



# **Shivaji University Kolhapur**

**Revised Syllabus  
as per**

**National Education Policy-2020  
(NEP-2.0)**

**T. Y. B. Tech.**

**Computer Science and Engineering  
(Artificial Intelligence and Machine Learning)**

**To be Implemented from  
Academic Year 2026-27**





# शिवाजी विद्यापीठ, कोल्हापूर SHIVAJI UNIVERSITY, KOLHAPUR

## SCHEME OF INSTRUCTIONS & SYLLABI

### Exit Course for Computer Science and Engineering After 2<sup>nd</sup> Year

- As part of the NEP 2020 Revised Syllabus, for the First Year B. Tech Exit, students must earn a total of 8 additional credits. This includes 6 credits from online SWAYAM NPTEL courses and 2 credits from Virtual Lab performance.
- Students must complete two SWAYAM NPTEL courses (12-week duration) from the provided list and successfully perform two Virtual Labs from the specified list.
- Each SWAYAM NPTEL course carries 3 credits, while each Virtual Lab is worth 1 credit.

| Sr. No. | Name of NPTEL Course                                                 |
|---------|----------------------------------------------------------------------|
| 1       | Artificial Intelligence: Knowledge Representation And Reasoning      |
| 2       | Cryptography and Network Security                                    |
| 3       | Computer Vision And Image Processing - Fundamentals And Applications |

| Sr. No. | Name of Virtual Lab        |
|---------|----------------------------|
| 1       | Data Analytics with Python |
| 2       | Programming In Java        |

**SCHEME OF INSTRUCTION & SYLLABI**  
**Programme Computer Science and Engineering (AIML)**  
**Scheme of Instructions: Third Year B. Tech. Computer Science and Engineering (AIML)**  
**Semester – V**

| Sr. No. | Course Category | Course Code | Course Title                               | L  | T  | P  | Contact Hrs/Wk | Course Credits | EXAM SCHEME |        |     |       |
|---------|-----------------|-------------|--------------------------------------------|----|----|----|----------------|----------------|-------------|--------|-----|-------|
|         |                 |             |                                            |    |    |    |                |                | MSE         | ISE/CA | ESE | TOTAL |
| 1       | PCC             | AIML3101    | Computer Algorithms                        | 3  | -- | -- | 3              | 3              | 30          | 10     | 60  | 100   |
| 2       | PCC             | AIML3102    | Machine Learning using Advanced Python     | 2  | -- | -- | 2              | 2              | 30          | 10     | 60  | 100   |
| 3       | PCC             | AIML3103    | Information Security                       | 3  | -- | -- | 3              | 3              | 30          | 10     | 60  | 100   |
| 4       | PEC             | AIML3104    | Elective-I                                 | 3  | -- | -- | 3              | 3              | 30          | 10     | 60  | 100   |
| 5       | MDM             | AIML3105    | Multi-disciplinary Minor – 03              | 3  | -- | -- | 3              | 3              | 30          | 10     | 60  | 100   |
| 6       | OE              | AIML3106    | Open Elective -03                          | 2  | -- | -- | 2              | 2              | 30          | 10     | 60  | 100   |
| 7       | PCC             | AIML3107    | Computer Algorithm Lab                     | -- | 1  | -- | 1              | 1              | -           | 25     | 25  | 50    |
| 8       | PCC             | AIML3108    | Machine Learning using Advanced Python Lab | -- | -- | 4  | 4              | 2              | -           | 25     | 25  | 50    |
| 9       | PEC             | AIML3109    | Elective-I Lab                             | -- | -- | 2  | 2              | 1              | -           | 25     | --  | 25    |
| 10      | MDM             | AIML3110    | Multi-disciplinary Minor– 03 Lab           | -- | -- | 2  | 2              | 1              | -           | 50     | --  | 50    |
| 11      | EL              | AIML3111    | Business English                           | -- | -- | 2  | 2              | 1              | -           | 25     | --  | 25    |
|         |                 |             | Total                                      | 16 | 1  | 10 | 27             | 22             | 180         | 210    | 410 | 800   |

L- Lecture      T-Tutorial      P-Practical

MSE- Mid Semester Examination

ISE/CA- In Semester Evaluation/Continuous Assessment

ESE- End Semester Examination (For Laboratory End Semester performance)

| Course Category                 | Basic Science Courses (BSC) | Engineering Science Courses (ESC) | Programme Core Course (PCC) | Programme Elective Course (PEC) | Open Elective other than particular program (OE/MDM) | Vocational and Skill Enhancement Course (VSEC) | Humanities Social Science and Management (HSSM) | Experiential Learning (EL) | Co-curricular And Extracurricular Activities (CCA) |
|---------------------------------|-----------------------------|-----------------------------------|-----------------------------|---------------------------------|------------------------------------------------------|------------------------------------------------|-------------------------------------------------|----------------------------|----------------------------------------------------|
| <b>Last Sem. Cumulative Sum</b> | <b>16</b>                   | <b>16</b>                         | <b>19</b>                   | <b>-</b>                        | <b>10</b>                                            | <b>09</b>                                      | <b>14</b>                                       | <b>02</b>                  | <b>02</b>                                          |
| <b>Semester Credits</b>         | -                           | -                                 | 11                          | 04                              | 06                                                   | -                                              | -                                               | 01                         | -                                                  |
| <b>Cumulative Sum</b>           | <b>16</b>                   | <b>16</b>                         | <b>30</b>                   | <b>04</b>                       | <b>16</b>                                            | <b>09</b>                                      | <b>14</b>                                       | <b>03</b>                  | <b>02</b>                                          |

**PROGRESSIVE TOTAL CREDITS: 88+22=110**

**SCHEME OF INSTRUCTION & SYLLABI**  
**Programme Computer Science and Engineering (AIML)**  
**Scheme of Instructions: Third Year B. Tech. Computer Science and Engineering (AIML)**  
**Semester – VI**

| Sr. No. | Course Category | Course Code | Course Title                       | L  | T  | P  | Contact Hrs/Wk | Course Credits | EXAM SCHEME |        |     |       |
|---------|-----------------|-------------|------------------------------------|----|----|----|----------------|----------------|-------------|--------|-----|-------|
|         |                 |             |                                    |    |    |    |                |                | MSE         | ISE/CA | ESE | TOTAL |
| 1       | PCC             | AIML3201    | Database Engineering               | 3  | -- | -- | 3              | 3              | 30          | 10     | 60  | 100   |
| 2       | PCC             | AIML3202    | Feature Engineering                | 3  | 1  | -- | 4              | 4              | 30          | 10     | 60  | 100   |
| 3       | PCC             | AIML3203    | Image Processing & Computer Vision | 3  | -- | -- | 3              | 3              | 30          | 10     | 60  | 100   |
| 4       | PEC             | AIML3204    | Elective-II                        | 3  | -- | -- | 3              | 3              | 30          | 10     | 60  | 100   |
| 5       | PEC             | AIML3205    | Elective-III                       | 3  | -- | -- | 3              | 3              | 30          | 10     | 60  | 100   |
| 6       | MDM             | AIML3206    | Multi-disciplinary Minor – 04      | 2  | -- | -- | 2              | 2              | 30          | 10     | 60  | 100   |
| 7       | PCC             | AIML3207    | Database Engineering Lab           | -- | -- | 2  | 2              | 1              | -           | 50     | 25  | 75    |
| 8       | PCC             | AIML3208    | IP & CV Lab                        | -- | -- | 2  | 2              | 1              | -           | 50     | 25  | 75    |
| 9       | EL              | AIML3209    | Domain-Specific Mini Project       | -- | -- | 4  | 4              | 2              | -           | 50     | --  | 50    |
|         |                 |             | Total                              | 17 | 1  | 8  | 26             | 22             | 180         | 210    | 410 | 800   |

L- Lecture

T-Tutorial

P-Practical

MSE- Mid Semester Examination

ISE/CA- In Semester Evaluation/Continuous Assessment

ESE- End Semester Examination (For Laboratory End Semester performance)

| Course Category          | Basic Science Courses (BSC) | Engineering Science Courses (ESC) | Programme Core Course (PCC) | Programme Elective Course (PEC) | Open Elective other than particular (OE/MDM) | Vocational and Skill Enhancement Course (VSEC) | Humanities Social Science and Management (HSSM) | Experiential Learning (EL) | Co-curricular And Extracurricular Activities (CCA) |
|--------------------------|-----------------------------|-----------------------------------|-----------------------------|---------------------------------|----------------------------------------------|------------------------------------------------|-------------------------------------------------|----------------------------|----------------------------------------------------|
| Last Sem. Cumulative Sum | 16                          | 16                                | 30                          | 04                              | 16                                           | 09                                             | 14                                              | 03                         | 02                                                 |
| Semester Credits         | -                           | -                                 | 12                          | 06                              | 02                                           | --                                             | -                                               | 02                         | -                                                  |
| Cumulative Sum           | 16                          | 16                                | 42                          | 10                              | 18                                           | 09                                             | 14                                              | 05                         | 02                                                 |

**PROGRESSIVE TOTAL CREDITS: 110+22 =132**

### **[I] List of Electives: Verticals**

| <b>Specialization</b> | <b>Hardware / Arch. / Network</b>   | <b>Algorithms / Math's / ML</b>     | <b>Image / Pattern / Security</b> | <b>Software / Data Management</b>    |
|-----------------------|-------------------------------------|-------------------------------------|-----------------------------------|--------------------------------------|
| <b>Elective-I</b>     | Internet of Things                  | Compilers                           | Ethical Hacking                   | Project Management                   |
| <b>Elective-II</b>    | Control Systems & Signal Processing | Applied Statistical Analysis with R | Cyber Security                    | Software Testing & Quality Assurance |
| <b>Elective-III</b>   | Robotics Intelligent Systems        | Data Mining                         | Speech Systems                    | Cloud Computing                      |
| <b>Elective-IV</b>    | Adhoc Wireless Sensor Networks      | Optimization Methods in AI and ML   | Image and Video Processing        | AI for Humanity                      |
| <b>Elective-V</b>     | Blockchain Technology               | Predictive Analysis                 | Surveillance Video Analytics      | Business Intelligence Systems        |
| <b>Elective-VI</b>    | High Performance Computing          | Game Theory                         | Cyber Forensics and Investigation | Augmented Reality & Virtual Reality  |

### **[II] List of Open Electives:**

|                          |                                                                      |
|--------------------------|----------------------------------------------------------------------|
| <b>Open Elective-I</b>   | 1. Programming Fundamentals using C++ (PFC++)<br>2. Web Technologies |
| <b>Open Elective-II</b>  | 1. Advanced Computer Network<br>2. Software Development using Agile  |
| <b>Open Elective-III</b> | 1. Cloud Computing<br>2. AI Tools                                    |

**[III] Minor in Emerging Areas basket of additional 18-20 credits starting from Sem-III**

**Basket No -01  
(Artificial Intelligence)**

| <b>Sr. No.</b> | <b>Semester</b> | <b>Subject</b>                                | <b>Credit</b> |
|----------------|-----------------|-----------------------------------------------|---------------|
| 1              | III             | AI Ethics and Responsible AI                  | 3             |
| 2              | IV              | Human Computer Interaction                    | 3             |
| 3              | V               | Recommendation Systems                        | 3             |
| 4              | VI              | Enhanced Natural Language Processing          | 3             |
| 5              | VII             | Reinforcement Learning and Autonomous Systems | 3             |
| 6              | VIII            | Search Engine Design and Optimization         | 3             |

**Basket No -02  
(Data Intelligence & AI Integration)**

| <b>Sr. No.</b> | <b>Semester</b> | <b>Subject</b>             | <b>Credit</b> |
|----------------|-----------------|----------------------------|---------------|
| 1              | III             | Decision Intelligence (DI) | 3             |
| 2              | IV              | AI-Powered Cybersecurity   | 3             |
| 3              | V               | Video Analytics            | 3             |
| 4              | VI              | Big Data Mining            | 3             |
| 5              | VII             | AI in Healthcare           | 3             |
| 6              | VIII            | Advanced AI Tools          | 3             |

**[IV] Basket of Multidisciplinary minor of 14 credits starting from Sem-III**

| <b>Semester</b> | <b>Course Offered</b>       | <b>L</b> | <b>P</b> | <b>Hrs.</b> | <b>Credits</b> |
|-----------------|-----------------------------|----------|----------|-------------|----------------|
| <b>III</b>      | Object Oriented Programming | 02       | --       | 02          | 02             |
| <b>IV</b>       | Introduction to AI          | 02       | --       | 02          | 02             |
| <b>V</b>        | Database Management         | 03       | 01       | 04          | 04             |
| <b>VI</b>       | Internet of Things          | 02       | --       | 02          | 02             |
| <b>VII</b>      | Machine Learning            | 02       | --       | 02          | 02             |
| <b>VIII</b>     | Data Science using Python   | 02       | --       | 02          | 02             |

**Instructions regarding Examinations:**

1. Compulsory passing with 40% marks is mandatory in ESE examinations and combined passing marks (MSE+ISE/CA+ESE) for theory course is 40 %
2. Mid sem. examination will be based on 50 % syllabus from beginning (First Three Units).
3. No compulsory passing for **MSE**.
4. ESE paper setting weightage will be, **25 % on syllabus covered for MSE (First Three Units) and 75 % on remaining syllabus (Last Three Units).**
5. Passing percentage for ESE practical examination 40%.



| Marking Scheme |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                | <ul style="list-style-type: none"> <li>Compulsory passing with 40% marks is mandatory in ESE examinations and combined passing marks (MSE+ISE/CA+ESE) for theory course is 40 %</li> <li>Mid sem. examination will be based on 50 % syllabus from beginning (First Three Units).</li> <li>No compulsory passing for MSE.</li> <li>ESE paper setting weightage will be, 25 % on syllabus covered for MSE (First Three Units) and 75 % on remaining syllabus (Last Three Units).</li> </ul> |

| Unit No. | Title and Content of Unit                                                                                                                                                                                                                                                                         | Hours |
|----------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| 1        | <b>Divide and Conquer</b>                                                                                                                                                                                                                                                                         | 7     |
|          | What is algorithm, Algorithm Specification, Recurrence relations, Performance Analysis, Randomized Algorithms Divide and Conquer: The general method, Binary search, Finding the maximum and minimum, Merge sort, Quick sort, Shell sort, and Stassen's matrix multiplication.                    |       |
| 2        | <b>Design and Analysis of Greedy Algorithms</b>                                                                                                                                                                                                                                                   | 7     |
|          | The general method, Knapsack problem, Job sequencing with deadlines, minimum-cost spanning trees – Prim's and Kruskal's Algorithms, Optimal storage on tapes, Optimal merge Patterns, Single source shortest paths The Bellman-Ford algorithm, Dijkstra's algorithm, The Floyd-Warshall algorithm |       |
| 3        | <b>Dynamic Programming and Applications</b>                                                                                                                                                                                                                                                       | 6     |
|          | The general method, Multistage graphs, All pair shortest paths, 0/1 knapsack, Reliability design, Travelling Sales person problem                                                                                                                                                                 |       |
| 4        | <b>Algorithmic Traversal and Backtracking Techniques</b>                                                                                                                                                                                                                                          | 6     |
|          | Techniques for Binary Trees, Game Tree, B+ Tree, RB Tree; Techniques for Graphs – Breadth First Search & Traversal, Depth First Search & Traversal, <b>Backtracking</b> - The general method, 8-queen problem, sum of subsets, Knapsack Problem, Hamiltonian Cycle, and Graph Coloring.           |       |
| 5        | <b>Foundations of NP-Hard and NP-Complete Problems</b>                                                                                                                                                                                                                                            | 5     |
|          | Basic Concepts, Cook's Theorem, Introduction to NP Hard Graph Problems, NP Hard Scheduling Problems                                                                                                                                                                                               |       |
| 6        | <b>Parallel Algorithms and Computational Models</b>                                                                                                                                                                                                                                               | 5     |
|          | Computational Model and Fundamental Techniques and Algorithms – PRAM, MESH and HYPERCUBE                                                                                                                                                                                                          |       |

| <b>Textbooks</b> |                                     |                                                       |                                    |
|------------------|-------------------------------------|-------------------------------------------------------|------------------------------------|
| <b>Sr. no.</b>   | <b>Title</b>                        | <b>Author</b>                                         | <b>Edition/Publication</b>         |
| 01               | Fundamentals of Computer Algorithms | Ellis Horowitz, Satraj Sahani, Saguthevar Rajasejaram | Universities Press, Second Edition |

| <b>Reference Books</b> |                                                          |                               |                            |
|------------------------|----------------------------------------------------------|-------------------------------|----------------------------|
| <b>Sr. no.</b>         | <b>Title</b>                                             | <b>Author</b>                 | <b>Edition/Publication</b> |
| 01                     | Fundamentals of Algorithmics                             | Gilles Brassard, Paul Bratley | Pearson Education          |
| 02                     | Mastering Algorithms with C                              | Kyle Loudon                   | SPD O'Reilly               |
| 03                     | Computer Algorithms- Introduction to Design and Analysis | Sara Baase, Allen Van Gelder  | Pearson Education          |



