Electronics & Computer Engineering Multidisciplinary Minor:

A. Advanced Embedded Systems:

Semester	Course Code	Course Title
III	ECEMDM-01A	Fundamentals Of Digital Circuits
IV	ECEMDM-02A	Microprocessors and Peripherals
V	ECEMDM-03A	Microcontrollers and Applications
VI	ECEMDM-04A	Internet Of Things (IoT)
VII	ECEMDM-05A	System Design Using Raspberry Pi

PUNYASHLOK AHILYADEVI HOLKAR SOLAPUR UNIVERSITY, SOLAPUR
Second Year B. Tech (Electronics and Computer Engineering)
Semester – III
ECEMDM-01A - Fundamentals of Digital Circuits

Teaching Scheme	**Examination Scheme**
Lectures : - 2 Hrs/Week, 2 credits	ESE: 70 Marks
Practical : - 2 Hrs/Week, 1 credit	ISE : 30 Marks
	ICA :25 Marks

Introduction:
This course provides a comprehensive understanding of digital electronics, focusing on the design and analysis of digital circuits. It covers number systems, Boolean algebra, combinational and sequential circuits, and introduces programmable logic devices.

Course Prerequisite:
Basic knowledge of binary number systems and logic gates.

Course Objectives:
1. To introduce the fundamental concepts of digital logic circuits, including number systems, Boolean algebra, and the operation of various gates.
2. To enable students to design combinational and sequential circuits.
3. To introduce the concept of synchronous state machines.
4. To provide an understanding of programmable logic devices and their applications in digital circuit design.

Course Outcomes:
Upon successful completion of this course, students will be able to:
1. Understand and apply the principles of digital logic circuits.
2. Design and analyse combinational and sequential circuits.
3. Comprehend the functioning of synchronous state machines.
4. Utilize programmable logic devices in digital circuit design.

SECTION I

Unit 1: Number Systems and Codes (05 Hours)
- Binary, Decimal, Octal, Hexadecimal Systems
- Conversion Between Number Systems
- Binary Arithmetic
- Signed Numbers, 1's and 2's Complement
- Codes: Gray Code, BCD, ASCII, Excess-3

Unit 2: Logic Gates and Circuits (05 Hours)
- Basic Gates: AND, OR, NOT
- Universal Gates: NAND, NOR
- XOR, XNOR Gates
- Implementation of Boolean Functions Using Gates

Unit 3: Boolean Algebra and Logic Simplification (05 Hours)
- Boolean Theorems
- De Morgan's Theorems

- Standard Forms: SOP and POS
- Karnaugh Map (K-map) Simplification

SECTION II

Unit 4: Combinational Circuits (05 Hours)
- Adder and Subtractor (Half and Full)
- Multiplexers and Demultiplexers
- Encoders and Decoders
- Comparators

Unit 5: Sequential Circuits (05 Hours)
- Flip-Flops: SR, JK, D, T
- Latches and Registers
- Counters: Asynchronous and Synchronous
- Shift Registers

Unit 6: Memory and Programmable Logic Devices (05 Hours)
- RAM, ROM, PROM, EPROM, EEPROM
- Basics of FPGA and CPLD
- Introduction to ADC and DAC

Text Book:

1. A. Anand Kumar, "Fundamentals of Digital Circuits," 4th Edition, PHI Learning Pvt. Ltd.
2. R. P. Jain, "Modern Digital Electronics," 4th Edition, Tata McGraw Hill.

Reference Books:

1. M. Morris Mano and Michael D. Ciletti, "Digital Design: With an Introduction to the Verilog HDL," 5th Edition, Pearson Education.
2. Donald P. Leach and Albert Paul Malvino, "Digital Principles and Applications," 8th Edition, McGraw Hill Education.
3. William H. Gothmann, "Digital Electronics: An Introduction to Theory and Practice," 2nd Edition, Prentice Hall.
4. John F. Wakerly, "Digital Design: Principles and Practices," 4th Edition, Pearson Education.

ISE Evaluation for the course will consist of three programming (hands on) tests.

Internal Continuous Assessment (ICA):

- The ICA for this course includes a minimum of 12 assignments designed to enhance students' practical proficiency in designing, analyzing, and implementing digital circuits.
- The assignments are aligned with the course objectives and outcomes, emphasizing problem-solving and critical thinking.

