct simple and advanced database queries using a data language.
3. To understand and apply logical database design principles and database normalization.
4. To recognize the need for transaction management and query processing

**SYLLABUS**

**Practicals Based on Above Syllabus of CAT 5003**

**Course Outcomes:**

**On completion of the course the student will be able to**

1. Identify the basic concepts and various data model used in database design.
2. Recognize the use of normalization and functional dependency.
3. Understand the purpose of query processing and optimization.
4. Apply and relate the concept of transaction, concurrency control and recovery in database.

**Text Books:**


1. Abraham Silberschatz, Henry F. Korth and S. Sudarshan; "Database System Concepts" Sixth Edition, Tata McGraw Hill, 2011.
2. Ramez Elmasri and Shamkant Navathe; "Fundamentals of Database Systems", Sixth Edition, Addison Wesley 2011.


**Reference Books:**


3. Raghu Ramakrishnan and Johannes Gehrke; "Database Management Systems"; Third Edition; Tata McGraw Hill Publication, 2003.
4. C. J. Date; "Database in Depth – Relational Theory for Practitioners"; O`Reilly Media, 2005.

**Syllabus for Semester V, B. Tech. Computer Science & Engineering**

**(Artificial Intelligence & Machine Learning)**

**Course Code : CAT5004 Course : Software Engineering(Program Elective-I)**

**L: 3Hrs, T: 0 Hr, P: 0Hrs, Per Week Total Credits: 03**

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**Course Objectives**

1. To familiarize students with the fundamentals of software engineering principles and practices.
2. To aid students in designing software systems using structured and object-oriented approaches.
3. To apprise students with different software testing and debugging strategies in building a quality software.
4. To introduce students to the practice of software project management.

**Syllabus**

**Unit-I**

The Evolving Role of Software - Software Characteristics, Applications, Principles and Myths; Software Engineering as a Layered Technology; Software Process Framework.

Software Process Models - Waterfall Model, Evolutionary Models, Unified Process Model, Agile Process Models, Extreme Programming (XP), Scrum Model; Requirements Engineering.

**Unit-II**

Requirements Analysis, Analysis Modeling Approaches; Data Modeling, Object-Oriented Analysis, Scenario-Based Modeling, Flow-Oriented Modeling, Class-based Modeling, Behavioral Model, Design Concepts, The Design Model, Component Level Design, User Interface Design.

**Unit-III**

Basic concepts of Testing, Software Testing Life Cycle (STLC), Verification and Validation, Unit Testing, Integration Testing, Validation Testing, System Testing,

Art of Debugging. White-Box Testing, Basis Path Testing, Control Structure Testing, Black-Box Testing, Equivalence Partitioning, Boundary Value Analysis, Web Testing, Test case design, Building, Execution, Automated Testing.

**Unit-IV**

Software Project management- Plans, Methods and Methodology; Project Success and Failure, Project Evaluation, Cost-benefit evaluation technique, Project Planning & Scheduling.

Software Effort Estimation- Albrecht Function Point Analysis, COSMIC Function Point, Cost Estimation, COCOMO Model, Project Scheduling. Software Quality.

A Framework for Product Metrics, Metrics for Analysis & Design Models, Metrics for Source Code, Metrics for Testing & Maintenance. Metrics for process & project - Software measurement.

**Unit-V**

Risk management - Risk strategies, Software risks, Risk identification, Risk refinement, RMMM Risk Response development & Risk Response Control, Risk Analysis.

Change Management- Software Configuration Management, SCM Repository, SCM Process, Estimation, Reengineering- Software reengineering, Reverse engineering.

**Course Outcomes:**

On successful completion of the course, students will be able to:

1. Elucidate software engineering practices and various process models.
2. Use software design approaches for designing real-time solutions.
3. Demonstrate White Box Testing and Black Box Testing for building bug-free quality software.
4. Integrate software project management practices in software product development.

**Text Books**


1. Roger S. Pressman and Bruce R. Maxim; Software Engineering – A Practitioner's Approach; Eighth Edition, McGraw Hill; 2015.
2. Ian Somerville; Software Engineering; Seventh Edition; Pearson Education. 2008.


**Reference Books**


1. Pankaj Jalote; An Integrated Approach to Software Engineering; Third Edition, Springer, 2005.
2. Rajib Mall; Software Project Management, 5th Edition, McGrawHill.
3. David Gustafsan; Software Engineering;Schaum's Series,Tata McGraw Hill,2002.

**Syllabus for Semester V, B. Tech. Computer Science & Engineering**

**(Artificial Intelligence & Machine Learning)**

**Course Code : CAT5004 Course : Design Pattern (Program Elective-I)**

**L: 3Hrs, T: 0 Hr, P: 0Hrs, Per Week Total Credits: 03**

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**Course Objectives**

1. To learn the fundamentals of software design by referring a catalog of design patterns
2. Demonstrate how to use design patterns to address code development issues.
3. Identify the most suitable design pattern to address a given application design problem.
4. Apply design principles (e.g., open-closed, dependency inversion, substitution, etc).
5. Critique code by identifying and refactoring anti-patterns.

**Syllabus**

**UNIT-I**

Elements of Design Pattern, Describing Design Pattern, Design Pattern Classification, Role of design patterns in software design, Selection and usage of Design Patterns, Example implementation of design pattern using UML, Case Study: Designing a Document Editor.

**UNIT-II**

Creational Patterns: Introduction, Role of Creational patterns, Creational Pattern types: Factory method, Abstract Factory, Builder, Prototype, Singleton, Comparative study of creational patterns, and examples based on real life applications.

**UNIT-III**

Structural Design Patterns: Introduction, Role of Structural patterns, Encapsulating complex structures to simplify interactions between components, Decoupling Components, Structural Pattern types: Adapter, Bridge, Composite, Decorator, Façade, Proxy, Comparative study of structural patterns, and examples based on real life applications.

**UNIT-IV**

Behavioral Patterns-I: Introduction, Role of Behavioral pattern, Encapsulation of Behavior, Behavioral Pattern types: Chain of Responsibility, Template Method, State, Strategy, and Iterator.

**UNIT-V**

Behavioral Patterns-II: Effect of single object on set of objects, Analysis of mutual behavior of classes and object's state, Reference control between objects, Behavioral Pattern types: Observer, Mediator, Memento, Interpreter, Comparative study of Behavioral patterns, and examples based on real life applications.

**Course Outcomes:**

On successful completion of the course, students will be able to:

1. Analyze the need and ability of design patterns in the software design process.
2. Implement various solutions for creation of objects, their structure and the interaction between objects.
3. Develop a loosely coupled application using design patterns.
4. Analyze the tradeoffs of applying a design pattern to a given problem.

**Text Books:**

1. Design Patterns: Elements of reusable object-oriented software by Gamma Erich, Helm Richard, Johnson Ralph, and Vlissides John, Pearson Education
2. Design Patterns Explained by Alan Shallowly and James Trott, Addison-Wesley

**Reference Books**:

1. Pattern's in JAVA Vol-I by Mark Grand, WileyDreamTech.
2. JAVA Enterprise Design Patterns Vol-III by Mark Grand, WileyDreamTech.
3. Head First Design Patterns by Eric Freeman, O'Reilly.