| Marking Scheme |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                | <ul style="list-style-type: none"> <li>Compulsory passing with 40% marks is mandatory in ESE examinations and combined passing marks (MSE+ISE/CA+ESE) for theory course is 40 %</li> <li>Mid sem. examination will be based on 50 % syllabus from beginning (First Three Units).</li> <li>No compulsory passing for MSE.</li> <li>ESE paper setting weightage will be, 25 % on syllabus covered for MSE (First Three Units) and 75 % on remaining syllabus (Last Three Units).</li> </ul> |

| Unit No. | Title and Content of Unit                                                                                                                                                                                                                                                                                                                                                               | Hours |
|----------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| 1        | <b>Introduction to Machine Learning</b>                                                                                                                                                                                                                                                                                                                                                 | 6     |
|          | <b>Machine Learning:</b> Definition, Terminology, Types of learning, Machine Learning Problem categories, Machine learning architecture, process, Lifecycle, Performance measures, tools and framework, data visualization, Data Pre-processing.                                                                                                                                        |       |
| 2        | <b>Supervised Learning : Regression and Regularization</b>                                                                                                                                                                                                                                                                                                                              | 6     |
|          | <b>Simple Linear regression:</b> Hypothesis, cost function, parameter learning with gradient descent, learning rate, Gradient Descent for linear regression.<br><b>Multivariate Linear Regression:</b> Multiple features, hypothesis functions, Gradient Descent for multiple variables, Feature scaling, polynomial regression Over fitting & Under fitting, cost function.            |       |
| 3        | <b>Classification Techniques and Model Optimization</b>                                                                                                                                                                                                                                                                                                                                 | 7     |
|          | <b>Classification Algorithms:</b> Logistic Regression, Decision tree, Ensemble Technique - Bagging and Boosting, Random Forest Algorithm with examples.<br><b>Model Evaluation metrics:</b> Confusion matrix, Precision, Recall, F1-score, ROC-AUC), Problem solving on evaluation metrics, Model Evaluation Techniques-Cross-validation: K-fold, Leave-One-Out, Hyper parameter Tuning |       |
| 4        | <b>Advanced Classification Methods: Naïve Bayes, KNN, and SVM</b>                                                                                                                                                                                                                                                                                                                       | 6     |
|          | Naïve Bayes Classifier: Instance-based classifier K- Nearest Neighbour Classifier: Elbow method Bayesian Network, Hidden Markov Model. Support Vector Machine: What is SVM, Kernel Trick, Cost Function, and Decision Trees vs. Support Vector Machine                                                                                                                                  |       |
| 5        | <b>Unsupervised Learning Techniques</b>                                                                                                                                                                                                                                                                                                                                                 | 6     |
|          | Clustering, K Means clustering, Hierarchical clustering, Association Rule mining, Dimensionality Reduction-Principal Component Analysis (PCA), Applications of unsupervised learning.                                                                                                                                                                                                   |       |
| 6        | <b>Neural Networks and Introduction to ANN Algorithms</b>                                                                                                                                                                                                                                                                                                                               | 5     |
|          | Neuron representation and model, Hypothesis for neuron, cost function, solution of a problem using single neuron. Gradient descent for a neuron. Neural network, ANN- Forward backward Propagation.                                                                                                                                                                                     |       |

| Textbooks |                                                            |                      |                                      |
|-----------|------------------------------------------------------------|----------------------|--------------------------------------|
| Sr. no.   | Title                                                      | Author               | Edition/Publication                  |
| 1         | Machine Learning with Python-<br>an approach to applied ML | Abhishek Vijayvargia | BPB Publications                     |
| 2         | Practical Machine Learning                                 | Sunila Gollapudi     | Packt Publishing Ltd                 |
| 3         | Machine Learning                                           | Tom M. Mitchell      | McGraw Hill Education; First Edition |

| Reference Books |                                                                                                                                                  |                  |                      |
|-----------------|--------------------------------------------------------------------------------------------------------------------------------------------------|------------------|----------------------|
| Sr. no.         | Title                                                                                                                                            | Author           | Edition/Publication  |
| 1               | Machine Learning for dummies                                                                                                                     | John Paul Muller | Wiley Publication    |
| 2               | Hands-On Machine Learning with Scikit-Learn, Keras, and Tensor Flow: Concepts, Tools, and Techniques to Build Intelligent Systems, Third Edition | Aurelien Geron   | O'Reilly Media       |
| 3               | Introduction to Machine Learning                                                                                                                 | Ethem Alpaydin   | PHI 2nd Edition-2013 |



| Marking Scheme |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                | <ul style="list-style-type: none"> <li>Compulsory passing with 40% marks is mandatory in ESE examinations and combined passing marks (MSE+ISE/CA+ESE) for theory course is 40 %</li> <li>Mid sem. examination will be based on 50 % syllabus from beginning (First Three Units).</li> <li>No compulsory passing for MSE.</li> <li>ESE paper setting weightage will be, 25 % on syllabus covered for MSE (First Three Units) and 75 % on remaining syllabus (Last Three Units).</li> </ul> |

| Unit No. | Title and Content of Unit                                                                                                                                                                                                                                                                                                                                                                                                                | Hours |
|----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| 1        | <b>Introduction to Information Security</b>                                                                                                                                                                                                                                                                                                                                                                                              | 6     |
|          | Need for security, Security Attacks, Services, Mechanisms, OSI security architecture , Principles: Confidentiality, Integrity, Availability (CIA), Authentication, Access Control, Legal, Ethical, and Professional Issues, A Model for Network Security.                                                                                                                                                                                |       |
| 2        | <b>Cryptography Fundamentals</b>                                                                                                                                                                                                                                                                                                                                                                                                         | 6     |
|          | Cryptography Concepts Overview: Classical Ciphers, Symmetric Key Cryptography: Block and Stream Ciphers, Data Encryption Standard (DES), Multiple Encryption and Triple DES, Advanced Encryption Standard (AES), Block Cipher Design Principles, Asymmetric (Public-Key) Cryptography: Principles of Public-Key Cryptosystems, RSA Algorithm, Diffie-Hellman Key Exchange, Elliptic Curve Cryptography (ECC)                             |       |
| 3        | <b>Hash Functions and Message Authentication</b>                                                                                                                                                                                                                                                                                                                                                                                         | 6     |
|          | Applications of Cryptographic Hash Functions, Two Simple Hash Functions, Requirements and Security of Hash Functions, Cipher Block Chaining (CBC), Secure Hash Algorithm (SHA), Message Authentication Requirements, Requirements for MAC and Security of MACs, MACs Based on Hash Functions, MACs Based on Block Ciphers: Data Authentication Algorithm, Cipher-based MAC                                                               |       |
| 4        | <b>Network Security and Access Control</b>                                                                                                                                                                                                                                                                                                                                                                                               | 6     |
|          | TCP/IP & Protocols (TLS, SSL), HTTPS, SSH, Email Security (PGP, S/MIME) & IP Security (IPSec). Authentication (Kerberos), Authorization, Accountability. Malware (Viruses, Worms, Ransom ware) & Controls. Operating System Security (Memory, File Protection).                                                                                                                                                                          |       |
| 5        | <b>Risk Management &amp; Security Planning</b>                                                                                                                                                                                                                                                                                                                                                                                           | 6     |
|          | Threat, Vulnerability, Risk Analysis, Firewalls, VPNs, Intrusion Detection/Prevention Systems (IDS/IPS). Security Policies, Standards (ISO 27001), Compliance (GDPR). Physical Security & Business Continuity.                                                                                                                                                                                                                           |       |
| 6        | <b>Digital Signatures and Cloud Security</b>                                                                                                                                                                                                                                                                                                                                                                                             | 6     |
|          | Digital Signatures: Concept and need, Working, Public and private keys, Digital certificates, Certificate Authorities (CA) and Registration Authorities (RA), Trust models in PKI, Applications and PKI.<br>Cloud Security: Concepts and challenges, Cloud service models: IaaS, PaaS, SaaS, Data security and privacy in cloud, Identity and Access Management (IAM), Virtualization, Compliance and risk management in cloud computing |       |

| Textbooks |                                                            |                                               |                       |
|-----------|------------------------------------------------------------|-----------------------------------------------|-----------------------|
| Sr. no.   | Title                                                      | Author                                        | Edition/Publication   |
| 01        | Cryptography and Network Security: Principles and Practice | William Stallings                             | Pearson Education.    |
| 02        | Network Security: Private Communication in a Public World  | Charlie Kaufman, Radia Perlman, Mike Speciner | Pearson Education.    |
| 03        | Cryptography and Network Security                          | Behrouz A. Forouzan                           | McGraw-Hill Education |

| Reference Books |                                                                                        |                                           |                       |
|-----------------|----------------------------------------------------------------------------------------|-------------------------------------------|-----------------------|
| Sr. no.         | Title                                                                                  | Author                                    | Edition/Publication   |
| 01              | Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives. | Nina Godbole & Sunit Belapure             | Wiley India           |
| 02              | Information Security Policies, Procedures, and Standards                               | Thomas R. Peltier                         | Auerbach Publications |
| 03              | CISSP Study Guide                                                                      | Eric Conrad, Seth Misenar, Joshua Feldman | Syngress              |



| Marking Scheme |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
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| Unit No. | Title and Content of Unit                                                                                                                                                                                                                                                                                     | Hours |
|----------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| 1        | <b>Introduction to IoT</b>                                                                                                                                                                                                                                                                                    | 6     |
|          | Introduction to Internet of Things (IoT), Functional Characteristics, Recent Trends in the Adoption of IoT, Role of cloud in IoT, Societal Benefits of IoT:- Health Care, Machine to Machine (M2M), Smart Transportation, Smart Living, Smart Cities, Smart Grid                                              |       |
| 2        | <b>Communication Principles</b>                                                                                                                                                                                                                                                                               | 5     |
|          | RFID, ZigBEE, Bluetooth, Internet Communication- IP Addresses - MAC Addresses , IEEE 802 Family of Protocols , I/O interfaces Software Components                                                                                                                                                             |       |
| 3        | <b>Sensing and Actuation</b>                                                                                                                                                                                                                                                                                  | 5     |
|          | Definition of Sensor, Sensor features, Resolution, Classes, Different types of sensors, Actuator, Different types of Actuators, purpose of Sensors and Actuators in IoT                                                                                                                                       |       |
| 4        | <b>IoT Application Development</b>                                                                                                                                                                                                                                                                            | 6     |
|          | Frame work for IoT Applications-Implementation of Device integration, Data acquisition and Integration, Device data storage on cloud/local server, Authentication, authorization of Devices                                                                                                                   |       |
| 5        | <b>Introduction IIoT</b>                                                                                                                                                                                                                                                                                      | 7     |
|          | Definition, IoT v IIoT, Next Generation Sensors, Sensor's calibration and validate sensor measurements, placement of IoT devices, sensors, low-cost communication system design, Top application areas include manufacturing, oil & gas, Embedded systems in the Automotive and Transportation market segment |       |
| 6        | <b>Internet of Robotic Things (IoRT)</b>                                                                                                                                                                                                                                                                      | 7     |
|          | Introduction to stationary and mobile robots, Brief introduction to localization, mapping, planning, and control of robotic systems; Introduction to cloud-enabled robotics; Applications of IIoT in robotics; Architectures for IoRT.                                                                        |       |

| Textbooks |                                                                                               |                                                                                 |                                 |
|-----------|-----------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------|---------------------------------|
| Sr. no.   | Title                                                                                         | Author                                                                          | Edition/Publication             |
| 01        | "IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet Things" | David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Robert Barton, Jerome Henry | 0Pearson Education              |
| 02        | Internet of Things: Architecture and Design Principles"                                       | Raj Kamal                                                                       | McGraw Hill Education, 2017     |
| 03        | Internet of Things A Hands-On-Approach",2014.                                                 | Vijay Madiseti, Arshdeep Bahga                                                  | Georgia Institute of Technology |

| Reference Books |                                                                   |                                               |                     |
|-----------------|-------------------------------------------------------------------|-----------------------------------------------|---------------------|
| Sr. no.         | Title                                                             | Author                                        | Edition/Publication |
| 01              | "Industry 4.0: The Industrial Internet of Things"                 | Alasdair Gilchrist                            | Apress, 2016        |
| 02              | "The Internet of Things in the Cloud: A Middleware Perspective" - | Honbo Zhou                                    | CRC Press 2012      |
| 03              | "Introduction to Industrial Internet of Things and Industry 4.0"  | Sudip Misra, Chandana Roy, Anadarup Mukherjee | CRC Press, 2021     |

|                           |                                                    |        |     |                    |                 |
|---------------------------|----------------------------------------------------|--------|-----|--------------------|-----------------|
| <b>Year and Semester</b>  | <b>Third Year B. Tech - Semester V – CSE(AIML)</b> |        |     |                    |                 |
| <b>Course Category</b>    | <b>Programme Elective Course</b>                   |        |     |                    |                 |
| <b>Title of Course</b>    | <b>Compilers</b>                                   |        |     | <b>Course Code</b> | <b>AIML3104</b> |
| <b>Teaching Scheme</b>    | L                                                  | T      | P   | Contact Hrs/Week   | Credits         |
|                           | 3                                                  | --     | --  | --                 | 3               |
| <b>Examination Scheme</b> | MSE                                                | ISE/CA | ESE | Total              |                 |
|                           | 30                                                 | 10     | 60  | 100                |                 |

|                      |                                                                                                                                                                                                                                                            |                                                                                                                                          |
|----------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------|
| Course Pre-Requisite | <ul style="list-style-type: none"> <li>• Programming in C/C++ or Python</li> <li>• Data Structures (stack, queue, tree, graph)</li> <li>• Discrete Mathematics &amp; Automata Theory (DFA, NFA, CFG)</li> <li>• Basics of Computer Organization</li> </ul> |                                                                                                                                          |
| Course Objective     | 1                                                                                                                                                                                                                                                          | To provide fundamental knowledge of compiler structure, phases, and workflow of program translation.                                     |
|                      | 2                                                                                                                                                                                                                                                          | To develop understanding of lexical, syntactic, and semantic analysis techniques.                                                        |
|                      | 3                                                                                                                                                                                                                                                          | To enable construction of intermediate representations and application of code optimization strategies.                                  |
|                      | 4                                                                                                                                                                                                                                                          | To familiarize students with code generation methods and runtime environment concepts.                                                   |
|                      | 5                                                                                                                                                                                                                                                          | To introduce modern AI/ML-driven enhancements in compiler design, parsing, optimization, and analysis.                                   |
|                      | 6                                                                                                                                                                                                                                                          | To enable students to integrate traditional compiler techniques with modern AI/ML methods for intelligent and efficient compiler design. |
| Course Outcomes      | After completion of this course Students will be able to ....                                                                                                                                                                                              |                                                                                                                                          |
|                      | CO1                                                                                                                                                                                                                                                        | Explain compiler phases and differentiate lexical, syntax, and semantic analysis.                                                        |
|                      | CO2                                                                                                                                                                                                                                                        | Construct finite automata, parse trees, and design basic syntax analyzers.                                                               |
|                      | CO3                                                                                                                                                                                                                                                        | Apply semantic rules, manage symbol tables, and generate intermediate code.                                                              |
|                      | CO4                                                                                                                                                                                                                                                        | Apply and analyze code optimization techniques for improved performance.                                                                 |
|                      | CO5                                                                                                                                                                                                                                                        | Design simple code generation modules including register allocation and instruction selection.                                           |
|                      | CO6                                                                                                                                                                                                                                                        | Evaluate and relate modern AI/ML-based compiler techniques with real-world applications.                                                 |

| CO PO Mapping                                  |     |     |     |     |     |     |     |     |     |      |      |      |
|------------------------------------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|
|                                                | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
| CO1                                            | 3   | 2   | –   | –   | 1   | –   | –   | –   | –   | –    | –    | 1    |
| CO2                                            | 3   | 3   | 2   | –   | 1   | –   | –   | –   | –   | –    | –    | 1    |
| CO3                                            | 3   | 3   | 3   | 2   | 1   | –   | –   | –   | –   | –    | –    | 1    |
| CO4                                            | 3   | 3   | 3   | 2   | 2   | –   | –   | –   | –   | –    | –    | 1    |
| CO5                                            | 3   | 2   | 3   | 2   | 3   | –   | –   | –   | –   | –    | –    | 1    |
| CO6                                            | 2   | 3   | 2   | 3   | 3   | 1   | –   | –   | –   | –    | –    | 3    |
| Level of Mapping as: Low 1, Moderate 2, High 3 |     |     |     |     |     |     |     |     |     |      |      |      |

| Marking Scheme                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <ul style="list-style-type: none"> <li>Compulsory passing with 40% marks is mandatory in ESE examinations and combined passing marks (MSE+ISE/CA+ESE) for theory course is 40 %</li> <li>Mid sem. examination will be based on 50 % syllabus from beginning (First Three Units).</li> <li>No compulsory passing for MSE.</li> <li>ESE paper setting weightage will be, 25 % on syllabus covered for MSE (First Three Units) and 75 % on remaining syllabus (Last Three Units).</li> </ul> |