PUNYASHLOK AHILYADEVI HOLKAR SOLAPUR UNIVERSITY, SOLAPUR
Second Year B.Tech (Electronics and Computer Engineering)
Semester – IV
ECEMDM-02A Microprocessors and Peripherals

Teaching Scheme	**Examination Scheme**
Lectures : - 2 Hrs/Week, 2 credits	ESE - 70 Marks
Practical : - 2 Hrs/Week, 1 credit	ISE - 30 Marks
	ICA - 25 Marks

Introduction:
This course introduces the architecture, programming, and interfacing of the 8085 microprocessors. It emphasizes the design and development of applications using assembly language programming and the integration of peripheral devices. The course also covers basic concepts of memory interfacing and data transfer techniques.

Course Prerequisite:
- Fundamental knowledge of digital electronics, logic gates, and number systems.
- Basic understanding of computer architecture and binary arithmetic.

Course Objectives:
1. To understand the architecture, functionality, and internal operations of the 8085 microprocessors.
2. To develop assembly language programs for solving real-world problems.
3. To explore the interfacing of memory and peripheral devices with the 8085 microprocessors.
4. To provide an understanding of interrupts and data transfer techniques.

Course Outcomes:
Upon successful completion of this course, students will be able to:
1. Describe the architecture and operations of the 8085 microprocessors.
2. Develop assembly language programs for various applications.
3. Design and implement interfacing solutions for memory and peripheral devices.
4. Demonstrate knowledge of interrupts, data transfer techniques, and their applications in microprocessor systems.

SECTION I

Unit 1: Introduction to 8085 Microprocessor (06 Hours)
- Architecture and pin configuration of 8085.
- Functional blocks: ALU, registers, control unit, and buses.
- Addressing modes and instruction set overview.

Unit 2: Assembly Language Programming (05 Hours)
- Introduction to assembly language programming.
- Data transfer, arithmetic, logical, and branch instructions.
- Writing and debugging simple assembly language programs.

Unit 3: Memory and I/O Interfacing (04 Hours)
- Memory organization and interfacing techniques.

- Address decoding and interfacing memory chips.
- Input-output (I/O) devices: I/O mapped I/O and memory-mapped I/O.

SECTION II

Unit 4: Interrupts and Data Transfer Techniques (05 Hours)

- Types of interrupts in 8085: Hardware and software interrupts.
- Interrupt handling mechanism.
- Data transfer techniques: Synchronous, asynchronous, DMA, and serial communication.

Unit 5: Peripheral Interfacing with 8085 (06 Hours)

- Introduction to peripheral devices: 8255 (Programmable Peripheral Interface), 8253 (Programmable Interval Timer), and 8279 (Keyboard/Display Controller).
- Interfacing of ADC/DAC with 8085.
- Stepper motor and DC motor control using 8085.

Unit 6: Applications and Advanced Concepts (04 Hours)

- Design of traffic light controller and temperature measurement system using 8085.
- 8086 microprocessor Architecture and Addressing modes, 8086 comparisons with 8085.

Text Book:

1. "8 Bit Microprocessor" By Late V.J.Vibhute And P.B.Borole, 5th Edition Tech Max Publications
2. Ramesh S. Gaonkar, "Microprocessor Architecture, Programming, and Applications with 8085," 6th Edition, Penram International.
3. B. Ram, "Fundamentals of Microprocessors and Microcontrollers," Dhanpat Rai Publications.

Reference Books:

1. Douglas V. Hall, "Microprocessors and Interfacing: Programming and Hardware," 2nd Edition, McGraw Hill.
2. A.K. Ray and K.M. Bhurchandi, "Advanced Microprocessors and Peripherals," 3rd Edition, McGraw Hill.
3. Krishna Kant, "Microprocessors and Microcontrollers: Architecture, Programming, and System Design," PHI Learning.
4. N. Senthil Kumar et al., "Microprocessors and Microcontrollers," Oxford University Press.

Internal Continuous Assessment (ICA):

- The ICA for this course includes a minimum of 12 practical assignments focused on the 8085 microprocessor and its peripherals, designed to provide hands-on experience in assembly language programming, interfacing techniques, and system design.
- Assignments are structured to align with the course objectives, emphasizing key concepts such as instruction set architecture, programming, and real-time application development.