**Syllabus for Semester V, B. Tech. Computer Science & Engineering**

**(Artificial Intelligence & Machine Learning)**

**Course Code : CAT5004 Course : Robotic Process Automation(Program Elective-I)**

**L: 3Hrs, T: 0 Hr, P: 0Hrs, Per Week Total Credits: 03**

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**Course Prerequisites**

Basic knowledge of Artificial Intelligence and Machine Learning

**Course Objectives**

1. To introduce the fundamentals of Robotic Process Automation (RPA) and its applications.
2. To understand RPA techniques, tools, and platforms for automation.
3. To develop skills in designing, implementing, and deploying RPA solutions.

**Syllabus**

**Unit I**

**Introduction to Robotic Process Automation (RPA):** Overview of RPA: Definition, Scope, and Benefits, Automation Techniques: What and How to Automate?, Components and Platforms of RPA, Introduction to UiPath: Installation and Setup, Recording and Playback: Task Recorder, Automating Gmail Trash & Recycle Bin

**Unit II**

**Workflow and Data Manipulation:** Workflow Design: Sequences, Flowcharts, and Control Flow, Looping and Decision-Making Mechanisms, Data Manipulation: Variables, Scope, Collections, Arguments, Working with Data Tables, Clipboard Management, and File Operations, CSV/Excel Integration: Data Table Conversion

**Unit III**

**UI Interaction and Plugins:** Identifying and Interacting with UI Controls, Techniques for Waiting and Acting on Controls, Screen Scraping and Optical Character Recognition (OCR), Integrating Plugins: SAP, Java, Citrix, Mail, PDF, Web, Excel, Word, Credential Management and Security Considerations

**Unit IV**

**Bot Development and Exception Handling:** Assistant Bots and Event Monitoring, Exception Handling: Common Errors and Debugging Techniques, Logging and Crash Reporting, Debugging Strategies and Error Reporting

**Unit V**

**Deployment and Maintenance of RPA Bots:** Project Organization and Workflow Reusability, Best Practices: Commenting, Config Files, State Machines, Publishing and Deploying Bots Using UiPath, Orchestration Server: Bot Management and Control, Monitoring and Maintaining Automated Processes

**Course Outcomes:**

On successful completion of the course, students will be able to:

1. Apply RPA concepts to automate various applications.
2. Analyze and choose suitable RPA techniques for different automation scenarios.
3. Design and implement automation workflows using UiPath.
4. Handle exceptions and optimize bot performance.
5. Deploy and maintain RPA solutions effectively.

**Text Books**


1. Alok Mani Tripathi, Learning Robotic Process Automation, 1st Edition, Packt Publishing, 2018.
2. Ed Freitas, Robotic Process Automation Succinctly, Succinctly EBook Series, 2020.


**Reference Books**


1. Robotic Process Automation, Nividous, 2018.
2. Vaibhav Srivastava, Getting Started with RPA using Automation Anywhere, BPB Publications, 2021.

**Syllabus for Semester V, B. Tech. Computer Science & Engineering**

**(Artificial Intelligence & Machine Learning)**

**Course Code : CAT5005** **Course : Microcontroller Design**

**L: 3Hrs, T: 0 Hr, P: 0Hrs, Per Week** **Total Credits: 03**

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## Course Objectives

1. To introduce the fundamentals of microcontrollers and the ARM Cortex-M architecture.
2. To develop an understanding of the ARM instruction set and programming using Embedded C.
3. To explore hardware interfacing techniques with various peripherals and sensors.
4. To understand the implementation of timers, interrupts, and communication protocols in ARM-based systems.
5. To provide knowledge on advanced ARM features, RTOS concepts, and real-time embedded applications.

## Syllabus

### Unit I Introduction to Microcontrollers

Overview of Microcontrollers and ARM-based Processors, Comparison of Microprocessors and Microcontrollers, ARM Cortex-M Family Overview (M0, M3, M4, M7), Architecture of ARM Cortex-M: Registers, ALU, Instruction Pipeline, Functional Pin Diagram and Description, Memory Organization: RAM, ROM, Flash, and Stack

### Unit II ARM Instruction Set and Embedded C Programming

Introduction to Embedded C for ARM: Data Types, Pointers, Bitwise Operations, Functions, and Structures. ARM Instruction Set Architecture (ISA), Addressing Modes: Immediate, Register, Direct, Indirect. Data Transfer Instructions (LDR, STR, PUSH, POP). Data Processing Instructions (ADD, SUB, MUL, DIV). Control Flow Instructions (B, BL, BX, CMP)

### Unit III Hardware Interfacing and Peripherals

GPIO Programming and Port Operations in ARM, Interfacing LEDs, Switches, and Buzzer, Matrix Keypad and Seven-Segment Display, LCD (Alphanumeric and Graphical), Analog-to-Digital (ADC) and Digital-to-Analog (DAC). Interfacing Sensors (Temperature, Ultrasonic, Accelerometer), Stepper Motor and DC Motor.

**Unit IV Timers, Interrupts, and Communication Protocols**

Basics of Timers and Counters in ARM Cortex-M, Timer Modes: Periodic, Capture, Compare, PWM Generation. Interrupts: NVIC (Nested Vectored Interrupt Controller), ISR (Interrupt Service Routines), Serial Communication Protocols: UART, SPI, I2C. Wireless Communication: Bluetooth, Wi-Fi, Zigbee.

**Unit V Advanced ARM Features, RTOS, and Applications**

ARM Cortex-M Pipeline: 3-stage, 5-stage Execution, ARM Memory Interface and Bus Architecture, Basics of Real-Time Operating Systems (RTOS), RTOS Concepts: Task Scheduling, Mutex, Semaphores, Handling Priority Inversion and Deadlocks.

**Course Outcomes:**

On successful completion of the course, students will be able to:

1. Understand microcontrollers & ARM Cortex-M architecture.
2. Develop Embedded C programs for ARM.
3. Interface and control peripherals like LEDs, LCDs, motors, and sensors using GPIO, ADC, and DAC.
4. Implement timers, interrupts, and communication protocols such as UART, SPI, I2C, and wireless interfaces.
5. Design ARM microcontroller based systems using advanced ARM features, RTOS concepts, and real-time embedded applications.

**Text Books**


1. "The Definitive Guide to ARM Cortex-M3 and Cortex-M4 Processors", Joseph Yiu.
2. “Embedded Systems with ARM Cortex-M Microcontrollers in Assembly and C “, *Yifeng Zhu.*
3. “Real-Time Operating Systems for ARM Cortex-M Microcontrollers”, *Qing Li & Carolyn Yao*.