| Unit No. | Title and Content of Unit                                                                                                                                                                                                                                                                           | Hours |
|----------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| 1        | <b>Introduction to Compilers</b>                                                                                                                                                                                                                                                                    |       |
|          | Introduction to compiler; Compiler phases; Front-end & Back-end structure; Error handling & recovery; Language processors – Assembler, Interpreter, Linker, Loader; Overview of AI-driven compiler optimization.                                                                                    |       |
| 2        | <b>Lexical Analysis</b>                                                                                                                                                                                                                                                                             |       |
|          | Role of lexical analyzer; Tokens, lexemes, patterns; Regular expressions; Regular languages; Finite automata (NFA & DFA); NFA → DFA conversion; Lexical analyzer construction; Introduction to Lex tool; ML relevance: tokenization in code models.                                                 |       |
| 3        | <b>Syntax Analysis</b>                                                                                                                                                                                                                                                                              |       |
|          | Parsing techniques – Top-down, Bottom-up; LL grammar, FIRST/FOLLOW; Predictive parsing; LR, SLR, LALR parsing; Parser table construction; YACC tool introduction; ML-based parsing and syntax error prediction.                                                                                     |       |
| 4        | <b>Semantic Analysis &amp; Intermediate Code Generation</b>                                                                                                                                                                                                                                         |       |
|          | Syntax-directed definitions; Semantic actions; Type checking & type inference; Symbol table management; Intermediate code forms – TAC, Quadruples, Triples; Boolean expressions; Control flow; AST & IR; ML for code quality prediction.                                                            |       |
| 5        | <b>Code Optimization Techniques</b>                                                                                                                                                                                                                                                                 |       |
|          | Need for optimization; Machine-independent optimizations (constant folding, dead code elimination, loop optimizations); Machine-dependent optimizations; CFG & data flow analysis; Peephole optimization; AI-driven optimization: profile-guided, ML-based prediction, RL in compiler optimization. |       |
| 6        | <b>Code Generation &amp; Modern Compiler Trends</b>                                                                                                                                                                                                                                                 |       |
|          | Issues in code generation; Register allocation; Instruction selection; Basic blocks; Runtime environments; Garbage collection; JIT compilers; ML in compilers: neural code generation, automatic error repair, LLMs in compiler design; Case studies: LLVM, GCC, TensorFlow XLA.                    |       |

| Textbooks |                                              |                                                             |                                         |
|-----------|----------------------------------------------|-------------------------------------------------------------|-----------------------------------------|
| Sr. no.   | Title                                        | Author                                                      | Edition/Publication                     |
| 01        | Compilers: Principles, Techniques, and Tools | Alfred V. Aho, Monica S. Lam, Ravi Sethi, Jeffrey D. Ullman | 2nd Edition, Pearson Education          |
| 02        | Modern Compiler Implementation in C          | Andrew W. Appel                                             | 2nd Edition, Cambridge University Press |
| 03        | Compiler Design                              | K. Muneeswaran                                              | 1st Edition, Oxford University Press    |

| Reference Books |                                             |                                |                                |
|-----------------|---------------------------------------------|--------------------------------|--------------------------------|
| Sr. no.         | Title                                       | Author                         | Edition/Publication            |
| 01              | Engineering a Compiler                      | Keith D. Cooper, Linda Torczon | 2nd Edition, Morgan Kaufmann   |
| 02              | Advanced Compiler Design and Implementation | Steven S. Muchnick             | 1st Edition, Morgan Kaufmann   |
| 03              | Machine Learning for Compiler Optimization  | Christophe Dubach et al.       | Springer / Research Monographs |



| Marking Scheme |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                | <ul style="list-style-type: none"> <li>Compulsory passing with 40% marks is mandatory in ESE examinations and combined passing marks (MSE+ISE/CA+ESE) for theory course is 40 %</li> <li>Mid sem. examination will be based on 50 % syllabus from beginning (First Three Units).</li> <li>No compulsory passing for MSE.</li> <li>ESE paper setting weightage will be, 25 % on syllabus covered for MSE (First Three Units) and 75 % on remaining syllabus (Last Three Units).</li> </ul> |

| Unit No. | Title and Content of Unit                                                                                                                                                                                                                                                                                                                                                                                              | Hours |
|----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| 1        | <b>Principles of Hacking &amp; Legal Parameters</b>                                                                                                                                                                                                                                                                                                                                                                    | 6     |
|          | Introduction of Ethical Hacking, Need of Ethical hacking, Principles of Ethical hacking, Types of Hacking, Phases of Ethical Hacking, Types of hackers, Hacking Technique, Types of Attacks on a System, Introduction to Malware, Viruses ,Worms & Trojan Concepts, Information Security control                                                                                                                       |       |
| 2        | <b>System Hacking and &amp; Exploitation</b>                                                                                                                                                                                                                                                                                                                                                                           | 6     |
|          | Introduction to Footprinting & Reconnaissance, Types of Footprinting, Footprinting through Web Services, Password Attacks<br>Enumeration: Techniques for Enumeration, Information Gathering Using Groups, Forums and Blogs. Network Scanning Concepts. Vulnerability Scanning, System Hacking, Malware Threats, Session Hijacking                                                                                      |       |
| 3        | <b>Sniffing And Social Engineering</b>                                                                                                                                                                                                                                                                                                                                                                                 | 6     |
|          | What is Sniffing , MAC Spoofing & Flooding, Active Scanning Techniques, DHCP Flooding, Types of Sniffing, Setup DHCP Rouge (MITM Attack), Protocols Vulnerable to Sniffing, Sniffing with Wireshark<br>Social Engineering Concepts :Social Engineering Techniques ,Insider Threat / Insider Attack, Social Engineering Countermeasures                                                                                 |       |
| 4        | <b>Network &amp; Wireless Security</b>                                                                                                                                                                                                                                                                                                                                                                                 | 6     |
|          | Packet Sniffing, Wireless Hacking, Attacks on Voice over IP systems such as eavesdropping, call hijacking, and denial of service attacks.<br>Firewall & Examples ,What is IDS & examples ,What is Honeypots & examples , SQL Injection methodology                                                                                                                                                                     |       |
| 5        | <b>Mobile &amp; Wireless Networks Hacking</b>                                                                                                                                                                                                                                                                                                                                                                          | 6     |
|          | Introduction to the Mobile architecture ,Working principle for mobile OS, Security of the application used in Mobiles ,Hacking Methodology for mobile with Metasploit<br>Introduction to Wireless Terminology, Networks, Standards Types of Wireless Authentication and Encryption , Wireless Hacking Methodology, Bluetooth Hacking, ,GPS Mapping, Traffic analysing, Launch Wireless attacks, Crack Wi-Fi Encryption |       |
| 6        | <b>IoT and Cloud Attacks</b>                                                                                                                                                                                                                                                                                                                                                                                           | 6     |
|          | IOT Concept and Attacks, Technology and Protocols, Challenges, Opportunity in IOT, OWASP Top 10 IOT Vulnerabilities and Obstacles , Hacking IOT Devices, Cloud Computing Overview , Introduction to Cloud & Virtualization, Cloud Deployment and responsibilities, Threats and attack in Cloud.                                                                                                                        |       |

| Textbooks |                                                                                      |                                                                |                     |
|-----------|--------------------------------------------------------------------------------------|----------------------------------------------------------------|---------------------|
| Sr. no.   | Title                                                                                | Author                                                         | Edition/Publication |
| 01        | CEH V10: EC-Council Certified Ethical Hacker Complete Training Guide by IPSpecialist | Ric Messier                                                    | CEH v11<br>Wiley    |
| 02        | The Complete Ethical Hacking Book                                                    | Thirumalesh                                                    | 1st Edition         |
| 03        | Hands-On Ethical Hacking and Network Defense                                         | Michael T. Simpson,<br>Nicholas D. Antill<br>&Robert S. Wilson | 4th Edition         |

| Reference Books |                                                         |                                             |                            |
|-----------------|---------------------------------------------------------|---------------------------------------------|----------------------------|
| Sr. no.         | Title                                                   | Author                                      | Edition/Publication        |
| 01              | CEH v10 Certified Ethical Hacker Study Guide            | Ric Messier                                 | Wiley                      |
| 02              | Gray Hat Hacking: The Ethical Hacker's Handbook         | Allen Harper, Daniel Regalado, et al.       | 6th Edition<br>McGraw-Hill |
| 03              | Ethical Hacking: Techniques, Tools, and Countermeasures | Michael G. Solomon &<br>Sean-Philip Oriyano | 4th Edition                |



| Marking Scheme |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                | <ul style="list-style-type: none"> <li>Compulsory passing with 40% marks is mandatory in ESE examinations and combined passing marks (MSE+ISE/CA+ESE) for theory course is 40 %</li> <li>Mid sem. examination will be based on 50 % syllabus from beginning (First Three Units).</li> <li>No compulsory passing for MSE.</li> <li>ESE paper setting weightage will be, 25 % on syllabus covered for MSE (First Three Units) and 75 % on remaining syllabus (Last Three Units).</li> </ul> |

| Unit No. | Title and Content of Unit                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Hours |
|----------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| 1        | <b>Introduction to Project Management</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 5     |
|          | Project and Project Management(PM), Role of project Manager, System view of PM, Organization, Stake holders, Project phases and life cycle, Context of IT projects, process groups, mapping groups to Knowledge areas                                                                                                                                                                                                                                                                                   |       |
| 2        | <b>Project Integration Management</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 6     |
|          | Strategic planning and project selection, Developing a Project Management Plan, Directing and Managing Project Work, Monitoring and Controlling Project Work, Performing Integrated Change Control, Closing Projects or Phases                                                                                                                                                                                                                                                                          |       |
| 3        | <b>Project Scope, Time and Cost management</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 9     |
|          | <b>Project Scope:</b> Planning Scope Management, Collecting Requirements, Defining Scope, Creating the Work Breakdown Structure, Validating Scope, Controlling Scope.<br><b>Project Schedule:</b> Planning Schedule Management, Defining Activities, Sequencing and Estimating Activity, Resources & Duration, Developing & Controlling Schedule<br><b>Cost Management:</b> Basic Principles of Cost Management, Planning Cost Management, Estimating Costs, Determining the Budget, Controlling Costs. |       |
| 4        | <b>Quality Management</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 5     |
|          | Quality Concepts and Terminology, Quality Standards and Models, Roles and Responsibilities of Quality Manager/QA team, Planning Quality Management, Performing Quality Assurance, Controlling Quality, root cause analysis, Quality Audits and Reviews-Internal and external, Tools and Techniques for Quality Control.                                                                                                                                                                                 |       |
| 5        | <b>Human Resource management</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 6     |
|          | Definition and Importance of HRM, Roles and Responsibilities in Project HR Manager, Leadership Styles, human resource planning, Motivation Theories and Their Application, Conflict Management in Project Teams, Performance Management and Appraisal, Ethics, Diversity, and Professional Behaviour.<br>Case Studies: Current Trends in HR Management( Remote teams and virtual collaboration, Agile teams and self-organizing teams, Use of HR software tools)                                        |       |
| 6        | <b>Risk management</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 5     |
|          | Definition and Importance of RM, risk management planning, sources of risk, risk identification, qualitative and quantitative risk analysis, risk response planning, risk monitoring and control.                                                                                                                                                                                                                                                                                                       |       |

| Textbooks |                                           |                                       |                     |
|-----------|-------------------------------------------|---------------------------------------|---------------------|
| Sr. no.   | Title                                     | Author                                | Edition/Publication |
| 01        | Information Technology Project Management | Kathy Schwalbe                        | Cengage Learning 7E |
| 02        | Software Project Management               | Bob Huges, Mike Cotterell, Rajib Mall | McGraw Hill Edu     |

| Reference Books |                                  |                                               |                       |
|-----------------|----------------------------------|-----------------------------------------------|-----------------------|
| Sr. no.         | Title                            | Author                                        | Edition/Publication   |
| 01              | Effective Project Management     | Robert K.Wysocki                              | Wiley India 7 Edition |
| 02              | Project Management Core Textbook | Mantel Jr., Meredith, Shafer, Sutton, Gopalan | Wiley India Edition   |
| 03              | IT Project Management            | Joseph Phillips 3E                            | McGraw Hill Edu       |



| Marking Scheme |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                | <ul style="list-style-type: none"> <li>Compulsory passing with 40% marks is mandatory in ESE examinations and combined passing marks (MSE+ISE/CA+ESE) for theory course is 40 %</li> <li>Mid sem. examination will be based on 50 % syllabus from beginning (First Three Units).</li> <li>No compulsory passing for MSE.</li> <li>ESE paper setting weightage will be, 25 % on syllabus covered for MSE (First Three Units) and 75 % on remaining syllabus (Last Three Units).</li> </ul> |

| Unit No. | Title and Content of Unit                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Hours |
|----------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| 1        | <b>Introduction to databases, E-R model and Relational Model</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 08    |
|          | <b>Introduction:</b> Purpose of Database Systems, View of data, Database architecture, Database users and administrator.<br><b>E-R Model:</b> Entity sets, Entity types, attributes, Notations, Relationship set, Relationship types, Keys- Super keys, candidate key, primary key, Extended features of ER Model- Generalization, Specialization and aggregation<br><b>Relational Model:</b> Structure of relational database, Reduction of ER model into Relational schemas, Schema-instance distinction, Referential integrity and foreign keys, Relational Algebra and Example queries. |       |
| 2        | <b>Fundamentals of SQL</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 06    |
|          | <b>SQL:</b> Introduction to SQL, Data definition statements with constraints, Insert, Update, Delete, Set Operations, Aggregate functions group by and having clauses, Nested Queries, Views, Complex queries, Joins<br><b>PLSQL:</b> Triggers, Stored Procedures, PL/SQL Processing with Cursors, PL/SQL Stored Functions                                                                                                                                                                                                                                                                  |       |
| 3        | <b>Functional Dependency and Normalization</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | 06    |
|          | Importance of good schema design, Motivation for normal form, Atomic domains and 1NF, Dependency Theory: Functional dependencies, Closure of set of FD's, Properties of them, Multivalued dependencies and 4NF, Join dependencies and 5NF, Temporal functional dependencies                                                                                                                                                                                                                                                                                                                 |       |
| 4        | <b>Data Storage and Indexing</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 06    |
|          | File organization, organization of records in files, Data Dictionary, Database Buffer<br><b>Indexing:</b> Concept, Ordered Indices-Primary, Secondary, Multilevel, B+ Tree index, Hashing, Hash Indices, Dynamic hashing, Multiple Key access, Bitmap Indices                                                                                                                                                                                                                                                                                                                               |       |
| 5        | <b>Transaction Management and Concurrency Control</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 06    |
|          | <b>Transaction Processing:</b> Concept, ACID properties, Transaction states, Storage structure, Implementations of atomicity, isolation and durability, Serializability, Testing of Serializability. <b>Concurrency Control:</b> Lock based protocols, Timestamp based Protocols, Validation based Protocols, Multiple Granularities, Deadlock handling                                                                                                                                                                                                                                     |       |
| 6        | <b>Recovery System</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 06    |
|          | Failure Classification, Storage structure, Implementation of stable storage, Recovery and Atomicity, Log based recovery, Checkpoints, Shadow Paging, buffer Management in crash recovery                                                                                                                                                                                                                                                                                                                                                                                                    |       |

| Textbooks |                                                             |                                                 |                                           |
|-----------|-------------------------------------------------------------|-------------------------------------------------|-------------------------------------------|
| Sr. no.   | Title                                                       | Author                                          | Edition/Publication                       |
| 01        | Database System Concepts                                    | A. Silberschatz,<br>H.F. Korth,<br>S. Sudarshan | 6th Edition,<br>McGraw Hill<br>Education. |
| 02        | Database Systems – Design,<br>Implementation and Management | Rob & Coronel                                   | 5th Edition,<br>Cengage Learning          |

| Reference Books |                                                                                        |                                       |                                   |
|-----------------|----------------------------------------------------------------------------------------|---------------------------------------|-----------------------------------|
| Sr. no.         | Title                                                                                  | Author                                | Edition/Publication               |
| 01              | Database Systems - A practical approach<br>to Design, Implementation and<br>Management | Thomos Connolly,<br>Carolyn Beg       | 3rd Edition, Pearson<br>Education |
| 02              | Fundamentals of Database Systems                                                       | Ramez Elmasri,<br>Shamkant B. Navathe | 4th Edition, Pearson<br>Education |

| Year and Semester  | Third Year B. Tech - Semester V – CSE(AIML) |        |     |                  |           |
|--------------------|---------------------------------------------|--------|-----|------------------|-----------|
| Course Category    | Program Core Course                         |        |     |                  |           |
| Title of Course    | Computer Algorithm Lab                      |        |     | Course Code      | AIML 3107 |
| Teaching Scheme    | L                                           | T      | P   | Contact Hrs/Week | Credits   |
|                    | --                                          | 01     | --  | 01               | 01        |
| Examination Scheme | MSE                                         | ISE/CA | ESE | Total            |           |
|                    | --                                          | 25     | 25  | 50               |           |

