

NATURE SCIENCE FOUNDATION

Coimbatore – 641 004, Tamil Nadu

Course Title: Artificial Intelligence and Machine Learning	
Mode of Delivery: Physical Classroom Training	Type of Learning: Lectures, Industry Study, Case Study & Student Activity
Total Learning Hours: 60	Total Marks: 75

Prerequisites

Basic knowledge of data structures, algorithms, programming (Python) and problem-solving abilities. Familiarity with machine learning basics is a plus

Learning Objectives

- Understand the fundamental concepts and principles of AI and ML.
- Learn the architecture, algorithms, and tools used in AI and ML development.
- Develop problem-solving skills by applying AI and ML techniques to real-world problems.
- Analyze and evaluate the performance of various AI/ML algorithms.
- Explore ethical, legal, and social implications of AI technologies.

Learning Outcome

On successful completion of the course, the students will be able to attain below Learning Outcome (LO):

Learning Outcome		CL	Linked LO	Teaching Hours
LO1	Explain the foundational concepts of Artificial Intelligence and Machine Learning.	U, A	1,2,5,6,7,8,9,10	9
LO2	Apply supervised and unsupervised learning techniques to solve real-world problems.	U, A	1,2,4,5,6,8,9,10	9
LO3	Evaluate AI/ML model performance using standard metrics and validation methods.	R, U	1,2,3,4,5,6,10	9
LO4	Discuss the ethical considerations and societal impact of AI applications.	A, U	1,2,5,6,8,9,10	9
LO5	Demonstrate the use of AI/ML frameworks and tools	U, A	1,2,5,6,8,9,10	9
LO6	Case Study and Student Activity	U, A	1,2,5,6,7,9,10	15
Total				60 hrs

Legends: CL = Cognitive Level, R = Remember, U= Understand, A= Apply and above levels (Bloom's Revised Taxonomy)

Learning - LO Attainment Matrix

Learning	Learning Outcomes									
	1	2	3	4	5	6	7	8	9	10
Artificial Intelligence and Machine Learning	3	3	1	2	3	3	2	3	3	3

Level 3- Highly Addressed, Level 2-Moderately Addressed, Level 1-Low Addressed.

- Method is to relate the level of LO with the number of hours devoted to the LOs which address the given LO.
- If $\geq 40\%$ of classroom sessions addressing a particular LO, it is considered that LO is addressed at Level 3
- If 25 to 40% of classroom sessions addressing a particular LO, it is considered that LO is addressed at Level 2 If 5 to 25% of classroom sessions addressing a particular LO, it is considered that LO is addressed at Level 1
- If $< 5\%$ of classroom sessions addressing a particular LO, it is considered that LO is considered not-addressed.

Learning Content and Blue Print of Marks for External

Unit No	Unit Name	Hour	Questions to be set for External			Marks Weightage	Marks Weightage (%)
			R	U	A	A	
I	Introduction to AI and ML	09	5	20	10	35	24.13
II	Machine Learning Algorithms	09	-	20	10	30	20.68
III	Deep Learning and Neural Networks	09	5	10	-	15	10.35
IV	AI Techniques and Applications	09	-	10	15	25	17.24
V	Emerging Trends and Challenges	09	-	15	10	25	17.24
VI	Industry Study, Case Study & Student Activity	15	-	15	-	15	10.35
Total		60	10	90	45	145	100

UNIT I: Introduction to AI and ML **09 Hrs**

History and Evolution, definitions, and scope of AI and ML, highlighting their interrelation. Key terminologies, AI problem-solving methods: Search Algorithms, Knowledge Representation & Expert Systems. Types of Learning - supervised, unsupervised, and reinforcement learning, Real-World AI Applications and Overview of AI applications in industries like healthcare, finance, and robotics.