**Reference Books**


1. “ARM Assembly Language: Fundamentals and Techniques”, *William Hohl & Christopher Hinds*.
2. "Embedded Systems: Introduction to ARM Cortex-M Microcontrollers”, *Jonathan W. Valvano.*
3. "Embedded Systems Fundamentals with ARM Cortex-M based Microcontrollers – *Alexander G. Dean*

**Syllabus for Semester V, B. Tech. Computer Science & Engineering**

**(Artificial Intelligence & Machine Learning)**

**Course Code : CAP5005** **Course : Microcontroller Design Lab**

**L: 0Hrs, T: 0 Hr, P: 2Hrs, Per Week** **Total Credits: 01**

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**Course Objectives**

1. To introduce the fundamentals of microcontrollers and the ARM Cortex-M architecture.
2. To develop an understanding of the ARM instruction set and programming using Embedded C.
3. To explore hardware interfacing techniques with various peripherals and sensors.
4. To understand the implementation of timers, interrupts, and communication protocols in ARM-based systems.
5. To provide knowledge on advanced ARM features, RTOS concepts, and real-time embedded applications.

**Syllabus**

**Practical's are based on Theory Syllabus CAT 5005**

**Course Outcomes:**

On successful completion of the course, students will be able to:

1. Understand microcontrollers & ARM Cortex-M architecture.
2. Develop Embedded C programs for ARM.
3. Interface and control peripherals like LEDs, LCDs, motors, and sensors using GPIO, ADC, and DAC.
4. Implement timers, interrupts, and communication protocols such as UART, SPI, I2C, and wireless interfaces.
5. Design ARM microcontroller based systems using advanced ARM features, RTOS concepts, and real-time embedded applications.

**Text Books**


1. "The Definitive Guide to ARM Cortex-M3 and Cortex-M4 Processors", Joseph Yiu.
2. "Embedded Systems with ARM Cortex-M Microcontrollers in Assembly and C ", *Yifeng Zhu.*
3. "Real-Time Operating Systems for ARM Cortex-M Microcontrollers", *Qing Li & Carolyn Yao*.

**Reference Books**


1. “ARM Assembly Language: Fundamentals and Techniques”, *William Hohl & Christopher Hinds*.
2. "Embedded Systems: Introduction to ARM Cortex-M Microcontrollers”, *Jonathan W. Valvano.*
3. "Embedded Systems Fundamentals with ARM Cortex-M based Microcontrollers – *Alexander G. Dean*

**Syllabus for Semester VI, B. Tech. Computer Science & Engineering**

**(Artificial Intelligence & Machine Learning)**

**Course Code : CAT6001** **Course : Deep Learning I**

**L: 3Hrs, T: 0 Hr, P: 0Hrs, Per Week** **Total Credits: 03**

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**Course Objectives**

1. To introduce basic deep learning algorithms.
2. To understand real-world problems which can be solved by deep learning methods.
3. To identify deep learning techniques suitable for a real-world problem.

**Syllabus:**

**UNIT I: Basics of Deep Learning**

History of Deep Learning, McCulloch Pitts Neuron, Thresholding Logic, Perceptrons,, Perceptron Learning Algorithm and Convergence, Multilayer Perceptrons (MLPs), Representation Power of MLPs, Sigmoid Neurons.

**UNIT II: Training of Feedforward Neural Networks**

Feedforward Neural Networks, Representation Power of Feedforward Neural Networks, Training of Feedforward Neural Networks, Gradient Descent (GD), Momentum Based GD, Nesterov Accelerated GD, Stochastic GD, AdaGrad, RMSProp, Adam

**UNIT III: Optimization Algorithm**

Activation Function and Initialization Methods: Sigmoid, Tanh, ReLU, Xavier and He Initialization, Regularization: Bias and Variance, Overfitting, Hyperparameters Tuning, L1 and L2 Regularization, Data Augmentation and Early Stopping, Parameter Sharing and Tying.

**UNIT IV: Convolutional Neural Network (CNN)**

Convolutional Neural Networks, 1D and 2D Convolution, Visualizing Convolutional Neural Networks, Guided Backpropagation.

**UNIT V: Recurrent Neural Network (RNN)**

Recurrent Neural Networks, Backpropagation Through Time (BPTT), Vanishing and Exploding Gradients, Long Short-Term Memory (LSTM) Cells, Gated Recurrent Units (GRUs) variants of CNN and RNN,Encoder-Decoder Models, Attention Mechanism, LeNet, AlexNet, ZF-Net, VGGNet, GoogLeNet, ResNet.

**Course Outcomes:**

On successful completion of the course, students will be able to:

1. Apply fully connected deep neural networks to real-world problem-solving scenarios.
2. Evaluate the performance of various deep learning models in terms of optimization, bias-variance trade-off, overfitting, and underfitting.
3. Analyze the role of convolutional and recurrent neural networks in addressing different real-world problems.
4. Create advanced deep learning models by designing variants of CNNs and RNNs tailored to specific applications.

**Text Books**


1. Sandro Skansi, *Introduction to Deep Learning*, Springer
2. Charu C. Aggarwal, *Neural Networks and Deep Learning: A Textbook*, Springer, 2019
3. Ian Goodfellow, Yoshua Bengio, and Aaron Courville, *Deep Learning*, MIT Press, 2016
4. Dr. S. Lovelyn Rose, Dr. L. Ashok Kumar, Dr. D. Karthika Renuka, *Deep Learning using Python*, Wiley Publication


**Reference Books:**


1. Bishop, C. M., *Pattern Recognition and Machine Learning*, Springer, 2006
2. Yegnanarayana, B., *Artificial Neural Networks*, PHI Learning Pvt. Ltd., 2009
3. A. Ravindran, K. M. Ragsdell, and G. V. Reklaitis, *Engineering Optimization: Methods and Applications*, John Wiley & Sons, Inc., 2016

**Syllabus for Semester VI, B. Tech. Computer Science & Engineering**

**(Artificial Intelligence & Machine Learning)**

**Course Code : CAP6001** **Course : Deep Learning I Lab**

**L: 0Hrs, T: 0 Hr, P: 2Hrs, Per Week** **Total Credits: 01**

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**Course Objectives:**

1. To solve problems in linear algebra, probability, optimization using artificial neurons.

2. To understand the usage of publically available datasets.

3. To use various python packages and tools for deep learning.

**Course Syllabus:**

Experiments based on

- Implementation of Linear Algebra, Probability etc.
- CDT/CST/CAT (Deep Learning-I) Syllabus.

Technology: Python, Tensorflow/Pytorch

**Course Outcomes:**

On completion of the course the student will be able to

1. Identify the deep learning algorithms which are more appropriate for various types of learning tasks in various domains.

2. Implement deep learning models in Python using the PyTorch/Tensorflow library and train them with real-world datasets.

3. Analyze and evaluate deep learning model's.

**Text Books:**


1. Sandro Skansi, Introduction to Deep Learning, Springer
2. Satish Kumar, Neural Networks: A Classroom Approach, Tata McGraw-Hill Education, 2004.


**Reference Books:**


1. Francois Chollet, Deep Learning with Python, Manning Publications Co.
2. Golub, G., H., and Van Loan, C., F., Matrix Computations, JHU Press, 2013.