| Course Pre-Requisite | Data Structures, Discrete Mathematics, Engineering Mathematics, Programming Concepts |                                                                                             |
|----------------------|--------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------|
| Course Objective     | 1                                                                                    | To introduce fundamental algorithm design methods and techniques along with their analysis. |
|                      | 2                                                                                    | Use greedy strategies to design efficient and optimal solutions.                            |
|                      | 3                                                                                    | Apply dynamic programming for solving complex optimization problems.                        |
|                      | 4                                                                                    | Implement traversal and backtracking methods for structured search problems.                |
|                      | 5                                                                                    | Explore the theory and classification of NP-Hard and NP-Complete problems.                  |
|                      | 6                                                                                    | Introducing parallel algorithms.                                                            |
| Course Outcomes      | After completion of this course Students will be able to ....                        |                                                                                             |
|                      | CO1                                                                                  | Understand and demonstrate algorithm design methods with analysis.                          |
|                      | CO2                                                                                  | Analyze algorithm space and time complexity by using recurrence relation                    |
|                      | CO3                                                                                  | Devise algorithm for given problem statement using various methods                          |
|                      | CO4                                                                                  | Create solution using search and traversal techniques                                       |
|                      | CO5                                                                                  | Categorize the problem to determine polynomial and non-polynomial based on its nature       |
|                      | CO6                                                                                  | Understand and demonstrate basic concepts of parallel algorithms                            |

| CO PO Mapping                                  |     |     |     |     |     |     |     |     |     |      |      |      |
|------------------------------------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|
|                                                | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
| CO1                                            | 3   | 3   | 2   | 1   | 2   | 1   | 1   | 1   | 1   | 2    | 1    | 2    |
| CO2                                            | 3   | 3   | 2   | 2   | 2   | 1   | 1   | 1   | 1   | 2    | 1    | 2    |
| CO3                                            | 3   | 3   | 3   | 2   | 2   | 1   | 1   | 1   | 1   | 2    | 2    | 2    |
| CO4                                            | 3   | 3   | 3   | 2   | 2   | 1   | 1   | 1   | 2   | 2    | 2    | 2    |
| CO5                                            | 3   | 2   | 2   | 2   | 1   | 1   | 1   | 2   | 1   | 1    | 1    | 1    |
| CO6                                            | 3   | 2   | 2   | 2   | 3   | 1   | 1   | 1   | 2   | 1    | 2    | 2    |
| Level of Mapping as: Low 1, Moderate 2, High 3 |     |     |     |     |     |     |     |     |     |      |      |      |

| Marking Scheme                                                                                                                                                                                                                                                                                                                                               |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <u>In Semester Evaluation/ Continuous Assessment has 25 Marks</u><br>Parameters for In Semester Evaluation could be: Attendance, Assignments, Unit Tests, Presentation, Online Activities like (Virtual Labs, NPTEL) etc.<br>Lab File should be prepared and should be assessed continuously during academic.<br><u>End Semester Evaluation has 25 Marks</u> |

| Guidelines for Lab Performance                                                                                             |                                                                      |
|----------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------|
| Faculty can create Experiment list based on following listed topics.<br>Minimum 10 to 12 Experiments should get performed. |                                                                      |
| Tutorial. No.                                                                                                              | Title of Experiment/ Problem Statement                               |
| 1                                                                                                                          | Fundamentals of Algorithms and Performance Analysis                  |
| 2                                                                                                                          | Divide-and-Conquer Techniques: Sorting and Matrix Multiplication     |
| 3                                                                                                                          | Greedy Strategy Applications in Optimization Problems                |
| 4                                                                                                                          | Greedy Algorithms for Shortest Path and Spanning Tree Problems       |
| 5                                                                                                                          | Dynamic Programming Formulation and Multistage Graph Problems        |
| 6                                                                                                                          | Dynamic Programming Applications: Knapsack and Traveling Salesperson |
| 7                                                                                                                          | Tree and Graph Traversal Algorithms                                  |
| 8                                                                                                                          | Backtracking Techniques for Constraint Satisfaction Problems         |
| 9                                                                                                                          | Introduction to Computational Complexity and Cook's Theorem          |
| 10                                                                                                                         | NP-Hard and NP-Complete Problems in Graphs and Scheduling            |
| 11                                                                                                                         | Parallel Computing Models: PRAM, Mesh, and Hypercube                 |
| 12                                                                                                                         | Fundamental Parallel Algorithms and Performance Considerations       |

| Textbooks |                                     |                                                       |                                    |
|-----------|-------------------------------------|-------------------------------------------------------|------------------------------------|
| Sr. no.   | Title                               | Author                                                | Edition/Publication                |
| 01        | Fundamentals of Computer Algorithms | Ellis Horowitz, Satraj Sahani, Saguthevar Rajasejaram | Universities Press, Second Edition |

| Reference Books |                                                          |                               |                     |
|-----------------|----------------------------------------------------------|-------------------------------|---------------------|
| Sr. no.         | Title                                                    | Author                        | Edition/Publication |
| 01              | Fundamentals of Algorithmics                             | Gilles Brassard, Paul Bratley | Pearson Education   |
| 02              | Mastering Algorithms with C                              | Kyle Loudon                   | SPD O'Reilly        |
| 03              | Computer Algorithms- Introduction to Design and Analysis | Sara Baase, Allen Van Gelder  | Pearson Education   |

|                          |                                                    |        |     |                    |                 |
|--------------------------|----------------------------------------------------|--------|-----|--------------------|-----------------|
| <b>Year and Semester</b> | <b>Third Year B. Tech - Semester V – CSE(AIML)</b> |        |     |                    |                 |
| <b>Course Category</b>   | <b>Program Core Course</b>                         |        |     |                    |                 |
| <b>Title of Course</b>   | <b>Machine Learning using Advanced Python Lab</b>  |        |     | <b>Course Code</b> | <b>AIML3108</b> |
| Teaching Scheme          | L                                                  | T      | P   | Contact Hrs/Week   | Credits         |
|                          | --                                                 | --     | 04  | 04                 | 02              |
| Examination Scheme       | MSE                                                | ISE/CA | ESE | Total              |                 |
|                          | -                                                  | 25     | 25  | 50                 |                 |

|                      |                                                                                      |                                                                                    |
|----------------------|--------------------------------------------------------------------------------------|------------------------------------------------------------------------------------|
| Course Pre-Requisite | Data Structures, Discrete Mathematics, Engineering Mathematics, Programming Concepts |                                                                                    |
| Course Objective     | 1                                                                                    | To understand the fundamental concepts and aspects of Machine Learning.            |
|                      | 2                                                                                    | To understand the learning process and primitives used by computers.               |
|                      | 3                                                                                    | To identify the nature and categories of problems solvable using Machine Learning. |
|                      | 4                                                                                    | To apply regression and classification techniques for predictive modelling.        |
|                      | 5                                                                                    | To analyze supervised and unsupervised learning methods for data analysis.         |
|                      | 6                                                                                    | To understand neural network models and basic deep learning concepts.              |
| Course Outcomes      | After completion of this course Students will be able to ....                        |                                                                                    |
|                      | CO1                                                                                  | Explain fundamental concepts of Machine Learning.                                  |
|                      | CO2                                                                                  | Analyze Machine Learning models and their performance.                             |
|                      | CO3                                                                                  | Design solutions using classification and decision tree algorithms.                |
|                      | CO4                                                                                  | Explain supervised learning algorithms for classification tasks.                   |
|                      | CO5                                                                                  | Describe unsupervised learning techniques.                                         |
|                      | CO6                                                                                  | Explain neural network models used in Machine Learning.                            |

| CO PO Mapping                                  |     |     |     |     |     |     |     |     |     |      |      |      |
|------------------------------------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|
|                                                | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
| CO1                                            | 3   | 2   | 1   | 1   | 2   | 1   | 1   | 1   | 1   | 2    | 1    | 2    |
| CO2                                            | 3   | 3   | 2   | 2   | 2   | 1   | 1   | 1   | 1   | 2    | 1    | 2    |
| CO3                                            | 3   | 3   | 3   | 2   | 3   | 1   | 1   | 1   | 2   | 2    | 2    | 2    |
| CO4                                            | 3   | 3   | 2   | 2   | 2   | 1   | 1   | 1   | 1   | 2    | 1    | 2    |
| CO5                                            | 2   | 2   | 2   | 2   | 2   | 1   | 2   | 1   | 1   | 2    | 1    | 2    |
| CO6                                            | 3   | 2   | 2   | 2   | 3   | 1   | 1   | 1   | 1   | 2    | 2    | 2    |
| Level of Mapping as: Low 1, Moderate 2, High 3 |     |     |     |     |     |     |     |     |     |      |      |      |

|                                                                                                                                                                                                                                                                                                                                                              |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Marking Scheme</b>                                                                                                                                                                                                                                                                                                                                        |
| <u>In Semester Evaluation/ Continuous Assessment has 25 Marks</u><br>Parameters for In Semester Evaluation could be: Attendance, Assignments, Unit Tests, Presentation, Online Activities like (Virtual Labs, NPTEL) etc.<br>Lab File should be prepared and should be assessed continuously during academic.<br><u>End Semester Evaluation has 25 Marks</u> |

| Guidelines for Lab Performance                                                                                             |                                                                                                                                                                                          |
|----------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Faculty can create Experiment list based on following listed topics.<br>Minimum 10 to 12 Experiments should get performed. |                                                                                                                                                                                          |
| Tutorial. No.                                                                                                              | Title of Experiment/ Problem Statement                                                                                                                                                   |
| 1                                                                                                                          | Study and Installation of Python. Explore Python IDEs such as Jupyter Notebook, PyCharm, and Visual Studio Code. Introduction to ML libraries (NumPy, Pandas, Matplotlib, Scikit-learn). |
| 2                                                                                                                          | Study of different types of datasets. Data visualization and Data Pre-processing techniques (handling missing values, encoding, feature scaling).                                        |
| 3                                                                                                                          | Study and Implementation of Linear Regression.                                                                                                                                           |
| 4                                                                                                                          | Study and Implementation of Logistic Regression for Classification.                                                                                                                      |
| 5                                                                                                                          | Study and Implementation of Regularization Techniques: Ridge (L2) and Lasso (L1) Regression.                                                                                             |
| 6                                                                                                                          | Study and Implementation of Decision Tree and Random Forest Algorithms for Classification.                                                                                               |
| 7                                                                                                                          | Study and Implementation of Support Vector Machine (SVM) and Naïve Bayes Classifier.                                                                                                     |
| 8                                                                                                                          | Study and Implementation of K-Nearest Neighbors (KNN) Classifier and Elbow Method.                                                                                                       |
| 9                                                                                                                          | Study and Implementation of Unsupervised Learning Techniques: K-Means Clustering and Hierarchical Clustering.                                                                            |
| 10                                                                                                                         | Study and Implementation of Neural Network using Artificial Neural Network (ANN) with Forward and Backward Propagation.                                                                  |
| 11                                                                                                                         | PBL Application Project :<br>Implement one problem statement using various ML algorithm and Evaluate the result.                                                                         |

#### PROGRAM BASED LEARNING (PBL) :

1. Maximum **4 students per team**.
2. Project must apply **Machine Learning concepts** studied in the course.
3. Focus on a **real-world, innovative, and industry-oriented application**.
4. **Digital report** with implementation, analysis, and evaluation to be submitted.

Assessment on a continuous basis with a minimum of 3 reviews.

#### Sample project domains:

- Intelligent Healthcare
- Smart Cities & IoT Analytics
- Cybersecurity & Intrusion Detection
- Financial Analytics & Fraud Detection

| Textbooks |                                                         |                      |                                      |
|-----------|---------------------------------------------------------|----------------------|--------------------------------------|
| Sr. no.   | Title                                                   | Author               | Edition/Publication                  |
| 1         | Machine Learning with Python- an approach to applied ML | Abhishek Vijayvargia | BPB Publications                     |
| 2         | Practical Machine Learning                              | Sunila Gollapudi     | Packt Publishing Ltd                 |
| 3         | Machine Learning                                        | Tom M. Mitchell      | McGraw Hill Education; First Edition |

| Reference Books |                                                                                                                                                  |                  |                      |
|-----------------|--------------------------------------------------------------------------------------------------------------------------------------------------|------------------|----------------------|
| Sr. no.         | Title                                                                                                                                            | Author           | Edition/Publication  |
| 1               | Machine Learning for dummies                                                                                                                     | John Paul Muller | Wiley Publication    |
| 2               | Hands-On Machine Learning with Scikit-Learn, Keras, and Tensor Flow: Concepts, Tools, and Techniques to Build Intelligent Systems, Third Edition | Aurelien Geron   | O'Reilly Media       |
| 3               | Introduction to Machine Learning                                                                                                                 | Ethem Alpaydin   | PHI 2nd Edition-2013 |

| Year and Semester  | Third Year B. Tech - Semester V – CSE(AIML) |        |     |                  |          |
|--------------------|---------------------------------------------|--------|-----|------------------|----------|
| Course Category    | Program Elective Course                     |        |     |                  |          |
| Title of Course    | Internet of Things Lab                      |        |     | Course Code      | AIML3109 |
| Teaching Scheme    | L                                           | T      | P   | Contact Hrs/Week | Credits  |
|                    | --                                          | --     | 02  | 02               | 01       |
| Examination Scheme | MSE                                         | ISE/CA | ESE | Total            |          |
|                    | --                                          | 25     | --  | 25               |          |

| Course Pre-Requisite | Basic concepts of network                                     |                                                                                                                                     |
|----------------------|---------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------|
| Course Objective     | 1                                                             | Understand the fundamentals of IoT                                                                                                  |
|                      | 2                                                             | Explain IoT communication principles by studying RFID, ZigBee, Bluetooth, IP/MAC addressing, and IEEE 802 protocol standards        |
|                      | 3                                                             | Analyze sensing and actuation mechanisms used in IoT systems, including sensor characteristics, classification, and actuator types. |
|                      | 4                                                             | Develop IoT applications using standard frameworks involving device integration, data acquisition                                   |
|                      | 5                                                             | Differentiate IoT and Industrial IoT (IIoT) and understand sensor calibration, validation, and deployment                           |
|                      | 6                                                             | Introduce Internet of Robotic Things (IoRT)                                                                                         |
| Course Outcomes      | After completion of this course Students will be able to .... |                                                                                                                                     |
|                      | CO1                                                           | Describe the IoT Characteristics and Conceptual Framework                                                                           |
|                      | CO2                                                           | Understand communication technologies such as RFID, ZigBee, Bluetooth, and IEEE 802 protocols to IoT-based system                   |
|                      | CO3                                                           | Classify sensors and actuators and analyze their role in data acquisition and control in IoT environments                           |
|                      | CO4                                                           | Apply design methodology and cloud platforms involved in IoT                                                                        |
|                      | CO5                                                           | Understand key skills employed in the IIoT                                                                                          |
|                      | CO6                                                           | Understand IOT systems for robotics                                                                                                 |

| Marking Scheme                                                                                                                                       |
|------------------------------------------------------------------------------------------------------------------------------------------------------|
| In Semester Evaluation/ Continuous Assessment has 25 Marks                                                                                           |
| Parameters for In Semester Evaluation could be: Attendance, Assignments, Unit Tests, Presentation, Online Activities like (Virtual Labs, NPTEL) etc. |
| Lab File should be prepared and should be assessed continuously during academic.                                                                     |

| Guidelines for Lab Performance        |                                                                                           |
|---------------------------------------|-------------------------------------------------------------------------------------------|
| All Experiments should get performed. |                                                                                           |
| Exp. No.                              | Title of Experiment/ Problem Statement                                                    |
| 1                                     | Understand the connection of Arduino board                                                |
| 2                                     | Identification of sensors, actuators, communication module                                |
| 3                                     | IoT based control of an LED using Arduino                                                 |
| 4                                     | Web-based home automation using Arduino Uno and Bluetooth                                 |
| 5                                     | Read and display sensor data using serial monitor                                         |
| 6                                     | Understand control logic for actuators                                                    |
| 7                                     | Understand the connection of Raspberry Pi board                                           |
| 8                                     | Understand and establish device-to-device communication                                   |
| 9                                     | IIoT Use Case – Smart Industrial Monitoring Monitor temperature, vibration, or gas levels |
| 10                                    | Study of Send sensor data to cloud platform (ThingSpeak / Blynk / Firebase)               |
| 11                                    | Understand and implement RFID Based Identification System                                 |
| 12                                    | Develop a program to demonstrate weather station readings using Arduino with Hadoop       |

| Textbooks |                                                                                               |                                                                                 |                                 |
|-----------|-----------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------|---------------------------------|
| Sr. no.   | Title                                                                                         | Author                                                                          | Edition/Publication             |
| 01        | "IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet Things" | David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Robert Barton, Jerome Henry | 0Pearson Education              |
| 02        | Internet of Things: Architecture and Design Principles"                                       | Raj Kamal                                                                       | McGraw Hill Education, 2017     |
| 03        | Internet of Things A Hands-On-Approach",2014.                                                 | Vijay Madiseti, Arshdeep Bahga                                                  | Georgia Institute of Technology |

| Reference Books |                                                                   |                                               |                     |
|-----------------|-------------------------------------------------------------------|-----------------------------------------------|---------------------|
| Sr. no.         | Title                                                             | Author                                        | Edition/Publication |
| 01              | "Industry 4.0: The Industrial Internet of Things"                 | Alasdair Gilchrist                            | Apress, 2016        |
| 02              | "The Internet of Things in the Cloud: A Middleware Perspective" - | Honbo Zhou                                    | CRC Press 2012      |
| 03              | "Introduction to Industrial Internet of Things and Industry 4.0"  | Sudip Misra, Chandana Roy, Anadarup Mukherjee | CRC Press, 2021     |



In Semester Evaluation/ Continuous Assessment has 50 Marks

Parameters for In Semester Evaluation could be: Attendance, Assignments, Unit Tests, Presentation, Online Activities like (Virtual Labs, NPTEL) etc.