UNIT II: Machine Learning Algorithms **09 Hrs**

Fundamental ML algorithms, including linear regression, logistic regression, decision trees, and support vector machines. Feature engineering (Preprocessing Techniques, Dimensionality Reduction, Handling Missing Data and Feature Selection), Overfitting, underfitting, and evaluation metrics like precision, recall, accuracy and F1 score. Model Performance and Ensemble Methods.

UNIT III: Deep Learning and Neural Networks **09 Hrs**

Definition and Overview of Deep learning and neural networks, covering feedforward and convolutional networks, activation functions and backpropagation. Practical applications like image recognition, Speech Recognition, Autonomous Vehicles and natural language processing, tools like TensorFlow and Keras, Model Evaluation and Fine-Tuning and Advanced Topics in Deep Learning

UNIT IV: AI Techniques and Applications **09 Hrs**

Search algorithms: Uninformed Search Methods, Informed Search Methods, Search Space and Complexity and Optimization Techniques. Knowledge representation: Logical Representation, Semantic Networks and Frames, Ontologies. Definition and Architecture of Expert systems, and Applications of AI planning. Applications such as chatbots, recommendation systems, and intelligent agents are explored. Ethical considerations, bias mitigation, and interpretability of AI models.

UNIT V: Emerging Trends and Challenges **09 Hrs**

Definition and Applications of Generative AI, federated learning, and quantum computing. Societal impacts, regulatory frameworks and governance of AI, and career opportunities in AI and ML. The challenges of data privacy, security, AI ethics and Impact of AI on Society: AI's Role in Enhancing Quality of Life, Challenges to Employment and Privacy and AI for Sustainable Development

UNIT VI: Industry Study, Case Study & Student Activity **15 Hrs**

Student Industry Visit – Real-world Case Studies Demonstrating the Applications of AI/ML – Hands-on Projects and Exercises for Implementation and Practice

References

- *AI: A Modern Approach* by Stuart Russell & Peter Norvig, Pearson, 2021.
- *Machine Learning* by Tom M. Mitchell, McGraw Hill, 1997.
- *Deep Learning* by Ian Goodfellow et al., MIT Press, 2016.
- *Pattern Recognition and Machine Learning* by Christopher Bishop, Springer, 2006.
- *Hands-On Machine Learning* by Aurélien Geron, O'Reilly, 2019.

Suggested list of student activities

Note: the following activities or similar activities for assessing Internal for 5 marks

1. Each student should do any one of the following type activity or any other similar activity related to the course and before conduction, get it approved from concerned learning coordinator
2. Each student should conduct different activity and no repeating should occur.

1	Understand the Different Types of AI and ML Algorithms and Their Applications
2	Learn the Role of Data Preprocessing in AI and ML Models
3	Explore the Working Principle of Supervised and Unsupervised Learning
4	Compare Different Types of Neural Networks Used in Deep Learning
5	Understand the Functionality and Selection Criteria of AI/ML Frameworks and Tools
6	Learn About Model Evaluation Metrics and Performance Tuning
7	Study Ethical Considerations and Bias in AI and ML Models
8	Design a Basic Machine Learning Model for a Real-World Application
9	Explore the Integration of AI and ML with IoT and Smart Technologies
10	Quiz on AI and ML Fundamentals

Case study

1. Building a Predictive Model for Healthcare Patient Outcomes Using ML
2. Designing a Recommender System for an E-commerce Platform
3. Developing an Autonomous Vehicle Navigation System Using AI Algorithms
4. Sentiment Analysis on Social Media Data Using Natural Language Processing
5. AI-Based Fraud Detection System for Financial Transactions
6. Predictive Maintenance Model for Industrial Equipment Using ML
7. Optimizing Supply Chain Processes with AI and Machine Learning
8. Building a Personalized Learning System for Online Education Using AI
9. Face Recognition System for Security Applications in Public Spaces
10. AI-Driven Crop Yield Prediction and Disease Detection in Agriculture
11. Customer Service Automation Using AI-Powered Chatbots
12. Climate Change Prediction Model Using Machine Learning Algorithms
13. AI-Enabled HR Recruitment System for Screening Job Applicants
14. Analyzing Customer Behavior and Improving Retention with Machine Learning
15. Performance and Injury Prediction in Sports Using Machine Learning Models