**Syllabus for Semester VI, B. Tech. Computer Science & Engineering**

**(Artificial Intelligence & Machine Learning)**

**Course Code : CAT6002** **Course : Computer Vision**

**L: 3Hrs, T: 0 Hr, P: 0Hrs, Per Week** **Total Credits: 03**

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## Course Objectives

1. To Learn the core principles of computer vision, image formation, transformations, camera geometry, including stereo vision and depth estimation.
2. To gain proficiency in image alignment techniques, feature detection and feature matching for object recognition and tracking.
3. To explore motion analysis, optical flow methods, and object tracking using algorithms such as Lucas-Kanade, Kalman filter, and background subtraction.
4. To utilize classification and clustering techniques for pattern analysis, along with dimensionality reduction methods.

## Syllabus

### Unit I: Introduction to Computer Vision & Image Formation

Introduction to computer vision, Digital Image Formation and Camera Geometry: Fundamentals of Image Formation, Transformations in 2D: translation, rotation, scaling, shearing; affine and rigid transformations, Transformations in 3D: translation, rotation about X,Y,Z axis, rotation about arbitrary axis, 3D affine, homogeneous coordinates in 2D and 3D, Concept of pinhole camera, camera calibration, Homography, Stereo Geometry, Binocular Stereopsis: Camera and Epipolar Geometry, Depth estimation.

### Unit II: Image Alignment & Feature Detection

Image Alignment: Physically and digitally corresponding points, Feature detection and description: Line detectors (Hough Transform), Corners - Harris and Hessian Affine, SIFT, SURF, HOG, Feature matching and model fitting, RANSAC, Control point based image alignment using least squares - derivation for pseudo-inverse, Applications of image alignment.

### Unit III: Motion Analysis & Object Tracking

Motion and Optical Flow: Motion Analysis: Background Subtraction and Modeling, Horn and Shunck method, Lucas-Kanade algorithm, Feature Point Tracking, moving object detection and tracking; Kalman filter

**Unit IV: Object Detection & Recognition**

Adaboost algorithm: binary classification, face detection, Adaboost for Computation of Haar-like features; Image Segmentation; Object recognition and shape representation, Viola Jones algorithm for face detection and Boosting: Features, Integral images, Boosting, cascade; Activity Recognition in videos.

**Unit V: Pattern Analysis & Dimensionality Reduction**

Pattern Analysis: Clustering: K-Means, K-Medoids, Classification: Supervised, Un-supervised, Semi-supervised; Classifiers: KNN, ANN models.

Dimensionality Reduction: PCA, LDA; Non-parametric methods; deep neural architectures and applications.

**Course Outcomes:**

**On successful completion of the course, students will be able to:**

1. Use the fundamental concepts of computer vision to solve different problems.
2. Apply feature detection, image alignment, motion analysis, and object tracking techniques to solve real-world problems.
3. Analyze the different object detection and recognition techniques to determine their effectiveness in different real-world scenarios.
4. Apply machine learning based techniques to perform pattern analysis and dimensionality reduction.

**Text Books**


1. Richard Szeliski, Computer Vision: Algorithms and Applications, Springer, 2nd edition, 2022.
2. R. C. Gonzalez, R. E. Woods, Digital Image Processing, Pearson Education; Fourth edition, 2018.
3. D. Forsyth and J. Ponce, Computer Vision: A modern approach, Pearson Education India, 2nd ed., 2015.
4. E. Trucco and A. Verri, Introductory Techniques for 3D Computer Vision, Pearson, 1998.


**Reference Books**


- Simon J. D. Prince, Computer Vision: Models, Learning, and Inference, Cambridge University Press, 2012.
- D. H. Ballard, C. M. Brown. Computer Vision. Prentice-Hall, 1982.
- E. R. Davies, Computer & Machine Vision: Theory, Algorithms, Practicalities, Academic Press, Fourth Edition, 2012

**Syllabus for Semester VI, B. Tech. Computer Science & Engineering**

**(Artificial Intelligence & Machine Learning)**

**Course Code : CAP6002** **Course : Computer Vision Lab**

**L: 0Hrs, T: 0 Hr, P: 2Hrs, Per Week** **Total Credits: 01**

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**Course Objectives**

1. To apply the core principles of computer vision, image formation, transformations, camera geometry, including stereo vision and depth estimation.
2. To gain proficiency in image alignment techniques, feature detection and feature matching for object recognition and tracking.
3. To explore motion analysis, optical flow methods, and object tracking using algorithms such as Lucas-Kanade, Kalman filter, and background subtraction.
4. To utilize classification and clustering techniques for pattern analysis, along with dimensionality reduction methods.

**Syllabus: Experiments based on the syllabus of Computer Vision Theory CAT6002.**

**Course Outcomes:**

**On successful completion of the course, students will be able to:**

1. Use the fundamental concepts of computer vision to solve different problems.
2. Apply feature detection, image alignment, motion analysis, and object tracking techniques to solve real-world problems.
3. Analyze the different object detection and recognition techniques to determine their effectiveness in different real-world scenarios.
4. Apply machine learning based techniques to perform pattern analysis and dimensionality reduction.

**Text Books**


1. Joseph Howse, Learning OpenCV 4 Computer Vision with Python 3, Packt Publishing; 3rd Edition, 2020.
2. Richard Szeliski, Computer Vision: Algorithms and Applications, Springer, 2nd edition, 2022.
3. D. Forsyth and J. Ponce, Computer Vision: A modern approach, Pearson Education India, 2nd ed., 2015.
4. R. C. Gonzalez, R. E. Woods, Digital Image Processing, Pearson Education; Fourth edition, 2018.

**Reference Books**


- Simon J. D. Prince, Computer Vision: Models, Learning, and Inference, Cambridge University Press, 2012.
- D. H. Ballard, C. M. Brown. Computer Vision. Prentice-Hall, 1982.
- E. R. Davies, Computer & Machine Vision: Theory, Algorithms, Practicalities, Academic Press, Fourth Edition, 2012.

**Syllabus for Semester VI, B. Tech. Computer Science & Engineering**

**(Artificial Intelligence & Machine Learning)**

**Course Code : CAT6003 Course : Natural Language Processing(PE-II)**

**L: 3Hrs, T: 0 Hr, P: 0Hrs, Per Week Total Credits: 03**

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**Course Objectives**

1. To familiarize the concepts and techniques of natural language processing.
2. To learn computational techniques that enable machines to process, understand, and generate human language efficiently.
3. To apply the statistical learning methods and cutting-edge research models to solve natural language processing problems.
4. To integrate natural language processing into real-world systems to develop, evaluate, and enhance applications.

**Syllabus:**

**UNIT I**

Introduction to NLP, Definition and Scope, A Brief History, Importance, Challenges, Tasks, Significance, NLP Pipeline and Applications, Morphological Analysis and Generation using Finite State Automata, Finite State Transducer, Hidden Markov model, Viterbi Algorithm, Applications of Tagging.

**UNIT II**

Lexical Analysis, Part-of-Speech (POS) Tagging, Approaches for POS Tagging, Rule-Based, Stochastic, Hybrid Approach, Taggers Evaluations, Tokenization with NLTK.

