MIT | Academy of Engineering (An Autonomous Institute Affiliated to Savitribai Phule Pune University)	**COURSE SYLLABUS**	
COMPUTER SCIENCE ENGINEERING(AIML)	**W.E.F**	**AY:** 2024 - 2025 (Rev. 2022)
THIRD YEAR BACHELOR OF TECHNOLOGY	**COURSE NAME**	Artificial Intelligence and Machine Learning (MDM)
	COURSE CODE	2311331T
	COURSE CREDITS	2
RELEASE DATE : 01/07/2024	**REVISION NO.**	2.0

TEACHING SCHEME (HOURS/WEEK)		**EXAMINATION SCHEME AND MARKS**					
		THEORY			LABORATORY		TOTAL
LECTURE	PRACTICAL	IA	MSE	ESE	CA	PRACT/DEMO/PRES.	
2	NIL	15	20	40	NIL	NIL	75

PREREQUISITE : Application Programming.

COURSE OBJECTIVES :

2311331.CEO.1: Provide strong foundation of fundamental Artificial Intelligence concepts of Perception, Knowledge, Inference and Search Strategies.

2311331.CEO.2: Provide the knowledge about various statistical machine learning models to ethically build computational intelligence.

2311331.CEO.3: Present optimal methodologies and evaluating the effectiveness of statistical machine learning models.

2311331.CEO.4: Illustrate diverse applications of machine learning across various domains and real world scenarios.

COURSE OUTCOMES :

After successful completion of the course, students will be able to,

2311331.CO.1: Apply basic principles of Perception, Knowledge Representation, Inference, Reasoning and Search Strategies in Artificial Intelligence [L3].

2311331.CO.2: Practice various artificial intelligence and machine learning statistical algorithms in a range of real-world applications [L3].

2311331.CO.3: Critical analyze of experimental results to draw conclusions on the effectiveness of different AI and ML problem-solving methods[L4].

2311331.CO.4: Evaluate the strengths and limitations of various AI and ML approaches, employing appropriate evaluation metrics[L4].

COURSE ABSTRACT:

The Artificial Intelligence and Machine Learning (AIML) course is designed to provide students with a comprehensive understanding of the theoretical foundations and practical applications of AI and ML technologies. This course covers a wide array of topics, including the history and evolution of AI and key machine learning algorithms.

Students will explore supervised and unsupervised paradigms, delving into algorithms such as linear regression, decision trees, support vector machines, and clustering methods. The course emphasizes hands-on experience through programming assignments, projects, case studies and performance evaluation, enabling students to apply learned concepts to real-world problems.

By integrating theoretical knowledge with practical skills, the AIML course prepares students to tackle complex challenges in various industries, including healthcare, finance, autonomous systems, and more. Graduates will be equipped with the tools and expertise necessary to innovate and drive advancements in the ever-evolving field of AI and ML.

THEORY COURSE CONTENTS

UNIT 1	**BASICS OF ARTIFICIAL INTELLIGENCE**	**04 HOURS**

Applications/Case Study: Medical Diagnosis System, Self Driving Vehicle.

Contents: Foundation and history of Artificial Intelligence (AI), AI applications and types, Impact and ethical concerns of AI, Intelligent Agents. Introduction to Reasoning and Knowledge Representation.

Self Study: Chatbot, Prompt Engineering

Further Readings: Artificial General Intelligence.

UNIT 2	**ARTIFICIAL INTELLIGENCE SEARCH STRATEGIES**	**06 HOURS**

Applications/Case Study: GPS Navigation System, Chess Game

Contents: Search Strategies: State Space Search, Uninformed Search (Breadth-First, Depth-First, Depth Limited, Iterative Deepening, Bidirectional), Heuristic Search (Greedy Best First Search, A* Algorithm, Admissibility of A*), Constraint Satisfaction Problem(CSP), Local Search. Adversarial Search, Minimax Search, Alpha-Beta Pruning.

Self Study: Genetic Algorithm

Further Readings: Game Theory

UNIT 3	**MACHINE LEARNING FUNDAMENTALS**	**06 HOURS**

Applications/Case Study: Real Estate Price Prediction, Healthcare Application.

Contents: Overview of Machine learning: Supervised, Unsupervised and Reinforcement Learning. Regression, Types of regression: Simple and Multiple Linear Regression, Polynomial Regression, Evaluation Metrics for Regression Models: Mean Squared Error, Root Mean Squared Error, Mean Absolute Error, and R-squared value.