Electronics & Computer Engineering Multidisciplinary Minor:

B. Multidisciplinary Minor in "Artificial Intelligence"

Semester	Course Code	Course Title
III	ECEMDM-01B	Fundamentals of Artificial Intelligence
IV	ECEMDM-02B	Fundamentals of Machine Learning
V	ECEMDM-03B	Fundamentals of Deep Learning
VI	ECEMDM-04B	Data Visualization Tools (Tableau & Power BI)
VII	ECEMDM-05B	Data Science

PUNYASHLOK AHILYADEVI HOLKAR SOLAPUR UNIVERSITY, SOLAPUR
Second Year B. Tech (Electronics & Computer Engineering)
Semester – III
ECEMDM-01B Fundamentals of Artificial Intelligence

Teaching Scheme	**Examination Scheme**
Lectures : - 2 Hrs/Week, 2 credits	ESE : 70 Marks
Practical : - 2 Hrs/Week, 1 credit	ISE : 30 Marks ICA: 25 Marks

Introduction:
This course introduces the foundational concepts of Artificial Intelligence (AI), emphasizing problem-solving, reasoning, learning, and intelligent decision-making. It provides insights into AI techniques, algorithms, and their applications across various domains. Students will explore the principles of machine learning, natural language processing, and knowledge representation, equipping them with essential skills for further AI research or application development.

Course Prerequisite:
- Basic knowledge of programming (Python preferred).
- Understanding of data structures and algorithms.
- Familiarity with linear algebra, probability, and statistics.

Course Objectives:
1. To introduce the key concepts, techniques, and tools used in AI.
2. To develop problem-solving skills using AI approaches like search algorithms and knowledge representation.
3. To explore the fundamentals of machine learning and its role in AI.
4. To examine ethical considerations and limitations of AI applications.

Course Outcomes:
Upon successful completion of this course, students will be able to:
1. Understand the fundamental principles and goals of Artificial Intelligence.
2. Apply search algorithms and knowledge representation techniques to solve real-world problems.
3. Implement basic machine learning algorithms and understand their applications.
4. Analyze the societal and ethical implications of AI technologies.

SECTION I

Unit 1: Introduction to Artificial Intelligence (05 Hours)
- **Definition and History**: What is AI, Evolution and milestones of AI
- **Goals and Scope of AI**: Narrow AI vs. General AI, AI applications: Healthcare, robotics, NLP, games, and more.
- **Foundations of AI**: Philosophical, mathematical, biological, and psychological underpinnings.
- **AI Problems and Approaches**: Search, reasoning, learning, and perception.

Unit 2: Problem Solving and Search (05 Hours)
- **Search Strategies**: Uninformed (blind) search: BFS, DFS, Uniform-cost, Informed (heuristic) search: Greedy, A* algorithm.
- **Game Playing**: Minimax algorithm, Alpha-beta pruning.
- **Constraint Satisfaction Problems (CSPs)**: Backtracking, forward-checking, and constraint propagation.

Unit 3: Knowledge Representation and Reasoning (05 Hours)

- **Knowledge Representation**: Logical representation, propositional and first-order logic, Frames, semantic networks, ontologies.
- **Reasoning Methods**: Logical inference, forward and backward chaining, Probabilistic reasoning.
- **Dealing with Uncertainty**: Fuzzy logic, Bayesian networks.

SECTION II

Unit 4: Machine Learning Basics (05 Hours)

- **Types of Learning**: Supervised, unsupervised, and reinforcement learning.
- **Learning Algorithms**: Decision trees, k-means clustering, and neural networks.
- **Applications**: Image recognition, predictive analytics, and recommendation systems.

Unit 5: Natural Language Processing (NLP) (05 Hours)

- **Introduction to NLP**: Key challenges in NLP.
- **Components:** Syntax, semantics, and pragmatics.
- **Text Processing**: Tokenization, stemming, and lemmatization.
- **Applications**: Sentiment analysis, machine translation, and chatbots.

Unit 6: Ethics and Future of AI (05 Hours)

- **AI Ethics**: Bias in AI, privacy concerns, and transparency.
- **Social Impacts**: AI's effect on jobs, society, and human interaction.
- **Future Directions**: General AI, superintelligence, and hybrid systems.

Textbooks:

1. Stuart Russell and Peter Norvig, **"Artificial Intelligence: A Modern Approach,"** 4th Edition, Pearson Education.
2. Elaine Rich, Kevin Knight, and Shivashankar B. Nair, **"Artificial Intelligence,"** 3rd Edition, McGraw Hill.

Reference Books:

1. Tom M. Mitchell, **"Machine Learning,"** McGraw Hill.
2. Christopher Bishop, **"Pattern Recognition and Machine Learning,"** Springer.
3. Nils J. Nilsson, **"Artificial Intelligence: A New Synthesis,"** Morgan Kaufmann.
4. Ethem Alpaydin, **"Introduction to Machine Learning,"** MIT Press.