Syntax and Parsing, Types of Constituents in Sentences, Context-Free Grammar (CFG), CFG Parsing, Top-Down Parser, Bottom-Up Parser, Shallow Parsing and Chunking, Thematic Roles, Conditional Random Fields, Maximum Likelihood Estimation, Lexical and Probabilistic Parsing, Probabilistic Context Free Grammars, The Probability of a String, Inside-Outside Algorithm, CKY Parsing**.**

**UNIT III**

Semantic Analysis, Lexical Vs Compositional Semantic Analysis, Word Senses and Relations, Types of Lexical Semantics, Word Sense Disambiguation, WordNet and Online Thesauri, Word Similarity and Thesaurus Methods, Text Representation, Word Embedding, TF-IDF, Bag of Words, Word2Vec, Skip-gram.

Pragmatic Analysis and Discourse, Discourse Phenomena, Coherence and Coreference, Importance of Coreference Relations, Discourse Segmentation, Algorithms for Coreference Resolution.

**UNIT IV**

N-Gram Language Model, Language Modeling and Chain Rule, Markov Chain in N-Gram Model, Shannon’s Method in N-Gram Model, Smoothing Techniques, Extrinsic

Evaluation Scheme, Zero Counts Problems, Smoothing Techniques, Laplace (Add-One) Smoothing, Add-k Smoothing, Backoff and Interpolation Smoothing, Good Turing Smoothing, The Transformer, Large Language Models, Language Model Evaluation, Entropy, Perplexity, ROUGE, BLEU.

**UNIT V**

Major NLP Applications, Information Retrieval Systems, Social Network Analysis, Sentiment Analysis, Information Extraction, Named Entity Recognition, Text Classification, Text Summarization Systems, Machine Translation, Word Alignment, Content Recommendation System, Answering Questions, Applications in Finance, E-Commerce, Travel and Hospitality, Marketing, Insurance, Healthcare, Law, Supply Chain, Telecommunication, Education and Research.

**Course Outcomes**

**On Successful completion of course, students will be able to:**

1. Understand core NLP concepts and techniques.
2. Apply various POS tagging approaches and parsing techniques to analyze sentence structure and utilize probabilistic models for syntactic analysis.
3. Analyze various semantic and pragmatic analysis techniques and discourse phenomena to enhance text representation and understanding.
4. Implement N-Gram language models and Transformer-based models for effective language modeling and text generation.
5. Design and develop innovative NLP solutions to address real-world challenges across industries like finance, healthcare, e-commerce, education and research.

**Textbooks**


1. Daniel Jurafsky and James H. Martin, Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition with Language Models, Third Edition, 2025, https://web.stanford.edu/~jurafsky/slp3.
2. Raymond ST. Lee, Natural Language Processing: A Textbook with Python Implementation, Springer Nature Singapore Pte Ltd. 2024, ISBN: 978-9819919987.
3. Sowmya Vajjala, Bodhisattwa Majumder, Anuj Gupta, and Harshit Surana, Practical Natural Language Processing: A Comprehensive Guide to Building Real-World NLP Systems, O'Reilly Media, Inc., USA, First edition, 2020, ISBN: 978-1492054054.
4. Dipanjan Sarkar, Text Analytics with Python: A Practitioner's Guide to Natural Language Processing, Second Edition, Apress Media, LLC, California, 2019, ISBN: 978-1484243534.

**Reference Books**


1. Natural Language Processing with Python: From Basics to Advanced Projects, Second Edition, 2024, Cuantum Technologies LLC. Plano, ISBN: 979-8894968483.
2. Jyotika Singh, Natural Language Processing in the Real World: Text Processing, Analytics, and Classification, First edition, 2023, CRC Press is an imprint of Taylor & Francis Group, LLC, ISBN: 978-1003264774.
3. Gerhard Paaß and Sven Giesselbach, Foundation Models for Natural Language Processing: Pre-trained Language Models Integrating Media, Artificial Intelligence: Foundations, Theory, and Algorithms, Springer Nature Switzerland Pte Ltd. 2022, ISBN: 978-3031231896.
4. Lewis Tunstall, Leandro von Werra, and Thomas Wolf, Natural Language Processing with Transformers: Building Language Applications with Hugging Face, O'Reilly Media, Inc., USA, Revised First edition, May 2022, ISBN: 978-1098136796.

**Syllabus for Semester VI, B. Tech. Computer Science & Engineering**

**(Artificial Intelligence & Machine Learning)**

**Course Code : CAP6003** **Course :Natural Language Processing Lab(PE-II)**

**L: 0Hrs, T: 0 Hr, P: 2Hrs, Per Week** **Total Credits: 01**

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**Syllabus:**

**Experiments based on the syllabus of CAT6003**

1. Few lab sessions shall be conducted using virtual lab platforms to enhance learning experiences and accessibility.
2. Utilise Hugging Face, Stanford, Kaggle, MIT OpenCourseWare, OpenAI Learning, Fast.ai, AllenNLP like repositories and platforms.

**Syllabus for Semester VI, B. Tech. Computer Science & Engineering**

**(Artificial Intelligence & Machine Learning)**

**Course Code : CAT6003 Course : Data Warehousing and Mining(PE-II)**

**L: 3Hrs, T: 0 Hr, P: 0Hrs, Per Week Total Credits: 03**

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**Course Pre-requisite:Database Management Systems**

**Course Objectives**

1. Understand and implement techniques for preprocessing of classical data models and algorithms in data warehouses and data mining
2. Characterize the kinds of patterns that can be discovered by association rule mining, classification and clustering.
3. Master data mining techniques in various applications like social, scientific and environmental context.

**Syllabus**

**Unit I**

Introduction to Data Warehouse, Data Warehouse basic Concepts, Architecture of Data Warehouse, Overview of ETL and OLAP OLTP integration – comparison of OLAP with OLTP systems, ROLAP, MOLAP and HOLAP, Multidimensional modeling, Data Cube, Data Cube Computation methods, Advanced SQL support for OLAP

**Unit II**

Data Cleaning methods, Descriptive Data Summarization, Data Reduction, Data Discretization, Data partitions, and Concept hierarchy generation Space Management in Data warehouse - Schemas for storing data in warehouse using different storage structures, B-tree index, hash index, clusters, Bitmap index functional index, domain index.

**Unit III**

Introduction: - What is Data mining? Data Mining on what kind of data, Data mining Functionalities, Classification of Data Mining Systems, Major Issues on Data mining, KDD Process, Association Rule mining, Association Rule Generation, APRIORI Algorithm, The Partition Algorithms, FP-Growth Algorithms.

**Unit IV**

Classification and Prediction: - Classification by decision tree induction, Bayesian Classification, Rule based Classification, Associative Classification, Classification by Back propagation, Support Vector Machines.

**Unit V**

Clustering: Measuring Data Similarity and Dissimilarity Partition based Clustering, Hierarchical based clustering, Density based clustering, Grid-Based Clustering.

**Course Outcomes:**

**On successful completion of the course, students will be able to:**

1. Use the fundamental theories and concepts of data warehousing in real life application.
2. Apply multi-dimensional modeling techniques in designing data warehouses and learn the process of data cleaning and pre-processing for mining applications.
3. Use the principles of data mining for designing data mining applications and Apply different methods and techniques involved in data mining.
4. Distinguish problems related to classification and clustering and evaluate accuracy of various classification and clustering algorithms.