Lab File should be prepared and should be assessed continuously during academic.

End Semester Evaluation has 25 Marks

External Practical Examination with Performance and Oral Examination

Guidelines for Lab Performance

Faculty can create Experiment list based on following listed topics.

Minimum 10 to 12 Experiments should get performed.

| Exp. No. | Title of Experiment/ Problem Statement                                                                           |
|----------|------------------------------------------------------------------------------------------------------------------|
| 1        | Study of Compiler Phases-Study the structure and phases of a compiler using sample programs                      |
| 2        | Lexical Analyzer (Manual)-Design a lexical analyzer to identify keywords, identifiers, operators, and constants. |
| 3        | Regular Expression Processing-Convert regular expressions into NFA and DFA.                                      |
| 4        | LEX Program for Tokenization-Write a LEX program to recognize tokens from source code.                           |
| 5        | FIRST and FOLLOW Sets-Compute FIRST and FOLLOW sets for a given grammar.                                         |
| 6        | Predictive Parsing (LL(1))-Construct LL(1) parsing table and validate input strings.                             |
| 7        | YACC Program for Expression Parsing-Implement arithmetic expression parsing using YACC.                          |
| 8        | Symbol Table Implementation-Implement a symbol table using arrays or hash tables.                                |
| 9        | Intermediate Code Generation-Generate three-address code for arithmetic expressions.                             |
| 10       | Code Optimization-Perform basic optimization such as constant folding or dead code elimination.                  |
| 11       | Simple Code Generation- Generate simple target code for arithmetic expressions.                                  |

Textbooks

| Sr. no. | Title                                        | Author                                                      | Edition/Publication                     |
|---------|----------------------------------------------|-------------------------------------------------------------|-----------------------------------------|
| 01      | Compilers: Principles, Techniques, and Tools | Alfred V. Aho, Monica S. Lam, Ravi Sethi, Jeffrey D. Ullman | 2nd Edition, Pearson Education          |
| 02      | Modern Compiler Implementation in C          | Andrew W. Appel                                             | 2nd Edition, Cambridge University Press |
| 03      | Compiler Design                              | K. Muneeswaran                                              | 1st Edition, Oxford University Press    |

| Reference Books |                                             |                                 |                                 |
|-----------------|---------------------------------------------|---------------------------------|---------------------------------|
| Sr. no.         | Title                                       | Author                          | Edition/Publication             |
| 01              | Engineering a Compiler                      | Keith D. Cooper, Linda Torczon  | 2nd Edition, Morgan Kaufmann    |
| 02              | Advanced Compiler Design and Implementation | Steven S. Muchnick              | 1st Edition, Morgan Kaufmann    |
| 03              | Compilers and Compiler Generators           | P. D. Terry                     | CRC Press                       |
| 04              | Programming Language Pragmatics             | Programming Language Pragmatics | Programming Language Pragmatics |



| Marking Scheme                                                                                                                                                                                                                                                                                                |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <u>In Semester Evaluation/ Continuous Assessment has 25 Marks</u><br>Parameters for In Semester Evaluation could be: Attendance, Assignments, Unit Tests, Presentation, Online Activities like (Virtual Labs, NPTEL) etc.<br>Lab File should be prepared and should be assessed continuously during academic. |

| Guidelines for Lab Performance                                                                                             |                                                                                                                                                    |
|----------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------|
| Faculty can create Experiment list based on following listed topics.<br>Minimum 10 to 12 Experiments should get performed. |                                                                                                                                                    |
| Exp. No.                                                                                                                   | Title of Experiment/ Problem Statement                                                                                                             |
| 1                                                                                                                          | To learn about hacking tools and skills.                                                                                                           |
| 2                                                                                                                          | To understand ethical hacking principles and explore Kali Linux                                                                                    |
| 3                                                                                                                          | To study about Footprinting and Reconnaissance.                                                                                                    |
| 4                                                                                                                          | To discover live hosts, open ports, and services.                                                                                                  |
| 5                                                                                                                          | To study about Fingerprinting                                                                                                                      |
| 6                                                                                                                          | To identify vulnerabilities in a target system.                                                                                                    |
| 7                                                                                                                          | To understand password security and cracking methods.                                                                                              |
| 8                                                                                                                          | To learn & study about Sniffing & their tools                                                                                                      |
| 9                                                                                                                          | To demonstrate SQL Injection vulnerability.                                                                                                        |
| 10                                                                                                                         | To study and exploit <b>Cross-Site Scripting (XSS)</b> vulnerabilities in a web application and understand the risks posed by client-side attacks. |
| 11                                                                                                                         | To study about Wireless Hacking.                                                                                                                   |
| 12                                                                                                                         | To prepare a professional penetration testing report.                                                                                              |

| Textbooks |                                                                                                  |                       |                     |
|-----------|--------------------------------------------------------------------------------------------------|-----------------------|---------------------|
| Sr. no.   | Title                                                                                            | Author                | Edition/Publication |
| 01        | CEH v11 Certified Ethical Hacker Study Guide                                                     | Ric Messier           | Wiley               |
| 02        | The Basics of Hacking and Penetration Testing: Ethical Hacking and Penetration Testing Made Easy | Patrick Engebretson   | Syngress            |
| 03        | Hacking: The Art of Exploitation                                                                 | Jon “Smibbs” Erickson | 2nd Edition         |

| Reference Books |                                                                      |                                  |                     |
|-----------------|----------------------------------------------------------------------|----------------------------------|---------------------|
| Sr. no.         | Title                                                                | Author                           | Edition/Publication |
| 01              | Ethical Hacking and Countermeasures: Attack Phases                   | EC-Council                       | Cengage Learning    |
| 02              | Hands-On Ethical Hacking and Network Defense                         | Michael T. Simpson, Kent Backman | 4th Edition         |
| 03              | The Ethical Hack: A Framework for Business-Value Penetration Testing | James S. Tiller                  | CRC Press           |



| Marking Scheme                                                                                                                                                                                                                                                                                                                                                                                                                       |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <u>In Semester Evaluation/ Continuous Assessment has 50 Marks</u><br>Parameters for In Semester Evaluation could be: Attendance, Assignments, Unit Tests, Presentation, Online Activities like (Virtual Labs, NPTEL) etc.<br>Lab File should be prepared and should be assessed continuously during academic.<br><u>End Semester Evaluation has 25 Marks</u><br>External Practical Examination with Performance and Oral Examination |

| Guidelines for Lab Performance                                                                                             |                                                                                              |
|----------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------|
| Faculty can create Experiment list based on following listed topics.<br>Minimum 10 to 12 Experiments should get performed. |                                                                                              |
| Exp. No.                                                                                                                   | Title of Experiment/ Problem Statement                                                       |
| 1                                                                                                                          | Study and analysis of real-life IT and non-IT projects and identify project characteristics. |
| 2                                                                                                                          | Preparation of Project Life Cycle diagram for an IT project.                                 |
| 3                                                                                                                          | Preparation of Project Charter for a selected project                                        |
| 4                                                                                                                          | Development of a Project Management Plan (PMP)                                               |
| 5                                                                                                                          | Study of Change Request and Change Control Process using a sample project.                   |
| 6                                                                                                                          | Creation of Work Breakdown Structure (WBS) for a project.                                    |
| 7                                                                                                                          | Identification and sequencing of activities using Network Diagram (PERT/CPM)                 |
| 8                                                                                                                          | Prepare Cost estimation using Bottom-up and Analogous estimation techniques                  |
| 9                                                                                                                          | Preparation of Quality Management Plan                                                       |
| 10                                                                                                                         | Study Application of Quality Control tools (Pareto chart, Fishbone diagram, Control chart).  |
| 11                                                                                                                         | Preparation of Human Resource Management Plan                                                |
| 12                                                                                                                         | Case study on Remote teams and virtual collaboration challenges                              |
| 13                                                                                                                         | Performing Qualitative Risk Analysis using probability–impact matrix                         |
| 14                                                                                                                         | Performing Quantitative Risk Analysis (EMV / Decision tree).                                 |

| Textbooks |                                           |                                       |                     |
|-----------|-------------------------------------------|---------------------------------------|---------------------|
| Sr. no.   | Title                                     | Author                                | Edition/Publication |
| 01        | Information Technology Project Management | Kathy Schwalbe                        | Cengage Learning 7E |
| 02        | Software Project Management               | Bob Huges, Mike Cotterell, Rajib Mall | McGraw Hill Edu     |

| Reference Books |                                  |                                               |                       |
|-----------------|----------------------------------|-----------------------------------------------|-----------------------|
| Sr. no.         | Title                            | Author                                        | Edition/Publication   |
| 01              | Effective Project Management     | Robert K.Wysocki                              | Wiley India 7 Edition |
| 02              | Project Management Core Textbook | Mantel Jr., Meredith, Shafer, Sutton, Gopalan | Wiley India Edition   |
| 03              | IT Project Management            | Joseph Phillips 3E                            | McGraw Hill Edu       |

| Year and Semester  | Third Year B. Tech - Semester V –CSE(AIML) |        |     |                  |          |
|--------------------|--------------------------------------------|--------|-----|------------------|----------|
| Course Category    | Multi-disciplinary Minor                   |        |     |                  |          |
| Title of Course    | Database Management System                 |        |     | Course Code      | AIML3110 |
| Teaching Scheme    | L                                          | T      | P   | Contact Hrs/Week | Credits  |
|                    | --                                         | --     | 02  | 02               | 01       |
| Examination Scheme | MSE                                        | ISE/CA | ESE | Total            |          |
|                    | --                                         | 50     | --  | 50               |          |

|                      |                                                                                                          |                                                                                              |
|----------------------|----------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------|
| Course Pre-Requisite | Database Fundamentals, Data Modeling, Proficiency in Python or Java, Basics of SQL and Operating Systems |                                                                                              |
| Course Objective     | 1                                                                                                        | To understand fundamental concepts of database systems and ER data modeling.                 |
|                      | 2                                                                                                        | To learn relational database concepts and SQL for database creation and manipulation.        |
|                      | 3                                                                                                        | To comprehend functional dependencies and normalization techniques for good database design. |
|                      | 4                                                                                                        | To explore database storage structures and indexing techniques for efficient data access.    |
|                      | 5                                                                                                        | To learn & understand transaction processing and concurrency control mechanisms in DBMS.     |
|                      | 6                                                                                                        | To describe and analyze database failures and recovery mechanisms used in DBMS.              |
| Course Outcomes      | After completion of this course students will be able to ....                                            |                                                                                              |
|                      | CO1                                                                                                      | Design ER diagrams representing real-world database systems.                                 |
|                      | CO2                                                                                                      | Construct and execute SQL queries to create and manipulate relational databases.             |
|                      | CO3                                                                                                      | Apply normalization methods to develop efficient and consistent database schemas.            |
|                      | CO4                                                                                                      | Analyze and implement appropriate indexing techniques to improve query performance.          |
|                      | CO5                                                                                                      | Evaluate transaction schedules and apply concurrency control protocols.                      |
|                      | CO6                                                                                                      | Apply database recovery techniques to maintain data consistency after failures.              |

| CO PO Mapping                                  |     |     |     |     |     |     |     |     |     |      |      |      |
|------------------------------------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|
|                                                | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
| CO1                                            | 3   | 2   |     |     |     |     |     |     |     | 3    |      |      |
| CO2                                            | 3   | 3   | 2   |     | 3   |     |     |     |     | 3    | 3    | 1    |
| CO3                                            | 3   | 3   | 3   | 2   |     |     |     |     |     | 3    | 2    |      |
| CO4                                            | 3   | 2   |     | 2   | 3   |     |     |     |     | 3    | 3    |      |
| CO5                                            | 3   | 3   | 2   | 2   |     |     |     |     |     | 3    | 2    |      |
| CO6                                            | 3   | 2   |     | 2   |     |     |     |     |     | 3    | 2    |      |
| Level of Mapping as: Low 1, Moderate 2, High 3 |     |     |     |     |     |     |     |     |     |      |      |      |

| Marking Scheme                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <u>In Semester Evaluation/ Continuous Assessment has 50 Marks</u><br>Parameters for In Semester Evaluation could be: Attendance, Assignments, Unit Tests, Practical and Oral Performance, Online Activities like (Virtual Labs, NPTEL) etc.<br>Lab File should be prepared and should be assessed continuously during academic.<br><u>End Semester Evaluation has 25 Marks</u><br>External Practical Examination with Performance and Oral Examination |

| Guidelines for Lab Performance                                                                                            |                                                                                                                                                    |
|---------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------|
| Faculty can create experiment list based on following listed topics.<br>Minimum 10 to 12 Experiments should be performed. |                                                                                                                                                    |
| Exp. No.                                                                                                                  | Title of Experiment/ Problem Statement                                                                                                             |
| 1                                                                                                                         | Draw an E-R Diagram of any organization                                                                                                            |
| 2                                                                                                                         | Converting E-R Diagram into Relational Table                                                                                                       |
| 3                                                                                                                         | Installation and Demonstration of DBMS Oracle/MySQL/SQL Server/PostgreSQL etc.                                                                     |
| 4                                                                                                                         | Study and Implementation of Data Definition Language(DDL) Queries (e.g. create, alter and drop tables)                                             |
| 5                                                                                                                         | Study and Implementation of Data Manipulation Language(DML) Queries. (e.g. Insert, delete, update and select statements)                           |
| 6                                                                                                                         | Implementation of Basic SQL SELECT statement for displaying/Extracting data from single multiple tables                                            |
| 7                                                                                                                         | Implementation of SQL constructs for aggregating data, use of group by, having clause.                                                             |
| 8                                                                                                                         | Implementation of nested sub queries, complex sub queries                                                                                          |
| 9                                                                                                                         | Display the results of Join Operations like cross join, self-join, inner join, natural join, left outer join, right outer join and full outer join |
| 10                                                                                                                        | Create & Update views for any created table                                                                                                        |
| 11                                                                                                                        | Write a program of Database connectivity with any object oriented language                                                                         |
| 12                                                                                                                        | Study and Implementation of Triggers                                                                                                               |
| 13                                                                                                                        | Study and Implementation of functions                                                                                                              |
| 14                                                                                                                        | Study and Implementation of Stored Procedures                                                                                                      |

| Textbooks |                                                             |                                                 |                                        |
|-----------|-------------------------------------------------------------|-------------------------------------------------|----------------------------------------|
| Sr. no.   | Title                                                       | Author                                          | Edition/Publication                    |
| 01        | Database System Concepts                                    | A. Silberschatz,<br>H.F. Korth,<br>S. Sudarshan | 6th Edition, McGraw<br>Hill Education. |
| 02        | Database Systems – Design,<br>Implementation and Management | Rob & Coronel                                   | 5th Edition,<br>Cengage Learning       |

| Reference Books |                                                                                        |                                       |                                   |
|-----------------|----------------------------------------------------------------------------------------|---------------------------------------|-----------------------------------|
| Sr. no.         | Title                                                                                  | Author                                | Edition/Publication               |
| 01              | Database Systems - A practical approach<br>to Design, Implementation and<br>Management | Thomos Connolly,<br>Carolyn Beg       | 3rd Edition, Pearson<br>Education |
| 02              | Fundamentals of Database Systems                                                       | Ramez Elmasri,<br>Shamkant B. Navathe | 4th Edition, Pearson<br>Education |



|                                                                                                                                                      |
|------------------------------------------------------------------------------------------------------------------------------------------------------|
| Marking Scheme                                                                                                                                       |
| In Semester Evaluation/ Continuous Assessment has 25 Marks                                                                                           |
| Parameters for In Semester Evaluation could be: Attendance, Assignments, Unit Tests, Presentation, Online Activities like (Virtual Labs, NPTEL) etc. |
| Lab File should be prepared and should be assessed continuously during academic.                                                                     |

| Unit No. | Title and Content of Unit                                                                                                                                                                                                                         | Hours |
|----------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| 1        | <b>Getting acquainted with professional culture:</b>                                                                                                                                                                                              | 6     |
|          | First day at work<br>Induction program<br>Company hierarchy<br>Behaviour pruning                                                                                                                                                                  |       |
| 2        | <b>Vocabulary building and Reading comprehension:</b>                                                                                                                                                                                             | 6     |
|          | Reading techniques and comprehension skills<br>Synonyms and antonyms<br>One-word substitution<br>Prefixes and Suffixes<br>Idioms and phrases<br>Homonyms and homographs<br>Irregular verbs like (write, wrote, written)<br>Situational vocabulary |       |
| 3        | <b>Effective vocal Communication:</b>                                                                                                                                                                                                             | 6     |
|          | Effective Meetings<br>Video Conferencing<br>Effective Telephonic Communication<br>Breaking Bad news                                                                                                                                               |       |
| 4        | <b>Effective written Communication:</b>                                                                                                                                                                                                           | 6     |
|          | Business letters<br>Resume Writing<br>E-mail writing<br>Report writing<br>Minutes of meeting<br>Memo writing                                                                                                                                      |       |
| 5        | <b>Public speaking and Presentation Skills:</b>                                                                                                                                                                                                   | 6     |
|          | Preparing and conducting presentation<br>Body language<br>Overcoming stage fear<br>Best practices<br>Interviewing and being interviewed                                                                                                           |       |
| 6        | <b>Miscellaneous:</b>                                                                                                                                                                                                                             | 6     |
|          | Group Discussion<br>Handling Complaints<br>Negotiation Skills<br>Business Etiquettes                                                                                                                                                              |       |

| Textbooks |                                  |                |                                           |
|-----------|----------------------------------|----------------|-------------------------------------------|
| Sr. no.   | Title                            | Author         | Edition/Publication                       |
| 01        | Technical Communication          | Ashraf Rizvi   | Tata McGraw Hill, 2005                    |
| 02        | Effective Business Communication | M. V Rodriques | Concept Publishing Company Pvt. Ltd. 2013 |

| Reference Books |                                     |                    |                          |
|-----------------|-------------------------------------|--------------------|--------------------------|
| Sr. no.         | Title                               | Author             | Edition/Publication      |
| 01              | English for Technical Communication | K. R. Laxminarayan | SCITECH 2nd Edition 2014 |
| 02              | Technical English                   | Dr. M. Hemamalini  | Wiley, 2014              |