Internal Continuous Assessment (ICA):

- The ICA for this course includes a minimum of 12 practical assignments designed to provide hands-on experience with foundational AI concepts, tools, and techniques.
- These assignments focus on real-world problem-solving, algorithm development, and the practical application of AI methodologies.

PUNYASHLOK AHILYADEVI HOLKAR SOLAPUR UNIVERSITY, SOLAPUR
Second Year B. Tech (Electronics and Computer Engineering)
Semester – IV
ECEMDM-02B Fundamentals of Machine Learning

Teaching Scheme	**Examination Scheme**
Lectures : - 2 Hrs/Week, 2 credits	ESE : 70 Marks
Practical : - 2 Hrs/Week, 1 credit	ISE : 30 Marks
	ICA : 25 Marks

Introduction: This course provides a comprehensive understanding of the principles, algorithms, and applications of machine learning (ML). It introduces supervised, unsupervised, and reinforcement learning methods and emphasizes practical implementations for real-world scenarios. The course covers foundational topics like data preprocessing, model evaluation, and overfitting while also introducing advanced concepts like neural networks and ensemble methods.

Course Prerequisite:

- Basic programming knowledge (Python preferred).
- Familiarity with linear algebra, probability, and statistics.
- Understanding of data structures and algorithms.

Course Objectives:

1. To introduce the fundamentals of machine learning, including key concepts, techniques, and applications.
2. To enable students to preprocess and analyze data for building predictive models.
3. To provide an in-depth understanding of supervised and unsupervised learning algorithms.
4. To explore reinforcement learning and neural networks for advanced ML tasks.
5. To develop the ability to evaluate and optimize machine learning models.

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

1. Understand the core concepts and types of machine learning.
2. Design and implement machine learning models using appropriate algorithms.
3. Preprocess and analyze data effectively to enhance model performance.
4. Evaluate model accuracy and address issues like overfitting and bias.
5. Apply machine learning to solve real-world problems in various domains.

SECTION I

Unit 1: Introduction to Machine Learning (05 Hours)

- Definition and significance of machine learning.
- Types of machine learning: Supervised, unsupervised, and reinforcement learning.
- Applications of machine learning in various industries.

Unit 2: Data Preprocessing and Feature Engineering (05 Hours)

- Data cleaning, normalization, and transformation.
- Handling missing values and outliers.
- Feature selection and dimensionality reduction (PCA, LDA).

Unit 3: Supervised Learning (05 Hours)

- Regression algorithms: Linear regression, polynomial regression.
- Classification algorithms: Logistic regression, decision trees, support vector machines (SVM).
- Model evaluation: Confusion matrix, accuracy, precision, recall, F1-score, and ROC-AUC.

SECTION II

Unit 4: Unsupervised Learning (05 Hours)

- Definition and importance of unsupervised learning.
- Clustering algorithms: K-means, hierarchical clustering, DBSCAN
- Association rule learning: Apriori and FP-growth algorithms.
- Dimensionality reduction revisited: t-SNE and Autoencoders.

Unit 5: Reinforcement Learning and Neural Networks (05 Hours)

- Basics of reinforcement learning: Q-learning and Markov Decision Processes.
- Introduction to artificial neural networks (ANN): Perceptron and multilayer perceptron (MLP).
- Overview of deep learning: Convolutional Neural Networks (CNN) and Recurrent Neural Networks (RNN).

Unit 6: Advanced Topics and Applications (05 Hours)

- Ensemble methods: Bagging, boosting (Adaboost, Gradient Boosting, XGBoost).
- Hyperparameter tuning: Grid search, random search, and Bayesian optimization.
- Applications of ML in natural language processing, image recognition, and recommendation systems.

Textbook:

1. Tom M. Mitchell, **"Machine Learning,"** McGraw Hill.
2. Christopher M. Bishop, **"Pattern Recognition and Machine Learning,"** Springer.
3.

Reference Books:

1. Ethem Alpaydin, "Introduction to Machine Learning," MIT Press.
2. Aurélien Géron, "Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow," O'Reilly Media.
3. Ian Goodfellow, Yoshua Bengio, and Aaron Courville, "Deep Learning," MIT Press.
4. Shai Shalev-Shwartz and Shai Ben-David, "Understanding Machine Learning: From Theory to Algorithms," Cambridge University Press.

Internal Continuous Assessment (ICA):

- The ICA for this course includes a minimum of **12 practical assignments** designed to provide hands-on experience with foundational machine learning concepts, tools, and techniques.
- ICA structure ensures that students develop a solid understanding of machine learning concepts and gain practical skills to apply ML techniques effectively in real-world scenarios.