**Text Books**


5. Jaiwei Han and Micheline Kamber; Data Mining Concepts and Techniques; 2 edition; Morgan Kaufmann Publishers, 2006.
6. Introduction to Data Mining, Pang-Ning Tan, Vipin Kumar, Michael Steinbanch, Pearson Education.


**Reference Books**


1. Tang and MacLennan, Data Mining with SQL Server 2005, Wiley Publishing, 2005
2. Data Warehousing and Fundamentals by Paulraj Ponniah, A Wiley-Interscience Publication
3. Margaret H Dunham, “Data Mining Introductory and advanced topics”, 6th Edition, Pearson Education, 2009.
4. Arun K Pujari, “Data Mining Techniques”,1st Edition, University Press, 2005.

**Syllabus for Semester VI, B. Tech. Computer Science & Engineering**

**(Artificial Intelligence & Machine Learning)**

**Course Code : CAP6003 Course : Data Warehousing and Mining Lab(PE-II)**

**L: 0Hrs, T: 0 Hr, P: 2Hrs, Per Week Total Credits: 01**

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**Course Pre-requisite:Database Management Systems**

**Course Objectives**

1. Understand and implement techniques for preprocessing of classical data models and algorithms in data warehouses and data mining
2. Characterize the kinds of patterns that can be discovered by association rule mining, classification and clustering.
3. Master data mining techniques in various applications like social, scientific and environmental context.

**Syllabus**

**Experiments based on the syllabus.**

**Course Outcomes:**

**On successful completion of the course, students will be able to:**

1. Use the fundamental theories and concepts of data warehousing in real life application.
2. Apply multi-dimensional modeling techniques in designing data warehouses and learn the process of data cleaning and pre-processing for mining applications.
3. Use the principles of data mining for designing data mining applications and Apply different methods and techniques involved in data mining.
4. Distinguish problems related to classification and clustering and evaluate accuracy of various classification and clustering algorithms.

**Text Books**

1. Jaiwei Han and Micheline Kamber; Data Mining Concepts and Techniques; 2 editions; Morgan Kaufmann Publishers, 2006.
2. Introduction to Data Mining, Pang-Ning Tan, Vipin Kumar, Michael Steinbanch, Pearson Education.

**Reference Books**

1. Tang and MacLennan, Data Mining with SQL Server 2005, Wiley Publishing, 2005
2. Data Warehousing and Fundamentals by Paulraj Ponniah, A Wiley-Interscience Publication
3. Margaret H Dunham, “Data Mining Introductory and advanced topics”, 6th Edition, Pearson Education, 2009.
4. Arun K Pujari, “Data Mining Techniques”,1st Edition, University Press, 2005.

**Syllabus for Semester VI, B. Tech. Computer Science & Engineering**

**(Artificial Intelligence & Machine Learning)**

**Course Code : CAT6003 Course : Compiler Design (PE-II)**

**L: 3Hrs, T: 0 Hr, P: 0Hrs, Per Week Total Credits: 03**

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## Course Objectives

The main objective of this course is to introduce the fundamental concepts of compiler design and language translation. It aims to develop an understanding of the structure, function, and complexity of modern compilers. The students will learn the various phases of compilation with practical implementation using compiler writing tools.

## Syllabus

### Unit I

Introduction to Compilers, Phases of Compiler, Relating Compilation Phases with Formal Systems, Lexical Analysis, tokens, pattern and lexemes, Design of Lexical analyser, Regular Expression, transition diagram, recognition of tokens, Lexical Errors.

### Unit II

Syntax Analysis- Specification of syntax of programming languages using CFG, Top-down parser, design of LL (1) parser, bottom-up parsing technique, LR parsing, Design of SLR, CLR, LALR parsers, Handling Ambiguous Grammars, Applications of the LR Parser.

### Unit III

Syntax directed translation- Study of syntax directed definitions & syntax directed translation schemes, Type and Type Checking, Implementation of SDTS, Intermediate notations, translation of Assignment Statement, controls structures, Array reference**.**

### Unit IV

Code optimization- machine independent Optimisation, Local optimization techniques, loop optimization- control flow analysis, data flow analysis, Loop invariant computation, Induction variable removal, other loop optimization techniques, Machine-dependent Optimization techniques.

Code generation- Problems in code generation, Simple code generator, code generation using labelling algorithm, code generation using gencode algorithm

### Unit V

Storage allocation & Error Handling- Run time storage administration, stack allocation, Activation of Procedures, Storage Allocation Strategies, Garbage Collection, symbol table management,

Error handling, Error detection and recovery- lexical, syntactic and semantic, Error recovery in LL & LR Parser

**Course Outcomes:**

**On successful completion of the course, students will be able to:**

1. Exhibit role of various phases of compilation, with understanding of types of grammars and design complexity of compiler.
2. Design various types of parses and perform operations like string parsing and error handling.
3. Demonstrate syntax directed translation schemes, their implementation for different programming language constructs.
4. Implement different code optimization and code generation techniques using standard data structures.

**Text Books**


1. Aho, Sethi, and Ullman; Compilers Principles Techniques and Tools; Second Edition, Pearson education, 2008.
2. Alfred V. Ahoand Jeffery D. Ullman; Principles of Compiler Design; NarosaPub.House, 1977.
3. VinuV. Das; Compiler Design using Flex and Yacc; PHI Publication, 2008.
4. Manoj B Chandak, Khushboo P Khurana; Compiler Design; Universities Press, 2018.


**Reference Books**


1. Vinu V. Das; Compiler Design using Flex and Yacc; PHI Publication
2. V. Raghavan; Principles of Compiler Design, McGraw Hill Education (India)

**Syllabus for Semester VI, B. Tech. Computer Science & Engineering**

**(Artificial Intelligence & Machine Learning)**

**Course Code : CAP6003 Course : Compiler Design Lab (PE-II)**

**L: 0Hrs, T: 0 Hr, P: 2Hrs, Per Week Total Credits: 01**

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## Course Objectives

This laboratory course is designed to provide students with hands-on experience in the fundamental techniques of compiler construction. Through a series of experiments and practical implementations, students will explore the core phases of a compiler. The course also introduces various compiler development tools which enables students to understand and build components of a working compiler.

## Syllabus

**Practicals based on syllabus of Complier Design CAT6003**

## Course Outcomes:

**On successful completion of the course, students will be able to:**

1. Use Open-Source tools to design lexical analyzer and parser.
2. Implement different types of Parsing techniques.
3. Implement various syntax directed translation schemes to generate intermediate code .
4. Implement various code optimization and code generation techniques.

## Text Books


1. Doug Brown, John Levine, Tony Mason, Lex and Yacc, O'Reilly Media, 2nd Edition, 2012
2. Des Watson, A Practical Approach to Compiler Construction, Springer, 1st ed. edition, 2017

**Syllabus for Semester VI, B. Tech. Computer Science & Engineering**

**(Artificial Intelligence & Machine Learning)**

**Course Code : CAT6004 Course : Customer Relationship Management (PE-III)**

**L: 3Hrs, T: 0 Hr, P: 0Hrs, Per Week Total Credits: 03**

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**Course Objectives**

1. To make the students understand the organizational need, benefits and process of creating long-term value for individual customers.
2. To disseminate knowledge regarding the concept of Salesforce and Salesforce technologies.
3. To enable the students understand the technological and human issues relating to implementation of Customer Relationship Management in the organizations.