Learning Assessment and Evaluation Scheme

Method	What		To whom	When/Where (Frequency in the course)	Max Marks	Evidence collected	Learning outcomes
Direct Assessment	External	Internal	Students	Three Internal tests (Average of three tests will be computed)	20	Blue books	1 to 6
				Student activities	10	Report	1 to 6
				Total	30		
	End Semester	End Exam		End of the Learning	70	Answer scripts	1 to 6
Indirect Assessment	Student Feedback on course		Students	Middle of the Learning		Feedback forms	1,2,3 Delivery of course
	End of Learning Survey			End of the Learning		Questionnaires	1 to 6 Effectiveness of Delivery of instructions & Assessment Methods

Note: Internal Evaluation shall be conducted for 20 marks. Average marks of three tests shall be rounded off to the next higher digit.

Questions for Internal and External will be designed to evaluate the various educational components (Bloom's taxonomy) such as:

Sl. No	Bloom's Category	%
1	Remembrance	07
2	Understanding	62
3	Application	31

Note to Internal verifier: The following documents to be verified by Internal verifier at the end of semester

1. Blue books (20 marks)
2. Student suggested activities report for 10 marks
3. Student feedback on learning regarding Effectiveness of Delivery of instructions & Assessment Methods.

FORMAT OF INTERNAL TEST QUESTION PAPER

Test/Date and Time	Semester/year	Course/Course Code	Max Marks			
			20			
	Year:					
Name of Learning coordinator : Units: __						
LO's: _____						
Question No	Questions	MARKS	CL	LO	LO	
1						
2						
3						
4						

Note: Internal choice may be given in each LO at the same cognitive level (CL).

Format for Student Activity Assessment

DIMENSION	Unsatisfactory 1	Developing 2	Satisfactory 3	Good 4	Exemplary 5	Score
Collection of data	Does not collect any information relating to the topic	Collects very limited information; some relate to the topic	Collects some basic information ; refer to the topic	Collects relevant information; concerned to the topic	Collects a great deal of information; all refer to the topic	3
Fulfill team's roles & duties	Does not perform any duties assigned to the team role	Performs very little duties	Performs nearly all duties	Performs all duties	Performs all duties of assigned team roles with presentation	4
Shares work equally	Always relies on others to do the work	Rarely does the assigned work; often needs reminding	Usually does the assigned work; rarely needs reminding	Does the assigned job without having to be reminded	Always does the assigned work without having to be reminded and on given time frame	3

Listen to other Team mates	Is always talking; never allows anyone else to speak	Usually does most of the talking; rarely allows others to speak	Listens, but sometime s talk too much	Listens and contribu tes to the relev ant topic	Listens and contributes precisely to the relevant topic and exhibit leadership qualities	3
	TOTAL					13/4=3.25=4

Note: This is only an example. Appropriate rubrics/criteria may be devised by the concerned Learning Coordinator for assessing the given activity

