INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)
Dundigal - 500 043, Hyderabad, Telangana

COURSE CONTENT

MACHINE LEARNING AND ARTIFICIAL INTELLIGENCE LABORATORY								
IV Semester: MBA								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
CMBE63	**Elective**	-	-	4	2	40	60	100
Contact Classes: Nil	**Tutorial Classes: Nil**	**Practical Classes: 40**				**Total Classes: 40**		
Prerequisite: Business Analytics								
SDGs Mapped: SDG 9 (Industry, Innovation and Infrastructure), SDG 8 (Decent Work & Economic Growth)								

I. COURSE OVERVIEW:

This course provides hands-on exposure to machine learning, recommender systems, decision tree classification, and artificial intelligence (AI) techniques using Python and relevant libraries. Students will implement supervised learning algorithms, recommender systems, decision tree classifiers, and AI problem-solving strategies including search algorithms, adversarial search, and constraint satisfaction problems. The course emphasizes practical skills in data analysis, model evaluation, and AI agent design, equipping students to solve real-world business and computational problems.

II.OBJECTIVES:

The students will try to learn:

I. Introduce students to Python programming environment, data handling, and exploratory data analysis for machine learning.
II. Develop practical skills in supervised learning algorithms such as KNN, Random Forest, and Boosting for predictive modeling.
III. Teach implementation of recommender systems using user-based, item-based, and matrix factorization techniques.
IV. Provide hands-on experience with decision tree classification and AI problem-solving methods, including search algorithms and intelligent agents.
V. Enable students to apply AI techniques for adversarial search, constraint satisfaction problems, and chatbot design in practical scenarios.

III. COURSE OUTCOMES:

At the end of the course students should be able to:

CO1 Recall the fundamental concepts of machine learning, AI, and Python libraries used for data analysis.

CO2 Apply supervised learning algorithms (KNN, Random Forest, Boosting) to solve classification problems and evaluate model performance.

CO3 Implement user-based, item-based, and matrix factorization recommender systems for personalized recommendations.

CO4 Analyze decision tree classifiers using Gini and Entropy criteria and optimize tree performance for real datasets.

CO5 Design and implement AI solutions using search algorithms, adversarial search, and constraint satisfaction techniques.

CO6 Evaluate AI applications such as intelligent agents and chatbots, and assess their relevance for practical business and computational problems.

IV. COURSE CONTENT:

EXPERIMENT – 1: INTRODUCTION TO MACHINE LEARNING ENVIRONMENT
Python, Jupyter Notebook/Colab setup, importing datasets, basic libraries (NumPy, Pandas, Scikit-learn, Matplotlib), exploratory data analysis.

EXPERIMENT – 2: SUPERVISED LEARNING – K-NEAREST NEIGHBORS (KNN)
Implement KNN for classification, distance metrics (Euclidean, Manhattan), hyperparameter tuning, case: employee churn dataset.

EXPERIMENT – 3: SUPERVISED LEARNING – RANDOM FOREST CLASSIFIER
Building a Random Forest model, feature importance, cross-validation, model evaluation metrics (accuracy, precision, recall, F1).

EXPERIMENT – 4: SUPERVISED LEARNING – BOOSTING ALGORITHMS
Implementation of AdaBoost/Gradient Boosting/XGBoost, comparison with RF and KNN, case: employee churn prediction.

EXPERIMENT – 5: USER-BASED RECOMMENDER SYSTEM
Calculate cosine similarity between users, find top similar users, challenges of scalability, build a user-user recommendation engine.

EXPERIMENT – 6: ITEM-BASED RECOMMENDER SYSTEM
Calculate item similarity (cosine similarity between movies/products), recommend top N items, comparison with user-based filtering.

EXPERIMENT – 7: MATRIX FACTORIZATION FOR RECOMMENDER SYSTEMS
Implement Singular Value Decomposition (SVD), Alternating Least Squares (ALS), performance evaluation with RMSE/MAE.

EXPERIMENT – 8: DECISION TREE CLASSIFICATION – GINI CRITERIA
Build Decision Tree using Gini Index, visualize tree, compute accuracy, advantages/disadvantages of decision trees.

EXPERIMENT – 9: DECISION TREE CLASSIFICATION – ENTROPY CRITERIA
Build Decision Tree using Entropy (Information Gain), tune max depth, case study: German Credit Data classification.

EXPERIMENT – 10: ARTIFICIAL INTELLIGENCE – INTELLIGENT AGENTS
Types of agents, structure of agents, simple agent-environment simulation (Grid World/Reflex Agent).

EXPERIMENT – 11: PROBLEM SOLVING WITH UNINFORMED SEARCH
Implement BFS, DFS for problem-solving (maze/pathfinding), compare time and space complexity.

EXPERIMENT – 12: PROBLEM SOLVING WITH INFORMED SEARCH
Implement A* search with heuristic functions (Manhattan, Euclidean), analyze optimality and efficiency.

EXPERIMENT – 13: ADVERSARIAL SEARCH AND GAME AGENTS
Implement Minimax algorithm with Alpha-Beta pruning, create a simple game-playing agent (Tic-Tac-Toe).

EXPERIMENT – 14: CONSTRAINT SATISFACTION & CHATBOT DESIGN
Constraint satisfaction problem solving (N-Queens / Sudoku / Map Coloring). Rule-based Chatbot using NLP (Python NLTK/spaCy), chatbot importance in business applications.

V. SOFTWARE / TOOLS

1. Python (Anaconda / Jupyter / Google Colab): https://www.python.org/
2. Scikit-learn (Machine Learning library): https://scikit-learn.org/

3. NumPy & Pandas (Data handling): https://numpy.org/ | https://pandas.pydata.org/
4. Matplotlib / Seaborn (Visualization): https://matplotlib.org/ | https://seaborn.pydata.org/
5. NLTK / spaCy (for Chatbot & NLP tasks): https://www.nltk.org/ | https://spacy.io/
6. R (optional for ML/AI analytics): https://www.r-project.org/
7. Tableau / Power BI (for visualization & dashboards): https://www.tableau.com/ https://powerbi.microsoft.com/

VI. TEXTBOOKS

1. Sergio's Theodoratos, Machine Learning: A Bayesian and Optimization Perspective, 1st edition, Elsevier, 2023.
2. Dheeraj Mehrotra, Basics of Artificial Intelligence & Machine Learning, 3rd edition, 2022.
3. Wei-Meng Lee, Python Machine Learning, 3rd edition, Wiley, 2021.
4. David L. Poole & Alan K. Mackworth, Artificial Intelligence, 2nd edition, 2018.
5. Steven W. Knox, Machine Learning: A Concise Introduction, 4th edition, Wiley, 2018.

VII. REFERENCE BOOKS

1. Paul Deitel & Harvy Deitel, Python for Programmers with Introductory AI Case Studies, Pearson, 2019.
2. Puneet Mathur, Machine Learning Applications Using Python: Case Studies from Healthcare, Retail, and Finance, Apress, 2019.
3. Joshua Eckroth, Python AI Projects for Beginners, Packt Publishers, 2018.
4. Shalev-Shwartz & Ben-David, Understanding Machine Learning: From Theory to Algorithms, Cambridge University Press, 2014.
5. Stephen Marsland, Machine Learning – An Algorithmic Perspective, 2nd edition, CRC Press, 2014.
6. Saroj Kaushik, Artificial Intelligence, Cengage Learning India, 2014.

VIII. WEB REFERENCES

1. https://scikit-learn.org
2. https://www.analyticsvidhya.com
3. https://towardsdatascience.com
4. https://www.kaggle.com
5. https://www.tensorflow.org