**Syllabus**

**UNIT I : Introduction to CRM and Salesforce**

Definition and importance of CRM, Key CRM concepts, Benefits of CRM for businesses, Introduction to Salesforce, Salesforce's role in business processes, Salesforce Cloud offerings , Overview of Salesforce architecture, Multi-tenant cloud architecture, Salesforce Data Model (Objects, Records, Fields), Understanding Tabs, Apps, and Objects

**UNIT II : Salesforce Administration Basics**

Understanding Salesforce Setup menu, Creating and managing users, Profiles, Roles, and Permission Sets, Organizing security settings (Organization-Wide Defaults, Sharing Rules), Data Validation Rules, Creating and customizing Objects, Object Relationships, Creating and managing Fields, Workflow Rules, Process Builder, and Flow.

**UNIT III: Introduction to Apex Programming**

Apex basics (Syntax, Variables, Methods), Apex classes and triggers, Working with SOQL and SOSL (Salesforce Object Query Language, Handling exceptions in Apex, Apex Triggers, Writing Apex triggers to handle database events, Trigger context variables and best practices, Governor limits and optimization techniques.

**Unit IV: Advanced Salesforce Development – Lightning Web Components (LWC)**
Overview of Lightning Web Components (LWC), LWC architecture and lifecycle, Creating and deploying LWC components, Handling events in LWC, Working with Apex from LWC, LWC Integration with Salesforce Data, Displaying Salesforce data in LWC, Handling record pages and lightning layouts, Best practices for LWC development.

**UNIT V : Salesforce Integration and Deployment, Salesforce Reports**

Overview of integration in Salesforce, Integration tools: REST API, SOAP API, and Bulk API, Salesforce Connect, Introduction to Mulesoft for Salesforce integration, Introduction to Salesforce DX, Source-driven development and version control, Continuous Integration and Continuous Delivery (CI/CD) in Salesforce., Introduction to

reports, types of reports, report builder, formatting reports, dashboard introduction, dashboard generation, charts in dashboards, limitations of Salesforce reports.

**Course Outcomes:**

**On successful completion of the course, students will be able to:**

1. Understand the fundamentals of Salesforce and its role in CRM.
2. Gain practical skills in configuring and managing Salesforce environments.
3. Apply the basics of Salesforce development using Apex to customize the platform.
4. Develop modern web applications on the Salesforce platform using Lightning Web Components.
5. Integrate Salesforce with external systems and deploy applications in a production environment.

**Text Books**


1. Jason Ouellette; Development with the Force.com Platform, Second Edn, Addison Wesley, 2011. 2. Mohith Shrivastava; Salesforce Lightning Application Development, 2018.
2. Mohith Shrivastava; Salesforce Lightning Application Development, 2018
3. Judith W .Kincaid , Customer Relationship Management Getting it Right, Pearson Education
4. Customer Centricity –Focus on right customer for strategic advantage, by Peter Fader, Wharton Digital Press, 2012


**Reference Books**


1. Learning Salesforce Development with Apex – Paul Battisson
2. Salesforce for Beginners – Sharif Shaalan

**Syllabus for Semester VI, B. Tech. Computer Science & Engineering**

**(Artificial Intelligence & Machine Learning)**

**Course Code : CAP6004 Course : Customer Relationship Management Lab**

**L: 0Hrs, T: 0 Hr, P: 2Hrs, Per Week Total Credits: 01**

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**Course Objectives**

1. To make the students understand the organizational need, benefits and process of creating long-term value for individual customers.
2. To disseminate knowledge regarding the concept of Salesforce and Salesforce technologies.
3. To enable the students understand the technological and human issues relating to implementation of Customer Relationship Management in the organizations.

**Syllabus**

The syllabus will be based on Salesforce environment management and use of Apex and Visualforce for implementing CRM using Salesforce

1. Creating and navigating a Salesforce Developer account and exploring Salesforce Classic and Lightning Experience interfaces
2. Basic Salesforce configurations and customizations
3. Creating custom objects and fields and setting up user roles and profiles
4. Implementing workflow rules and process automation
5. Writing basic Apex classes and triggers and Developing Visualforce pages to customize user interface
6. Building triggers for automation
7. Building basic LWC components and creating interactive user interfaces using LWC

**Course Outcomes:**

On successful completion of the course, students will be able to:

1. Understand the fundamentals of Salesforce and its role in CRM.
2. Gain practical skills in configuring and managing Salesforce environments.
3. Apply the basics of Salesforce development using Apex to customize the platform.
4. Develop modern web applications on the Salesforce platform using Lightning Web Components.

**Text Books**


1. Jason Ouellette; Development with the Force.com Platform, Second Edn, Addison Wesley, 2011. 2. Mohith Shrivastava; Salesforce Lightning Application Development, 2018.
2. Mohith Shrivastava; Salesforce Lightning Application Development, 2018
3. Judith W .Kincaid , Customer Relationship Management Getting it Right, Pearson Education
4. Customer Centricity –Focus on right customer for strategic advantage, by Peter Fader, Wharton Digital Press, 2012


**Reference Books**


1. Learning Salesforce Development with Apex – Paul Battisson
2. Salesforce for Beginners – Sharif Shaalan

**Syllabus for Semester VI, B. Tech. Computer Science & Engineering**

**(Artificial Intelligence & Machine Learning)**

**Course Code : CAT6004** **Course : Software Testing(PE-III)**

**L: 3Hrs, T: 0 Hr, P: 0Hrs, Per Week** **Total Credits: 03**

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**Course Objectives**

1. To familiarize the students with the strong fundamental knowledge of software testing and practices.
2. To understand the strategies and approaches of Industry Level Testing.
3. To enable the students to apply the advanced testing approaches on Live applications and to channelize solutions to challenging real- world problems.

**Syllabus**

**Unit I**

Fundamentals of Software Testing: Introduction to Software Testing, Software Development Life Cycle (SDLC) & Testing Life Cycle (STLC), Testing Principles & Objectives, Defect, Bug, Error, and Failure, Test Plan, Test Case, and Test Strategy, Verification vs. Validation, Levels of Testing i.e. Unit Testing, Integration Testing, System Testing, Acceptance Testing, Types of Testing i.e. Manual vs. Automation, Functional vs. Non-Functional, Black Box vs. White Box Testing, Regression & Smoke Testing, Alpha & Beta Testing.

**Unit II**

Test Case Design & Execution: Agile Methodology, Writing Effective Test Cases, Test Data & Test Environment Setup, Equivalence Partitioning & Boundary Value Analysis, Decision Table Testing & State Transition Testing, Error Guessing Technique, Test Execution & Bug Reporting, Defect Life Cycle & Bug Tracking Tools (JIRA, Bugzilla), Test Metrics & Reporting.