MODEL QUESTION BANK

Course Title: Artificial Intelligence and Machine Learning

LO	Question	CL	Marks
I	What is the difference between Artificial Intelligence (AI) and Machine Learning (ML)?	R	05
	Explain the history and evolution of AI and ML.	A	
	Define key terminologies in AI and ML, such as algorithms and datasets.	U	
	What are the primary AI problem-solving methods?	U	
	Differentiate between supervised, unsupervised, and reinforcement learning.	U	
	Explain the concept and process of supervised learning with an example.	U	
	What is unsupervised learning, and how is it applied?	U	
	Describe the concept of reinforcement learning and its key components.	U	
	How is AI applied in healthcare for diagnosis and patient care?	U	
	Discuss the role of AI and ML in robotics and industrial automation.	R	
I	Explain the history, definitions, and scope of AI and ML, and their interrelation.	A	10
	Describe the different types of learning algorithms (supervised, unsupervised, reinforcement learning) and their applications.	A	
	Discuss AI problem-solving methods, including search algorithms and knowledge representation.	U	
	Evaluate the role and impact of AI and ML in healthcare, finance, and robotics.	U	
	Discuss the ethical challenges of AI and ML, such as bias, privacy concerns, and transparency.	U	
II	What is linear regression, and how is it used in machine learning?	A	5
	Explain logistic regression and its application in binary classification.	A	
	How do decision trees work, and what are their advantages in machine learning?	A	
	What are support vector machines (SVM), and how do they separate data in classification problems?	A	
	What is feature engineering, and why is it important in building machine learning models?	A	
	Define overfitting and underfitting, and explain how they affect model performance	U	
	How does linear regression work, and what are its assumptions and applications?	A	
	What is logistic regression, and how is it applied in classification problems?	A	

	How are decision trees constructed, and what are their advantages and limitations?	U	10
	What are support vector machines (SVM), and how does the kernel trick improve their performance?	A	
	What are the key feature engineering techniques, and how do they impact model performance?	A	
	How do precision, recall, and F1 score differ, and why are they important in model evaluation?	A	
III	What is deep learning, and how does it differ from traditional machine learning?	U	5
	Explain the working of feedforward neural networks and their structure.	R	
	What are convolutional neural networks (CNNs), and how are they used in image recognition?	R	
	What are activation functions, and why are they important in neural networks?	U	
	How does backpropagation work in training neural networks?	U	
	Explain the architecture of feedforward and convolutional neural networks and their applications in deep learning.	U	10
	Discuss the role of activation functions in neural networks, including common types and their effects on training.	U	
	How do deep learning techniques like CNNs and RNNs apply to natural language processing and image recognition	U	
IV	What are search algorithms in AI, and how do they facilitate problem-solving?	U	5
	Define knowledge representation in AI and discuss its significance.	A	
	What are expert systems, and how do they emulate human expertise?	A	
	Explain AI planning and its role in autonomous decision-making.	A	
	How do chatbots function, and what are their primary applications?	U	
	Discuss the ethical considerations in AI, focusing on bias mitigation and model interpretability.	U	10
	Compare and contrast AI agents and chatbots in terms of architecture, capabilities, and applications.	A	
	Evaluate the role of recommendation systems in personalized user experiences and their impact on businesses.	A	
	Analyze the challenges and solutions in ensuring fairness and transparency in AI models.	A	
V	What is generative AI, and how does it create new data or content?	U	5
	Explain federated learning and its benefits in distributed machine learning.	A	
	How is quantum computing expected to influence AI and machine learning?	A	
	What are the societal impacts of AI and ML in modern industries?	U	
	How do regulatory frameworks shape the development and use of AI technologies?	U	
	What are the challenges surrounding data privacy and security in AI systems?	U	
	Discuss the advancements in AI, including generative AI, federated learning, and quantum computing, and their potential future applications.	A	10
	Evaluate the challenges of AI ethics, data privacy, and security, and their implications for AI adoption and regulation.	U	
VI	What are the differences between supervised, unsupervised, and reinforcement learning in AI?	U	5
	How does linear regression work in machine learning, and what are its limitations?	U	
	Explain the role of feature engineering in improving machine learning models.	A	
	What is the purpose of backpropagation in neural networks, and how does it help in training?	A	
	Describe how support vector machines (SVM) work for classification problems.	U	

	How do AI planning and problem-solving methods contribute to intelligent decision-making in real-world scenarios?	U	
	Discuss the evolution of AI and ML, including their historical development, key terminologies, and their interrelationship.	U	10
	Explain the advancements in AI technologies such as generative AI, federated learning, and quantum computing, and analyze their societal impacts and ethical considerations.	A	