# Semester-

# VI



| Marking Scheme |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                | <ul style="list-style-type: none"> <li>Compulsory passing with 40% marks is mandatory in ESE examinations and combined passing marks (MSE+ISE/CA+ESE) for theory course is 40 %</li> <li>Mid sem. examination will be based on 50 % syllabus from beginning (First Three Units).</li> <li>No compulsory passing for MSE.</li> <li>ESE paper setting weightage will be, 25 % on syllabus covered for MSE (First Three Units) and 75 % on remaining syllabus (Last Three Units).</li> </ul> |

| Unit No. | Title and Content of Unit                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Hours |
|----------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| 1        | <b>Introduction to databases, E-R model and Relational Model</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 08    |
|          | <b>Introduction:</b> Purpose of Database Systems, View of data, Database architecture, Database users and administrator.<br><b>E-R Model:</b> Entity sets, Entity types, attributes, Notations, Relationship set, Relationship types, Keys- Super keys, candidate key, primary key, Extended features of ER Model- Generalization, Specialization and aggregation<br><b>Relational Model:</b> Structure of relational database, Reduction of ER model into Relational schemas, Schema-instance distinction, Referential integrity and foreign keys, Relational Algebra and Example queries. |       |
| 2        | <b>Fundamentals of SQL</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 06    |
|          | <b>SQL:</b> Introduction to SQL, Data definition statements with constraints, Insert, Update, Delete, Set Operations, Aggregate functions group by and having clauses, Nested Queries, Views, Complex queries, Joins<br><b>PLSQL:</b> Triggers, Stored Procedures, PL/SQL Processing with Cursors, PL/SQL Stored Functions                                                                                                                                                                                                                                                                  |       |
| 3        | <b>Functional Dependency and Normalization</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | 06    |
|          | Importance of good schema design, Motivation for normal form, Atomic domains and 1NF, Dependency Theory: Functional dependencies, Closure of set of FD's, Properties of them, Multivalued dependencies and 4NF, Join dependencies and 5NF, Temporal functional dependencies                                                                                                                                                                                                                                                                                                                 |       |
| 4        | <b>Data Storage and Indexing</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 06    |
|          | File organization, organization of records in files, Data Dictionary, Database Buffer<br><b>Indexing:</b> Concept, Ordered Indices-Primary, Secondary, Multilevel, B+ Tree index, Hashing, Hash Indices, Dynamic hashing, Multiple Key access, Bitmap Indices                                                                                                                                                                                                                                                                                                                               |       |
| 5        | <b>Transaction Management and Concurrency Control</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 06    |
|          | <b>Transaction Processing:</b> Concept, ACID properties, Transaction states, Storage structure, Implementations of atomicity, isolation and durability, Serializability, Testing of Serializability. <b>Concurrency Control:</b> Lock based protocols, Timestamp based Protocols, Validation based Protocols, Multiple Granularities, Deadlock handling                                                                                                                                                                                                                                     |       |
| 6        | <b>Recovery System</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 06    |
|          | Failure Classification, Storage structure, Implementation of stable storage, Recovery and Atomicity, Log based recovery, Checkpoints, Shadow Paging, buffer Management in crash recovery                                                                                                                                                                                                                                                                                                                                                                                                    |       |

| Textbooks |                                                             |                                                 |                                        |
|-----------|-------------------------------------------------------------|-------------------------------------------------|----------------------------------------|
| Sr. no.   | Title                                                       | Author                                          | Edition/Publication                    |
| 01        | Database System Concepts                                    | A. Silberschatz,<br>H.F. Korth,<br>S. Sudarshan | 6th Edition, McGraw<br>Hill Education. |
| 02        | Database Systems – Design,<br>Implementation and Management | Rob & Coronel                                   | 5th Edition,<br>Cengage Learning       |

| Reference Books |                                                                                        |                                       |                                   |
|-----------------|----------------------------------------------------------------------------------------|---------------------------------------|-----------------------------------|
| Sr. no.         | Title                                                                                  | Author                                | Edition/Publication               |
| 01              | Database Systems - A practical approach<br>to Design, Implementation and<br>Management | Thomos Connolly,<br>Carolyn Beg       | 3rd Edition, Pearson<br>Education |
| 02              | Fundamentals of Database Systems                                                       | Ramez Elmasri,<br>Shamkant B. Navathe | 4th Edition, Pearson<br>Education |



| Marking Scheme |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
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| Unit No. | Title and Content of Unit                                                                                                                                                                                                                                                                              | Hours |
|----------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| 1        | <b>Introduction to Feature Engineering</b>                                                                                                                                                                                                                                                             | 6     |
|          | Introduction to feature engineering, Importance of feature engineering, , Types of data, Data levels, The types of features, Evaluation of machine learning algorithms and feature engineering procedures, Feature understanding                                                                       |       |
| 2        | <b>Basics of Feature Representation</b>                                                                                                                                                                                                                                                                | 5     |
|          | Scalars, Vectors, and Spaces, Dealing with Counts: Binarization, Quantization or Binning, Log Transformation, Feature Scaling or Normalization: Min-Max Scaling, Standardization (Variance Scaling), $\ell_2$ Normalization, Feature Selection                                                         |       |
| 3        | <b>Features of Text Data</b>                                                                                                                                                                                                                                                                           | 6     |
|          | Bag-of-X: Turning Natural Text into Flat Vectors, Filtering for Cleaner Features: Stopwords, Frequency-Based Filtering, Stemming, Atoms of Meaning: From Words to n-Grams to Phrases, Parsing and Tokenization, Collocation Extraction for Phrase Detection Tf-Idf: A Simple Twist on Bag-of-Words     |       |
| 4        | <b>Features of Categorical Data</b>                                                                                                                                                                                                                                                                    | 6     |
|          | Encoding Categorical Variables: One-Hot Encoding, Dummy Coding, Effect Coding , Pros and Cons of Categorical Variable Encodings, Dealing with Large Categorical: Variables, Feature Hashing, Bin Counting                                                                                              |       |
| 5        | <b>Feature Selection</b>                                                                                                                                                                                                                                                                               | 7     |
|          | Importance of Feature Selection in Machine Learning, Goals of Feature Selection, Classes of Feature Selection Methodologies, Effect of Irrelevant Feature, Overfitting to Predictors and External Validation, Greedy Search Methods- Simple Filters, Recursive Feature Elimination, Stepwise Selection |       |
| 6        | <b>Feature Transformation</b>                                                                                                                                                                                                                                                                          | 6     |
|          | Feature transformation Techniques, Dimensionality Reduction: Curse of dimensionality Principal Component Analysis (PCA), Benefits of dimensionality reduction, Feature Construction                                                                                                                    |       |

| Textbooks |                                                                                        |                              |                                                                       |
|-----------|----------------------------------------------------------------------------------------|------------------------------|-----------------------------------------------------------------------|
| Sr. no.   | Title                                                                                  | Author                       | Edition/Publication                                                   |
| 01        | Feature Engineering for Machine Learning: Principles and Techniques for data scientist | Alice Zheng & Amanda Casari  | Oreilly                                                               |
| 02        | Feature Engineering Made Easy                                                          | Sinan Ozdemir, Divya Susarla | Packt Publishing                                                      |
| 03        | The Art of Feature Engineering Essentials for Machine Learning                         | Pablo Duboue                 | Cambridge University Press<br>is part of the University of Cambridge. |

| Reference Books |                                                                               |                         |                     |
|-----------------|-------------------------------------------------------------------------------|-------------------------|---------------------|
| Sr. no.         | Title                                                                         | Author                  | Edition/Publication |
| 01              | Feature Engineering and Selection: A Practical Approach for Predictive Models | Max Kuhn, Kjell Johnson | CRC Press           |



| Marking Scheme |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
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| Unit No. | Title and Content of Unit                                                                                                                                                                                                                                                                                                                                                          | Hours |
|----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| 1        | <b>Basic Concepts of Image Formation</b>                                                                                                                                                                                                                                                                                                                                           | 6     |
|          | Introduction, Goals of Image Processing, Image Sensing and acquisition, Image Formation Concepts, Digital Image Fundamentals, Image representation – Gray scale and Colour images, image sampling and quantization.                                                                                                                                                                |       |
| 2        | <b>Image Enhancement and Processing</b>                                                                                                                                                                                                                                                                                                                                            | 6     |
|          | Image Transforms, Image Enhancement, Image Filtering, Color Image Processing, Image Segmentation, Geometric primitives and transformations, Plotting images, points and lines, Image contours and Histogram equalization, Interactive annotation                                                                                                                                   |       |
| 3        | <b>Morphological Processing</b>                                                                                                                                                                                                                                                                                                                                                    | 6     |
|          | Erosion, dilation, opening, closing, Basic Morphological Algorithms: hole filling, connected components, thinning, skeletons, Edge linking and boundary detection                                                                                                                                                                                                                  |       |
| 4        | <b>Introduction to Computer Vision</b>                                                                                                                                                                                                                                                                                                                                             | 6     |
|          | Definition of Computer Vision, Components of a vision system, Applications of Computer vision, Image Sources for computer Vision, Image structure and Pixels, Frameworks for Computer Vision.                                                                                                                                                                                      |       |
| 5        | <b>Object Recognition and Motion Estimation:</b>                                                                                                                                                                                                                                                                                                                                   | 6     |
|          | Object Recognition techniques: Viola-Jones, Yolo, Deep learning algorithms for object Recognition, Optical Flow, Gaussian Mixture Model (GMM), Structure of Motion, Motion Estimation and Object Tracking, Scale-Invariant Feature Transform, Speeded-Up Robust Features, Histogram of Oriented Gradients Line Detection-Hough Transforms, Harris corner detector, Edge Detection. |       |
| 6        | <b>Intelligent Vision Systems</b>                                                                                                                                                                                                                                                                                                                                                  | 6     |
|          | Artificial Neural Network for Pattern Classification, Convolutional Neural Networks, CNN applications and Advantages, Layers and Training CNNs, Autoencoders, Gesture Recognition, Face detection and Face recognition.                                                                                                                                                            |       |

| Textbooks |                                         |                                       |                     |
|-----------|-----------------------------------------|---------------------------------------|---------------------|
| Sr. no.   | Title                                   | Author                                | Edition/Publication |
| 01        | Digital Image Processing                | Rafael C. Gonzalez & Richard E. Woods | Pearson             |
| 02        | Computer Vision: A Modern Approach      | David A. Forsyth, Jean Ponce          | Prentice Hall       |
| 03        | Fundamental of Digital Image Processing | A. K. Jain                            | PHI                 |

| Reference Books |                                                                                                                                        |                                       |                                 |
|-----------------|----------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------|---------------------------------|
| Sr. no.         | Title                                                                                                                                  | Author                                | Edition/Publication             |
| 01              | Digital Image Processing                                                                                                               | Rafael C. Gonzalez & Richard E. Woods | Wesley                          |
| 02              | Computer Vision                                                                                                                        | D. H. Ballard                         | Prentice-Hall, Englewood Cliffs |
| 03              | NPTEL Courses: <a href="https://onlinecourses.nptel.ac.in/noc19_cs58/preview">https://onlinecourses.nptel.ac.in/noc19_cs58/preview</a> |                                       |                                 |



| Marking Scheme |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
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| Unit No. | Title and Content of Unit                                                                                                                                    | Hours |
|----------|--------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| 1        | <b>Basics of Control Systems</b>                                                                                                                             | 6     |
|          | Introduction to control systems; Open-loop & closed-loop systems; Feedback; Transfer function; Block diagrams; Signal flow graphs.                           |       |
| 2        | <b>Time-Domain Analysis</b>                                                                                                                                  | 6     |
|          | Time response of first-order & second-order systems; Transient and steady-state response; Errors; Stability concepts; Routh–Hurwitz stability test.          |       |
| 3        | <b>Frequency-Domain Analysis</b>                                                                                                                             | 6     |
|          | Frequency response; Bode plots (basics); Nyquist plot (concept); Gain & phase margin; Importance of frequency response in AI-based control.                  |       |
| 4        | <b>Basics of Signal Processing</b>                                                                                                                           | 6     |
|          | Types of signals; Continuous vs. Discrete signals; Sampling; Quantization; LTI systems; Impulse response; Convolution (easy examples).                       |       |
| 5        | <b>Transforms in Signal Processing</b>                                                                                                                       | 6     |
|          | Fourier Series; Fourier Transform; Laplace Transform; Z-Transform (basic formulas and simple problems); Use of transforms in filtering & feature extraction. |       |
|          | <b>Digital Signal Processing &amp; Modern Applications</b>                                                                                                   | 6     |
|          | Digital filters (FIR, IIR basics); DFT & FFT (concept); Noise removal; AI/ML applications in signal processing; Speech, image & sensor data processing.      |       |

| Textbooks |                             |                                    |                                    |
|-----------|-----------------------------|------------------------------------|------------------------------------|
| Sr. no.   | Title                       | Author                             | Edition/Publication                |
| 1         | Modern Control Engineering  | Katsuhiko Ogata                    | 5th Edition, Pearson Education     |
| 2         | Control Systems Engineering | I. J. Nagrath, M. Gopal            | 5th Edition, New Age International |
| 3         | Signals and Systems         | Alan V. Oppenheim, Alan S. Willsky | 2nd Edition, Pearson Education     |

| Reference Books |                                                                    |                                               |                                      |
|-----------------|--------------------------------------------------------------------|-----------------------------------------------|--------------------------------------|
| Sr. no.         | Title                                                              | Author                                        | Edition/Publication                  |
| 1               | Digital Signal Processing: Principles, Algorithms and Applications | John G. Proakis, Dimitris G. Manolakis        | 4th Edition, Pearson Education       |
| 2               | Linear Control System Analysis and Design                          | G. F. Franklin, J. D. Powell, A. Emami-Naeini | 6th Edition, Pearson                 |
| 3               | Signal Processing and Linear Systems                               | B. P. Lathi                                   | 2nd Edition, Oxford University Press |



| Unit No. | Title and Content of Unit                                        | Hours |
|----------|------------------------------------------------------------------|-------|
| 1        | <b>Introduction to R and Statistical Computing</b>               | 6     |
|          | Overview of R and its applications                               |       |
|          | Installation of R and R Studio                                   |       |
|          | R environment and workspace                                      |       |
|          | Basic syntax, variables, data types, operators                   |       |
|          | Working with vectors and objects                                 |       |
| 2        | Executing scripts and help system                                | 6     |
|          | <b>Data Structures and Control Flow in R</b>                     |       |
|          | Vectors, Lists, Matrices, Arrays, Data Frames and Factors        |       |
|          | Data indexing, sorting, merging                                  |       |
| 3        | Conditional statements and loops                                 | 6     |
|          | <b>Functions, Packages, and Reproducible Analysis</b>            |       |
|          | User-defined functions                                           |       |
|          | Function arguments and scope                                     |       |
|          | Built-in functions                                               |       |
|          | R packages and package management                                |       |
| 4        | Reproducible coding practices                                    | 6     |
|          | <b>Data Visualization for Statistical Analysis</b>               |       |
|          | Importance of visualization                                      |       |
|          | Histograms, box plots, bar charts                                |       |
| 5        | Line plots and scatter plots                                     | 6     |
|          | Customization and saving plots                                   |       |
|          | <b>Data Import, Export, and External Interfaces</b>              |       |
|          | Reading data from files                                          |       |
| 6        | CSV, Excel, XML, JSON                                            | 6     |
|          | Exporting data                                                   |       |
|          | Introduction to database connectivity                            |       |
|          | <b>Applied Statistical Modelling and Machine Learning with R</b> |       |
|          | Descriptive statistics                                           |       |
|          | Probability distributions                                        |       |
| 6        | Hypothesis testing                                               | 6     |
|          | Regression and ANOVA                                             |       |
|          | Logistic regression                                              |       |
|          | Introduction to supervised and unsupervised learning             |       |