Self Study: Ridge Regression, Lasso Regression, Elastic Net Regression

Further Readings: K-Fold Cross-Validation.

UNIT 4	INSTANCES AND PROBABILISTIC MODEL	04 HOURS

Applications/Case Study: Customer Churn Prediction.
Contents: Naive Bayes: Bayes' theorem, Independence Assumption, Logistic Regression for Classification, Model Evaluation Metrics: Accuracy, Precision, Recall, F1, Confusion Matrix, ROC-AUC.
Self Study: k-Nearest Neighbors (KNN) for Regression and Classification.
Further Readings: Variation Inference.

UNIT 5	LINEAR AND DECISION MODELS	06 HOURS

Applications/Case Study: Pima Diabetes Prediction
Contents: Decision Trees, Gini Impurity, Information Gain, Pruning.
Support Vector Machines: Hyperplane, Support Vectors and Kernel Types.
Ensemble learning: Significance, Bagging, Boosting and Stacking.
Performance Evaluation of Machine Learning Models.
Self Study: Adaboost Ensemble Learning.
Further Readings: Decision Tree for Regression Analysis.

UNIT 6	UNSUPERVISED LEARNING MODELS	04 HOURS

Applications/Case Study: Anomaly Detection and Noise Reduction
Contents: Association Rule, Apriori Algorithm.
Introduction to Clustering, Partitional Clustering, Hierarchical Clustering, Density Based Clustering.
Dimensionality Reduction, Feature Selection and Extraction, Principal Component Analysis.
Self Study: Probability Distribution Based Methods.
Further Readings: Linear Discriminant Analysis.

TEXT BOOKS

1. Stuart Russel and Peter Norvig(2020). *Artificial Intelligence: A Modern Approach.* 4^{th} Edition, Pearson . ISBN: 0-13-461099-7. Rich, Kevin Knight(2020). *Shivashankar B. Nair, Artificial Intelligence,.* 3^{rd} Edition, TataMcGraw Hill. ISBN-13: 978-0-07-008770-5.
2. Ethem Alpaydin(2020). *Introduction to Machine Learning.* 4^{th} Edition,The MIT Press publication. ISBN:978-0-262-04379-3.
3. S. Harrington (1987). *Computer Graphics.* 2^{nd} Edition, McGraw-Hill publication. ISBN 0-07-100472-6.
4. Tom Mitchell(1997). *Machine Learning.* 2^{nd} Edition, Tata McGraw-Hill publication, ISBN 007-0-42807-7.
5. Jason Bell(1994). *"Machine Learning: Hands-On for Developers and Technical Professionals.* 2^{nd} Edition,Willey Publication,ISBN-10: 8126553375, ISBN-13: 978- 8126553372.
6. James, G., Witten, D., Hastie, T. and Tibshirani, R(2013). *An Introduction to Statistical Learning*,Springier Publication,VOl 112.

REFERENCE BOOKS

1. Deepak Khemani (2013). *A First course in Artificial Intelligence.* 1^{st} Edition, Mc Graw Hill,ISBN: 9781259029981.
2. Peter Harrington (2012)*Machine Learning in Action.* 2^{nd} Edition, Dreamtech Press,ISBN 978-1-617-29018-3.
3. *Trevor Hastie,Robert Tibshirani, Jerome Friedman.* The Elements of Statistical Learning: Data Mining,Inference and Prediction ^{3rd} Edition,ISBN: 978-0-387-84857-0.
4. Christopher M. Bishop(2016)*"Pattern Recognition and Machine Learning.* 4^{th} Edition, Springier New York.
5. *Andrea's Muller.*Introduction to Machine Learning with Python: A Guide for Data Scientists(2016),1^{st} Edition,Shroff/O'Reilly,ISBN-10: 9352134575, ISBN-13: 978-9352134571.

E-LEARNING RESOURCES

1. MITCourseWare, "https://openlearning.mit.edu/news/explore-world-artificial-intelligence-online-courses-mit".
2. IEEE Transactions on Artificial Intelligence, "https://ieeexplore.ieee.org".
3. Swayam/NPTEL Course Introduction to Machine Learning, "https://onlinecourses.nptel.ac.in/".
4. Pioneering research on the path to Artificial General Intelligence (AGI),"https://openai.com/research/"