ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING OF MECHANICAL SYSTEMS

Course Code	22MEMD2T2	**Year**	I	**Semester**	II
Course Category	Programme core	**Branch**	ME	**Course Type**	Theory
Credits	4	**L-T-P**	4-0-0	**Prerequisites**	Nil
Continuous Internal Evaluation:	40	**Semester End Evaluation:**	60	**Total Marks:**	100

Course outcomes: At the end of the course, the student will be able to:

CO	Statement	BTL	Units
CO1	Understand the core concepts of Mechanical Systems in the context of Industry 4.0	L2	1
CO2	Apply AI concepts on Various Mechanical Systems	L3	2
CO3	Apply ML and Deep Learning concepts on Various Mechanical Systems	L3	3
CO4	To provide adequate knowledge of fuzzy logic, in solving engineering problems	L3	4

Contribution of Course outcomes towards achievement of programme outcomes & Strength of correlations (High: 3, Medium: 2, Low: 1)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	3	3	2							1		2	3	2
CO 2	3	3	2							1		2	3	2
CO 3	3	3	2							1		2	3	2
CO 4	3	3	2							1		2	3	2

Syllabus		
Unit	**Contents**	**Mapped CO**
1	**Introduction to Mechanical Systems:** Evolution in the context of Industry 4.0,Key issues: Adaptability, Intelligence, Autonomy, Safety, Sustainability, Interoperability, Flexibility of Mechanical Systems. **Introduction of Statistics**: Descriptive statistics: Central tendency measures, Dispersion measures, data distributions, centre limit theorem, sampling, sampling methods; Inferential Statistics: Hypothesis testing, confidence level, degree of freedom, P-value, Chi-square test, ANOVA, Correlation V's Regression, Uses of Correlation and regression.	**CO1**
2	**Artificial Intelligence:** Brief review of AI history, Problem formulation: Graph structure, Graph implementation, state space representation, search graph and search tree, Search Algorithms: random search, Depth-first, breadth-first search and uniform-cost search. Heuristic: Best first search, A* and AO* algorithm, Generalization of search problems. Ontology; Fuzzy; Metaheuristics.	**CO2**

3	**Machine Learning:** Overview of supervised and unsupervised learning; Supervised Learning: Linear Regression, Non-linear Regression Model evaluation methods, Logistic Regression, Neural Networks; Unsupervised Learning: K-means clustering, C-means Clustering. Convolution Neural Networks (CNN), Pooling, Padding Operations, Interpretability in CNNs, Limitations in CNN. Cases with respect to different mechanical systems.	**CO3**
4	**CLASSICAL LOGIC AND FUZZY LOGIC** Classical Predicate Logic – Tautologies, Contradictions, Equivalence, Exclusive OR and Exclusive NOR, Logical Proofs, Deductive Inferences. Fuzzy Logic, Approximate Reasoning, Fuzzy Tautologies, Contradictions, Equivalence and Logical Proofs, Other forms of the Implication Operation, Other forms of the Composition Operation	**CO4**

Learning Resources

Text Book(s):

1. Rajkumar, Dionisio De Niz, and Mark Klein, Cyber-Physical Systems, WesleyProfessional.
2. Robert Levine et al., "A Comprehensive guide to AI and Expert Systems", McGraw HillInc, 1986.
3. Ross, T. J. (2005), "Fuzzy logic with engineering applications," John Wiley & Sons.

References:

1. Rajeev Alur, Principles of Cyber-Physical Systems, MIT Press, 2015.
2. E. A. Lee and S. A. Seshia, "Introduction to Embedded Systems: A Cyber-Physical Systems Approach", 2011.
3. C. Cassandras, S. Lafortune, "Introduction to Discrete Event Systems", Springer 2007.
4. Constance Heitmeyer and Dino Mandrioli, "Formal methods for real-time computing",Wiley publisher, 1996.
5. Montgomery Douglas, 2017. Design of Experiments, John Wiley and Sons, Inc.
6. J.-S. R. Jang, C.-T. Sun, and E. Mizutani, "Neuro-Fuzzy and Soft Computing" PrenticeHall.

Course coordinator: HOD