| Textbooks |                                                                     |                       |                                              |
|-----------|---------------------------------------------------------------------|-----------------------|----------------------------------------------|
| Sr. no.   | Title                                                               | Author                | Edition/Publication                          |
| 01        | Big Data (Black Book)                                               | DT Editorial Services | Dreamtech Press                              |
| 02        | R for Everyone: Advanced Analytics and Graphics<br>(Second edition) | Jared P. Lander       | Addison-Wesley<br>Data & Analytics<br>Series |

| Reference Books |                                                                                                     |                  |                                              |
|-----------------|-----------------------------------------------------------------------------------------------------|------------------|----------------------------------------------|
| Sr. no.         | Title                                                                                               | Author           | Edition/Publication                          |
| 01              | The Art of R Programming                                                                            | Norman Matloff   | William Pollock                              |
| 02              | The Book of R                                                                                       | Tilman M. Davies | William Pollock                              |
| 03              | Introductory R: A Beginner's Guide to Data Visualisation, Statistical Analysis and Programming in R | Robert Knell,    | Amazon Digital South Asia Services Inc, 2013 |
| 04              | Beginning R – The Statistical Programming Language                                                  | Mark Gardener    | Wiley, 2013                                  |
| 05              | Probability & Statistics with R for Engineers and Scientists                                        | Michael Akritas  | 2nd Edition on, CRC Press, 2016              |



| Marking Scheme |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
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| Unit No. | Title and Content of Unit                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Hours |
|----------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| 1        | <b>Introduction to Cybersecurity</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | 7     |
|          | <p><b>Overview to Computer Security:</b> Meaning, importance in the digital world, core concepts, and major issues and challenges.</p> <p><b>Threat Fundamentals:</b> Threats, vulnerabilities, attacks, risks, and common cyber-threat types—malware (viruses, worms, ransomware), phishing and social-engineering, and DoS/DDoS attacks.</p> <p><b>Basic Cyber Hygiene:</b> Strong passwords and two-factor authentication, regular software updates and patching, securing personal devices and networks, Online Security Resources</p> <p><b>Networks and the Internet:</b> Introduction, Network Basics, How the Internet Works, Basic Network Utilities</p> |       |
| 2        | <b>Cybersecurity Vulnerabilities and Protections</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | 6     |
|          | <p><b>Cyber Security Safeguards:</b> Overview of security controls, access control, authentication, biometrics, cryptography, auditing, deception, and DoS protection.</p> <p><b>Authentication &amp; Remote Access:</b> User/group/role management, password policies, Single Sign-On, permissions, and data-loss prevention. Remote-access process and methods.</p> <p><b>Intrusion Detection &amp; Prevention:</b> IDS overview, network-based and host-based IDS, IPS, honeypots, and honeynets, Imporatanats of HTTPS .</p> <p><b>Firewalls &amp; Threat Management:</b> Firewall types, policies, and threat-management mechanisms.</p>                     |       |
| 3        | <b>Frauds and Cyber crime</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 6     |
|          | <p><b>Cyber Stalking, Fraud and Abuse:</b> How internet fraud works, identity theft, cyberstalking, and personal protection against cybercrime.</p> <p><b>Cybercrime Classification:</b> Cybercrimes targeting computers and mobile devices, including password attacks, financial fraud, social-engineering, malware and ransomware, zero-day/zero-click exploits, reporting procedures, mitigation strategies, and legal perspectives.</p>                                                                                                                                                                                                                      |       |
| 4        | <b>IT Act</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 6     |
|          | Introduction to Cyber Laws E-Commerce and E-Governance, Need of Cyber laws- The Indian context, Certiffing Authority and Controller, Offences under IT Act 2000, Digital signature and the Indian IT Act, Computer Offences and its penalty under IT Act 2000, Amendments in Indian IT Act 2008, Intellectual Property Rights .                                                                                                                                                                                                                                                                                                                                   |       |

|   |                                                                                                                                                                                                                                                                                                                           |   |
|---|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|
| 5 | <b>Ethical hacking</b>                                                                                                                                                                                                                                                                                                    | 6 |
|   | Types of hacking technologies, phases of ethical hacking, Foot Printing, Social Engineering, Scanning and enumeration, Understanding the password hacking techniques, Session hijacking, Google Hacking, Windows Hacking, Linux Hacking, Email hacking, Proxy & Packet Filtering, Sniffer, Incident handling and response |   |
| 6 | <b>Overview of Computer Forensics</b>                                                                                                                                                                                                                                                                                     | 5 |
|   | Introduction to Digital Forensics, General Guidelines in Forensics, Finding Evidence on the PC, Finding Evidence in System Logs, Recovering Deleted Files, Operating System Utilities in Forensics, Mobile Forensics                                                                                                      |   |

| Textbooks |                                              |                                      |                                         |
|-----------|----------------------------------------------|--------------------------------------|-----------------------------------------|
| Sr. no.   | Title                                        | Author                               | Edition/Publication                     |
| 01        | Cyber Security: With Cryptography Essentials | Shishir Kumar Shandilya, Agni Datta  | 1st Edition McGraw Hill                 |
| 02        | CyberSpace and Cyber Security                | George K.Kostopoulous                | 1st Edition CRC Press                   |
| 03        | Computer Forensics and Investigations        | Nelson Phillips and Enfinger Steuart | 1st Edition Cengage Learning, New Delhi |

| Reference Books |                                    |                                  |                      |
|-----------------|------------------------------------|----------------------------------|----------------------|
| Sr. no.         | Title                              | Author                           | Edition/Publication  |
| 01              | Cyber Security Essential           | J. Graham, R. Howard, Ryan Olson | CRC Press(2010)      |
| 02              | Computer Forensics and Cyber Crime | Marjie T.Bitiz                   | Pearson(2013)        |
| 03              | Cryptography and Security          | CK Shyamala                      | Wiley India Pvt. Ltd |



| Marking Scheme |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
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| Unit No. | Title and Content of Unit                                                                                                                                                                                                                                                                                                      | Hours |
|----------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| 1        | <b>Introduction to Software Engineering</b>                                                                                                                                                                                                                                                                                    | 7     |
|          | Software Engineering and its importance Software Process and Project Component Software Processes, SDLC, Software Development Process Models: Waterfall , Prototype, Time Boxing, Spiral, Iterative, Project Management Process, Agile Development, XP (Extreme Programming).                                                  |       |
| 2        | <b>Introduction to Software Testing</b>                                                                                                                                                                                                                                                                                        | 5     |
|          | Testing Process, Selection of Good Test Cases, Measurement of Testing, Incremental Testing Approach, Basic Terminology Related to Software Testing, Software Testing Life Cycle (STLC), Principles of Testing, Limitations of Testing                                                                                          |       |
| 3        | <b>Software Verification and Validation</b>                                                                                                                                                                                                                                                                                    | 6     |
|          | Differences between Verification and Validation, Differences between QA and QC, V&V Limitations, Categorizing V&V Techniques, Role of V&V in SDLC– Tabular Form (IEEE Std. 1012), Software V&V Planning (SVVP), Software Technical Reviews (STRs)                                                                              |       |
| 4        | <b>Types of Testing and Levels of Testing</b>                                                                                                                                                                                                                                                                                  | 7     |
|          | Functional and Non-Functional Testing, Introduction to: Unit Testing, Integration Testing, System Testing, Acceptance Testing, Testing Relationships, Integration Testing: Classification of Integration Testing, Decomposition-Based Integration, Call Graph-Based Integration, Path-Based Integration with its Pros and Cons |       |
| 5        | <b>Specialized Testing Types</b>                                                                                                                                                                                                                                                                                               | 5     |
|          | Regression Testing, Smoke Testing, Sanity Testing, Exploratory Testing, Ad-hoc Testing, Testing in Agile Development, Introduction to Agile Development, Agile Testing Quadrants.                                                                                                                                              |       |
| 6        | <b>Software Quality Assurance &amp; Security</b>                                                                                                                                                                                                                                                                               | 6     |
|          | Project Scheduling: Basic principles, Work Breakdown Structure (WBS), Project Tracking: Timeline charts, Phases of Software Quality Assurance, Quality Evaluation Standards: Six Sigma, ISO for Software, CMMI: Levels, Process areas, Software Security, Introduction to DevOps, Secure Software Engineering                  |       |

| <b>Textbooks</b> |                                                               |                                        |                                                                  |
|------------------|---------------------------------------------------------------|----------------------------------------|------------------------------------------------------------------|
| Sr. no.          | Title                                                         | Author                                 | Edition/Publication                                              |
| 01               | Software Engineering – A Precise Approach                     | Pankaj Jalote                          | Wiley India, 2010<br>(Unit 1, 3, 4)                              |
| 02               | Software Testing – A Self Teaching Introduction               | Rajiv Chopra                           | Mercury Learning and Information, 2018<br>(Unit 2, 3, 4, 5)      |
| 03               | Software Testing: Principles, Techniques and Tools            | Limaye, M. G.                          | Tata McGraw Hill Education, New Delhi, 2007<br>(Unit 2, 3, 4, 5) |
| 04               | Software Testing and Quality Assurance – Theory and Practices | Kshirasagar Naik, Priyadarshi Tripathi | Wiley, 2008<br>(Unit 6)                                          |

| <b>Reference Books</b> |                                               |                |                                |
|------------------------|-----------------------------------------------|----------------|--------------------------------|
| Sr. no.                | Title                                         | Author         | Edition/Publication            |
| 01                     | Software Engineering: Principles and Practice | Hans van Vliet | Wiley-India Edition, 2006      |
| 02                     | Software Engineering                          | P. Fleeger     | Pearson Education, India, 2009 |
| 03                     | Software Testing                              | Yogesh Singh   | Cambridge, 2012                |



| Marking Scheme |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                | <ul style="list-style-type: none"> <li>Compulsory passing with 40% marks is mandatory in ESE examinations and combined passing marks (MSE+ISE/CA+ESE) for theory course is 40 %</li> <li>Mid sem. examination will be based on 50 % syllabus from beginning (First Three Units).</li> <li>No compulsory passing for MSE.</li> <li>ESE paper setting weightage will be, 25 % on syllabus covered for MSE (First Three Units) and 75 % on remaining syllabus (Last Three Units).</li> </ul> |

| Unit No. | Title and Content of Unit                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Hours |
|----------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| 1        | <b>Introduction to robotics</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 7     |
|          | Degrees of freedom, Robot types- Manipulators- Anatomy of a robotic manipulator- links, joints, actuators, sensors, controllers. Robot configurations-PPP, RPP, RRP, RRR. Mobile robots- wheeled, legged, aerial robots, underwater robots, surface water robots. Dynamic characteristics- speed of motion, load carrying capacity & speed of response. Introduction to End effectors mechanical grippers, special tools, Magnetic grippers, Vacuum grippers, adhesive grippers, Active and Passive grippers. Ethics in robotics - 3 laws - applications of robots. |       |
| 2        | <b>Sensors, Actuators and Control</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 6     |
|          | Sensor classification- touch, force, proximity, vision sensors. Internal sensors- Position sensors, velocity sensors, acceleration sensors, Force sensors; External sensors-contact type, non contact type; Digital Camera - CCD camera - CMOS camera - Omnidirectional cameras Sensor characteristics. Actuators DC Motors H-Bridge Pulse Width Modulation - Stepper Motors Servos, Hydraulic & pneumatic actuators. Control On-Off Control PID Control -Velocity Control and Position Control                                                                     |       |
| 3        | <b>Robotic vision</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 5     |
|          | Robotic Vision: Sensing, Pre-processing, Segmentation, Description, Recognition, Interpretation, Feature extraction -Camera sensor hardware interfacing. Representation of Transformations Representation of a Pure Translation - - Pure Rotation about an Axis - Combined Transformations - Transformations Relative to the Rotating Frame.                                                                                                                                                                                                                        |       |
| 4        | <b>Localization and Mapping</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 6     |
|          | Position and Orientation Representing robot position. Basics of reactive navigation; Robot Localization, Challenges in localization - An error model for odometric position estimation, Current Map Representation Continuous representations Decomposition strategies challenges in map representation. Probabilistic map-based localization                                                                                                                                                                                                                       |       |
| 5        | <b>Path Planning and Navigation</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | 7     |
|          | Path Planning- Graph search, deterministic graph search, breadth first search depth first search- Dijkstra's algorithm, A*, D* algorithms, Potential field based path planning. Obstacle avoidance Bug algorithm                                                                                                                                                                                                                                                                                                                                                    |       |
| 6        | <b>Ai And Other Research Trends In Robotics</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 5     |
|          | Application of Machine learning - AI, Expert systems; Tele-robotics and Virtual Reality, Micro & Nanorobots, Unmanned vehicles, Cognitive robotics, Evolutionary robotics, Humanoids                                                                                                                                                                                                                                                                                                                                                                                |       |

| Textbooks |                                                                               |                                          |                     |
|-----------|-------------------------------------------------------------------------------|------------------------------------------|---------------------|
| Sr. no.   | Title                                                                         | Author                                   | Edition/Publication |
| 01        | Introduction to Autonomous Mobile Robots                                      | Siegwart, IR Nourbakhsh,<br>D Scaramuzza | MIT Press, USA      |
| 02        | Embedded Robotics, Mobile Robot Design and Applications with Embedded Systems | Thomas Bräunl                            | Springer            |
| 03        | Introduction to Mobile Robot Control                                          | S.G. Tzafestas                           | Elsevier            |

| Reference Books |                                                                |               |                                                 |
|-----------------|----------------------------------------------------------------|---------------|-------------------------------------------------|
| Sr. no.         | Title                                                          | Author        | Edition/Publication                             |
| 01              | Introduction to Robotics                                       | John J. Craig | Pearson Education Inc., Asia, 3rd Edition, 2005 |
| 02              | Introduction to Robotics 2e                                    | S. K. Saha    | TATA McGraw Hills Education (2014)              |
| 03              | Robotics, Vision and Control_ Fundamental Algorithms in MATLAB | Peter Corke   | Springer-Verlag Berlin Heidelberg (2021)        |



| Marking Scheme |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                | <ul style="list-style-type: none"> <li>Compulsory passing with 40% marks is mandatory in ESE examinations and combined passing marks (MSE+ISE/CA+ESE) for theory course is 40 %</li> <li>Mid sem. examination will be based on 50 % syllabus from beginning (First Three Units).</li> <li>No compulsory passing for MSE.</li> <li>ESE paper setting weightage will be, 25 % on syllabus covered for MSE (First Three Units) and 75 % on remaining syllabus (Last Three Units).</li> </ul> |

| Unit No. | Title and Content of Unit                                                                                                                                                                                                                                                                                                                                                                                                                               | Hours |
|----------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| 1        | <b>Speech Systems – Introduction:</b>                                                                                                                                                                                                                                                                                                                                                                                                                   | 6     |
|          | The Human speech production mechanism, Discrete-Time model of speech production, Speech perception – human auditory system, Phonetics – articulatory phonetics, acoustic phonetics, and auditory phonetics, Categorization of speech sounds, Spectrographic analysis of speech sounds, Pitch frequency, Pitch period measurement using spectral and cepstral domain, Formants, Evaluation of Formants for voiced and unvoiced speech.                   |       |
| 2        | <b>Speech Signal Analysis and Feature Extraction</b>                                                                                                                                                                                                                                                                                                                                                                                                    | 5     |
|          | Time Domain Processing: Introduction to short-time speech analysis, including windowing, short-time energy/magnitude, and zero-crossing rates for speech vs. silence discrimination.<br>Frequency Domain Processing: Short-Time Fourier Transform (STFT), spectral displays (spectrograms), and filter-bank methods.<br>Feature Extraction Techniques: LPC (Linear Predictive Coding), Cepstral Analysis, Pattern Comparison                            |       |
| 3        | <b>Speech Modeling</b>                                                                                                                                                                                                                                                                                                                                                                                                                                  | 6     |
|          | Stochastic Processes: Introduction to Markov processes. Hidden Markov Models (HMMs): Components of an HMM, training and building HMMs, Viterbi search for optimal state sequence, and Baum-Welch parameter re-estimation.<br>Other Models: Gaussian Mixture Models (GMM), Support Vector Machines (SVM), and an overview of neural network approaches.<br>Vector Quantization: Data compression, codebook design using algorithms like K-means and LBG. |       |
| 4        | <b>Speech Recognition Systems</b>                                                                                                                                                                                                                                                                                                                                                                                                                       | 6     |
|          | Architecture of ASR: Components of an automatic speech recognition system, including acoustic and language models.<br>Recognition Types: Isolated word recognition, connected word recognition, and large vocabulary continuous speech recognition (LVCSR).<br>Language Modeling: N-grams and context-dependent sub-word units.<br>Deep Learning ASR: Introduction to end-to-end deep learning pipelines for modern speech recognition systems.         |       |
| 5        | <b>Speech Enhancement</b>                                                                                                                                                                                                                                                                                                                                                                                                                               | 7     |
|          | Classes of Speech Enhancement Algorithms, Spectral-Subtractive Algorithms - Multiband Spectral Subtraction, MMSE Spectral Subtraction Algorithm, Spectral Subtraction Based on Perceptual Properties, Wiener Filtering - Wiener Filters in the Time Domain, Wiener Filters in the Frequency Domain, Wiener Filters for Noise Reduction, Maximum-Likelihood Estimators, Bayesian Estimators, MMSE and Log-MMSE Estimator, Subspace Algorithms            |       |