**Unit III**

Database Testing: Approach For Database testing, Introduction of basic of Database commands (DDL, DML, DCL), Application of Software Testing Techniques in Database Testing, Types of testing perform in DB i.e. White box testing and Black Box Testing, Typical Test scenario in DB Testing.

**Unit IV**

Automation Testing & Tools: Introduction to Automation Testing, Benefits & Challenges of Automation, Introduction to Selenium WebDriver, Writing First Test Script in Selenium, Handling Elements (Buttons, Text Fields, Dropdowns, Alerts), Data-Driven Testing using Excel, CI/CD in Testing (Jenkins, Git).

**Unit V**

API Testing & Performance Testing: Introduction to API Testing, Basics of REST APIs and HTTP Methods (GET, POST, PUT, DELETE), Testing APIs using Postman, Introduction to Performance Testing, Load Testing using Apache JMeter.

**Course Outcomes:**

**On successful completion of the course, students will be able to:**

1. Understand core software testing principles, methodologies, and techniques to ensure software quality and reliability.
2. Design and execute effective test cases using various test case design techniques to ensure comprehensive test coverage and defect identification.
3. Implement database testing techniques to ensure robust, secure, and high-performing backend systems.
4. Utilize automation testing tools to design and execute test scripts, enhancing software testing efficiency and reliability.
5. Apply API and performance testing techniques to ensure functionality, reliability, and scalability of software systems.

**Text Books**


1. Software Testing: A Craftsman's Approach, Paul C. Jorgensen, Auerbach Publications; 4th edition, 2013.
2. Foundations of Software Testing, Aditya P. Mathur, Pearson, 1st edition, 2011.
3. The Art of Software Testing, Glenford J. Myers, Tom Badgett, Corey Sandler, John Wiley & Sons Inc; 3rd edition, 2011.


**Reference Books**


1. Software Engineering: A Practitioner's Approach, Roger S. Pressman, Bruce R. Maxim Dr., McGraw Hill, 8th edition, 2014.
2. Software Testing: Principles and Practices, Srinivasan Desikan & Gopalaswamy Ramesh, Pearson, 1st edition, 2005.
3. Practical Software Testing: A Process-Oriented Approach, Ilene Burnstein, Springer-Nature New York Inc, 1st Edition, 2003.
4. Software Testing Techniques, Boris Beizer, Wiley India, Second edition 2002.

**Syllabus for Semester VI, B. Tech. Computer Science & Engineering**

**(Artificial Intelligence & Machine Learning)**

**Course Code : CAP6004** **Course : Software Testing Lab(PE-III)**

**L: 0Hrs, T: 0 Hr, P: 2Hrs, Per Week** **Total Credits: 01**

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**Course Objectives**

1. To gain hands-on experience in designing, executing, and automating test cases to ensure software quality.
2. To utilize manual and automated testing tools for functional, database, API, and performance testing.
3. To enable the students to gain practical knowledge and hands-on experience in software testing methodologies and tools, preparing them for industry roles in quality assurance and software testing.

**Course Outcomes:**

**On successful completion of the course, students will be able to:**

1. Demonstrate an understanding of software testing principles, testing life cycle, and defect management.
2. Design, document, and execute effective test cases using various test design techniques.
3. Perform database testing to ensure data accuracy, consistency, and constraint validation using SQL queries.
4. Utilize automation tools to develop and execute test scripts, enhancing test coverage and efficiency.
5. Implement API testing and performance testing methodologies to ensure software reliability and scalability.

**Syllabus for Semester VI, B. Tech. Computer Science & Engineering**

**(Artificial Intelligence & Machine Learning)**

**Course Code : CAT6005** **Course : Internet of Things**

**L: 3Hrs, T: 0 Hr, P: 0Hrs, Per Week** **Total Credits: 03**

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## Course Objectives

1. Understand the fundamentals of IoT, including sensing, actuation, networking, and communication protocols, along with machine-to-machine communication and interoperability.
2. To develop hands-on experience with Arduino and Raspberry Pi by designing IoT applications using sensors, actuators, and communication modules while programming in Arduino IDE and Raspberry Pi environments.
3. To explore cloud and fog computing, data analytics, and real-world IoT applications in smart cities, healthcare, agriculture, and industrial automation.

## Syllabus

### UNIT-I

Introduction to IoT, Sensing, Actuation, Basics of Networking, Communication Protocols Sensor Networks Machine-to-Machine Communications Interoperability in IoT.

### UNIT-II

Introduction to Arduino Programming Integration of Sensors and Actuators with Arduino Introduction to Raspberry Pi and programming, Implementation of IoT with Raspberry Pi Introduction to SDN, SDN for IoT.

### UNIT-III

Data Handling and Analytics, Cloud Computing, and Fog Computing, Introduction to Industrial IoT

### UNIT-IV

Preparing the development environment (Arduino IDE), Exploring the Arduino language (C/C++) syntax, Coding, compiling, and uploading to the microcontroller, working with Arduino Communication Modules: Bluetooth Modules, WiFi Modules and I2C and SPI, Interfacing arduino and Blynk via USB: LED Blinking, Controlling a Servomotor.

### UNIT-V

Case Studies: Smart Cities and Smart Homes, Connected Vehicles, Smart Grid, Agriculture, Healthcare, Activity Monitoring

**Course Outcomes:**

**On successful completion of the course, students will be able to:**

1. Conceptualize interaction of IoT device with the physical world environment.
2. Understand individual components of IoT systems.
3. To estimate the requirements of IoT systems from individual components.
4. To conceptualize the sensor node for capturing data from the physical world.
5. To conceptualize complete IoT systems using components of IoT system.

**Text Books**


1. Internet of Things - A Hands-on Approach, Arshdeep Bahga and Vijay Madisetti, Universities Press, 2015, ISBN: 9788173719547
2. Getting Started with Raspberry Pi, Matt Richardson & Shawn Wallace, O'Reilly (SPD), 2014, ISBN: 9789350239759 3. Raspberry Pi Cookbook, Software and Hardware Problems and solutions, Simon Monk, O'Reilly (SPD), 2016, ISBN 7989352133895


**Reference books:**


1. Peter Waher, 'Learning Internet of Things', Packt Publishing, 2015 3. Editors Ovidiu Vermesan
2. Peter Friess,'Internet of Things – From Research and Innovation to Market Deployment', River Publishers, 2014.

**Syllabus for Semester VI, B. Tech. Computer Science & Engineering**

**(Artificial Intelligence & Machine Learning)**

**Course Code : CAP6006** **Course : Mini Project**

**L: 0Hrs, T: 0 Hr, P: 4Hrs, Per Week** **Total Credits: 02**

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**Course Objectives**

The objective of the mini project is to let the students map and utilize the technical knowledge acquired in the previous semesters to solve a real-world problem through team effort.

**Course Outcomes:**

**On successful completion of the course, students will be able to:**

1. Identify and finalize the problem statement by investigating various domains and society needs.
2. Perform requirement analysis and design methodology for solving the identified problem.
3. Apply programming techniques and modern tools for the development of the solution.
4. Apply ethical principles, project management skills and demonstrate the ability to work in teams for project development within the confines of a deadline.
5. Communicate technical information employing written reports and presentations.