|   |                                                                                                                                                                                                                                                                                                                          |   |
|---|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|
| 6 | <b>Speech Synthesis and Application</b>                                                                                                                                                                                                                                                                                  | 6 |
|   | A Text-to-Speech systems (TTS), Synthesizers technologies - Concatenative synthesis, Use of Formants for concatenative synthesis, Use of LPC for concatenative synthesis, HMM-based synthesis, Sinewave synthesis, Speech transformations, Watermarking for authentication of a speech, Emotion recognition from speech. |   |

| Textbooks |                                         |                    |                                                |
|-----------|-----------------------------------------|--------------------|------------------------------------------------|
| Sr. no.   | Title                                   | Author             | Edition/Publication                            |
| 01        | Speech and Audio Processing             | Shaila D. Apte     | Wiley India (P) Ltd, New Delhi                 |
| 02        | Speech Enhancement Theory and Practice, | Philipos C. Loizou | Second Edition, CRC Press, Inc., United States |
| 03        | Text-to-Speech Synthesis                | Paul Taylor        | Cambridge University Press                     |

| Reference Books |                                                                  |                              |                     |
|-----------------|------------------------------------------------------------------|------------------------------|---------------------|
| Sr. no.         | Title                                                            | Author                       | Edition/Publication |
| 01              | Fundamentals of speech recognition                               | Rabiner L. R. and Juang B. H | Pearson Education   |
| 02              | Discrete-time speech signal processing - Principles and practice | Thomas F. Quatieri           | Pearson             |
| 03              | Pattern Recognition and Machine Learning,                        | CM Bishop                    | Springer            |



| Marking Scheme |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                | <ul style="list-style-type: none"> <li>Compulsory passing with 40% marks is mandatory in ESE examinations and combined passing marks (MSE+ISE/CA+ESE) for theory course is 40 %</li> <li>Mid sem. examination will be based on 50 % syllabus from beginning (First Three Units).</li> <li>No compulsory passing for MSE.</li> <li>ESE paper setting weightage will be, 25 % on syllabus covered for MSE (First Three Units) and 75 % on remaining syllabus (Last Three Units).</li> </ul> |

| Unit No. | Title and Content of Unit                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Hours |
|----------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| 1        | <b>Introduction to Cloud Computing</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 6     |
|          | Basics of cloud computing, Evolution of cloud computing, Key characteristics and benefits, Cloud computing use cases and real-world applications, Cloud computing vs. Cluster computing vs. Grid computing                                                                                                                                                                                                                                                                                 |       |
| 2        | <b>Cloud Architecture and Models</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 6     |
|          | Cloud computing stack - Comparison with traditional computing architecture , How Cloud Computing Works, Data centers, Role of Networks in Cloud computing, protocols used, Role of Web services ,Cloud computing service models (IaaS, PaaS, SaaS), Deployment models (Public, Private, Hybrid, Community), Comparative analysis of cloud service providers                                                                                                                                |       |
| 3        | <b>Virtualization in Cloud Computing</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 6     |
|          | Introduction and benefits, Virtualization Structure , Types of virtualization, Hypervisors, Virtual machines, Virtualization at the OS Level, Virtualization of CPU, Memory and I/O Devices, , Resource allocation and management, Performance optimization through virtualization, Open-Source Virtualization Technology                                                                                                                                                                  |       |
| 4        | <b>Cloud Management &amp; Security</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 6     |
|          | Service Level Agreements (SLAs), Billing & Accounting, Comparing Scaling Hardware: Traditional vs. Cloud, Managing Data, Load balancing, Auto scaling, Cloud monitoring, Security issues in cloud computing, Identity and access management, Compliance and legal issues, Jurisdictional issues raised by Data location , Encryption techniques for cloud data security, Cloud Security: Infrastructure Security - Network level security, Host level security, Application-level security |       |
| 5        | <b>Cloud Storage and Databases</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 6     |
|          | Cloud storage architectures, Database services in cloud, Big data management in cloud, Data replication and consistency models, Green Computing                                                                                                                                                                                                                                                                                                                                            |       |
| 6        | <b>Cloud Computing Platforms , Applications &amp; AI</b>                                                                                                                                                                                                                                                                                                                                                                                                                                   | 6     |
|          | Overview of AWS, Google Cloud, Microsoft Azure, Cloud-based application development, Serverless computing, Edge computing and its impact on cloud services, Cloud ML tools, Cloud for AI & Machine Learning                                                                                                                                                                                                                                                                                |       |

| Textbooks |                                           |                                                   |                      |
|-----------|-------------------------------------------|---------------------------------------------------|----------------------|
| Sr. no.   | Title                                     | Author                                            | Edition/Publication  |
| 1         | Cloud Computing: Principles and Paradigms | Rajkumar Buyya, James Broberg, Andrzej Goscinski, | Wiley, 2024 Edition. |
| 2         | Cloud Computing Black Book                | Jayaswal , Kallakurchi, Houde , Shah              | Dreamtech Press      |
| 3         | Cloud Security                            | Ronald Krutz and Russell Dean Vines               | Wiley-India          |

| Reference Books |                                       |                                        |                     |
|-----------------|---------------------------------------|----------------------------------------|---------------------|
| Sr. no.         | Title                                 | Author                                 | Edition/Publication |
| 1               | Cloud Computing Bible                 | Barrie Sosinsky                        | Wiley India         |
| 2               | Cloud Computing: A Practical Approach | Anthony T.Velte, et.al                 | McGraw Hill         |
| 3               | Cloud Security & Privacy              | Tim Mather, S.Kumaraswamy, S.Latif SPD | O'REILLY            |



| Marking Scheme |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                | <ul style="list-style-type: none"> <li>Compulsory passing with 40% marks is mandatory in ESE examinations and combined passing marks (MSE+ISE/CA+ESE) for theory course is 40 %</li> <li>Mid sem. examination will be based on 50 % syllabus from beginning (First Three Units).</li> <li>No compulsory passing for MSE.</li> <li>ESE paper setting weightage will be, 25 % on syllabus covered for MSE (First Three Units) and 75 % on remaining syllabus (Last Three Units).</li> </ul> |

| Unit No. | Title and Content of Unit                                                                                                                                                                                                                                        | Hours |
|----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| 1        | <b>Introduction to IoT</b>                                                                                                                                                                                                                                       | 4     |
|          | Introduction to Internet of Things (IoT), Functional Characteristics, Recent Trends in the Adoption of IoT, Role of cloud in IoT, Societal Benefits of IoT:- Health Care, Machine to Machine (M2M), Smart Transportation, Smart Living, Smart Cities, Smart Grid |       |
| 2        | <b>Communication Principles</b>                                                                                                                                                                                                                                  | 3     |
|          | RFID, ZigBEE, Bluetooth, Internet Communication- IP Addresses - MAC Addresses , IEEE 802 Family of Protocols , I/O interfaces Software Components                                                                                                                |       |
| 3        | <b>Sensing and Actuation</b>                                                                                                                                                                                                                                     | 3     |
|          | Definition of Sensor, Sensor features, Resolution, Classes, Different types of sensors, Actuator, Different types of Actuators, purpose of Sensors and Actuators in IoT                                                                                          |       |
| 4        | <b>IoT Application Development</b>                                                                                                                                                                                                                               | 4     |
|          | Frame work for IoT Applications-Implementation of Device integration, Data acquisition and Integration, Device data storage on cloud/local server, Authentication, authorization of Devices                                                                      |       |
| 5        | <b>Applications of IoT</b>                                                                                                                                                                                                                                       | 5     |
|          | Home Automation, Smart Cities, Energy, Retail Management, Logistics, Agriculture, Health and Lifestyle, Industrial IoT, Legal challenges, IoT design Ethics, IoT in Environmental Protection                                                                     |       |
| 6        | <b>Web of Things and Cloud of Things</b>                                                                                                                                                                                                                         | 5     |
|          | Web of Things versus Internet of Things, Two pillars of the Web, Architecture Standardization for WoT, Platform Middleware for WoT, Cloud of Things. IoT Physical Servers                                                                                        |       |

| Textbooks |                                                                                               |                                                                                 |                                 |
|-----------|-----------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------|---------------------------------|
| Sr. no.   | Title                                                                                         | Author                                                                          | Edition/Publication             |
| 01        | "IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet Things" | David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Robert Barton, Jerome Henry | 0Pearson Education              |
| 02        | Internet of Things: Architecture and Design Principles"                                       | Raj Kamal                                                                       | McGraw Hill Education, 2017     |
| 03        | Internet of Things A Hands-On-Approach",2014.                                                 | Vijay Madiseti, Arshdeep Bahga                                                  | Georgia Institute of Technology |

| Reference Books |                                                                   |                                             |                     |
|-----------------|-------------------------------------------------------------------|---------------------------------------------|---------------------|
| Sr. no.         | Title                                                             | Author                                      | Edition/Publication |
| 01              | "Industry 4.0: The Industrial Internet of Things"                 | Alasdair Gilchrist                          | Apress, 2016        |
| 02              | "The Internet of Things in the Cloud: A Middleware Perspective" - | Honbo Zhou                                  | CRC Press 2012      |
| 03              | "Introduction to Industrial Internet of Things and Industry 4.0"  | Sudip Misra,Chandana Roy,Anadarup Mukherjee | CRC Press,2021      |



| Marking Scheme                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <u>In Semester Evaluation/ Continuous Assessment has 50 Marks</u><br>Parameters for In Semester Evaluation could be: Attendance, Assignments, Unit Tests, Practical and Oral Performance, Online Activities like (Virtual Labs, NPTEL) etc.<br>Lab File should be prepared and should be assessed continuously during academic.<br><u>End Semester Evaluation has 25 Marks</u><br>External Practical Examination with Performance and Oral Examination |

| Guidelines for Lab Performance                                                                                            |                                                                                                                                                    |
|---------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------|
| Faculty can create experiment list based on following listed topics.<br>Minimum 10 to 12 Experiments should be performed. |                                                                                                                                                    |
| Exp. No.                                                                                                                  | Title of Experiment/ Problem Statement                                                                                                             |
| 1                                                                                                                         | Draw an E-R Diagram of any organization                                                                                                            |
| 2                                                                                                                         | Converting E-R Diagram into Relational Table                                                                                                       |
| 3                                                                                                                         | Installation and Demonstration of DBMS Oracle/MySQL/SQL Server/PostgreSQL etc.                                                                     |
| 4                                                                                                                         | Study and Implementation of Data Definition Language(DDL) Queries (e.g. create, alter and drop tables)                                             |
| 5                                                                                                                         | Study and Implementation of Data Manipulation Language(DML) Queries. (e.g. Insert, delete, update and select statements)                           |
| 6                                                                                                                         | Implementation of Basic SQL SELECT statement for displaying/Extracting data from single multiple tables                                            |
| 7                                                                                                                         | Implementation of SQL constructs for aggregating data, use of group by, having clause.                                                             |
| 8                                                                                                                         | Implementation of nested sub queries, complex sub queries                                                                                          |
| 9                                                                                                                         | Display the results of Join Operations like cross join, self-join, inner join, natural join, left outer join, right outer join and full outer join |
| 10                                                                                                                        | Create & Update views for any created table                                                                                                        |
| 11                                                                                                                        | Write a program of Database connectivity with any object oriented language                                                                         |
| 12                                                                                                                        | Study and Implementation of Triggers                                                                                                               |
| 13                                                                                                                        | Study and Implementation of functions                                                                                                              |
| 14                                                                                                                        | Study and Implementation of Stored Procedures                                                                                                      |

| Textbooks |                                                             |                                                 |                                        |
|-----------|-------------------------------------------------------------|-------------------------------------------------|----------------------------------------|
| Sr. no.   | Title                                                       | Author                                          | Edition/Publication                    |
| 01        | Database System Concepts                                    | A. Silberschatz,<br>H.F. Korth,<br>S. Sudarshan | 6th Edition, McGraw<br>Hill Education. |
| 02        | Database Systems – Design,<br>Implementation and Management | Rob & Coronel                                   | 5th Edition,<br>Cengage Learning       |

| Reference Books |                                                                                        |                                       |                                   |
|-----------------|----------------------------------------------------------------------------------------|---------------------------------------|-----------------------------------|
| Sr. no.         | Title                                                                                  | Author                                | Edition/Publication               |
| 01              | Database Systems - A practical approach<br>to Design, Implementation and<br>Management | Thomos Connolly,<br>Carolyn Beg       | 3rd Edition, Pearson<br>Education |
| 02              | Fundamentals of Database Systems                                                       | Ramez Elmasri,<br>Shamkant B. Navathe | 4th Edition, Pearson<br>Education |



| Marking Scheme                                                                                                                                                                                                                                                                                                                                                                  |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p><u>In Semester Evaluation/ Continuous Assessment has 50 Marks</u></p> <p>Parameters for In Semester Evaluation could be: Attendance, Assignments, Unit Tests, Presentation, Online Activities like (Virtual Labs, NPTEL) etc.</p> <p>Lab File should be prepared and should be assessed continuously during academic.</p> <p><u>End Semester Evaluation has 25 Marks</u></p> |

| Guidelines for Lab Performance                                                                                                        |                                                                                                         |
|---------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------|
| <p>Faculty can create Experiment list based on following listed topics.</p> <p>Minimum 10 to 12 Experiments should get performed.</p> |                                                                                                         |
| Exp. No.                                                                                                                              | Title of Experiment/ Problem Statement                                                                  |
| 1                                                                                                                                     | Implement various grey level transformations for Image Enhancement.                                     |
| 2                                                                                                                                     | Implement Histogram Equalization technique.                                                             |
| 3                                                                                                                                     | Write a Program to apply convolution processes on an input image for image smoothing.                   |
| 4                                                                                                                                     | Implement Histogram of Oriented Gradient (HOG) for Feature extraction.                                  |
| 5                                                                                                                                     | Write a Program to apply Scale Invariant Feature Transform on input image.                              |
| 6                                                                                                                                     | Implement frame differencing technique for background subtraction from video.                           |
| 7                                                                                                                                     | Implement Principal Component Analysis for the computation of Eigenvector to reduce the dimensionality. |
| 8                                                                                                                                     | Implement object detection algorithm YOLO.                                                              |
| 9                                                                                                                                     | Implement R-CNN algorithms for object detection.                                                        |
| 10                                                                                                                                    | Implement motion estimation using optical flow technique.                                               |
| 11                                                                                                                                    | Implement Object recognition.                                                                           |
| 12                                                                                                                                    | Implement Facial Expression Recognition.                                                                |

| Textbooks |                                                                           |                                      |                     |
|-----------|---------------------------------------------------------------------------|--------------------------------------|---------------------|
| Sr. no.   | Title                                                                     | Author                               | Edition/Publication |
| 01        | Digital Image Processing and Analysis: Computer Vision and Image Analysis | Scott E. Umbaugh                     | 4th Edition         |
| 02        | Handbook of Image Processing and Computer Vision                          | Arcangelo Distanto & Cosimo Distanto | 1st Edition         |
| 03        | Digital Image Processing (Illustration using Python)                      | S. Esakkirajan et al.                | 1st Edition         |

| Reference Books |                                                                                                 |                                         |                     |
|-----------------|-------------------------------------------------------------------------------------------------|-----------------------------------------|---------------------|
| Sr. no.         | Title                                                                                           | Author                                  | Edition/Publication |
| 01              | Image Processing Techniques and its Applications in Computer Vision and Artificial Intelligence | Shafqat Alauddin, Mrutyunjaya S Yalawar | Rademics            |
| 02              | Image Processing and Computer Vision Masterclass with Python                                    | Sandipan Dey                            | 2nd Edition         |
| 03              | Computer Vision and Image Processing: Fundamentals and Applications                             | CRC Press                               | 1st Edition         |



| Marking Scheme                                                                                                                                                                                                                                                                                                               |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p><u>In Semester Evaluation/ Continuous Assessment has 50 Marks</u></p> <p>Parameters for In Semester Evaluation could be: Attendance, Assignments, Unit Tests, Presentation, Online Activities like (Virtual Labs, NPTEL) etc.</p> <p>Lab File should be prepared and should be assessed continuously during academic.</p> |

| Guidelines for Lab Performance                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>The students should form group of 4-5 students and every group is supposed to choose a specific domain for the mini project. Further the group should identify the relevant problem in the selected domain and propose the solution, which can be implemented as a mini-project using suitable technology. The synopsis for the same should be submitted by students to their respective guide. The mini-project work should be evaluated by a team of teachers appointed by the department. The evaluation and marking should include Continuous assessment during which the group should give presentation and demonstration of their work done. The Project Report should be submitted by students as a part of Term Work.</p> |