ME 520 3(3,0,0)

Application of Artificial Intelligence in Mechanical Engineering

Instructor Contact Information:

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Course Description:

This course introduces the basic fundamental principles of Artificial Intelligence (AI) and Machine Learning (ML) and their applications in mechanical engineering. Students will explore supervised and unsupervised learning techniques, feature selection, and core algorithms such as linear regression, logistic regression, decision trees, random forest, SVM, KNN, and clustering methods. The course emphasizes practical applications, including predictive maintenance, fault detection, design optimization, and smart manufacturing. Students will gain hands-on experience in developing, evaluating, and implementing AI models while considering performance, reliability, and ethical implications in engineering practice.

Course Objectives:

1) Understand basic concepts of Artificial Intelligence and Machine Learning, and know the difference between supervised and unsupervised learning.
2) Apply AI and ML methods to solve mechanical engineering problems like predictive maintenance, fault detection, and design optimization.
3) Check and evaluate how well AI models work and consider their impact and limitations in engineering practice

Course Learning Outcomes (CLOs):

CLO1 *Knowledge*: Understand the basic concepts of Artificial Intelligence and Machine Learning, and differentiate between supervised and unsupervised learning methods.

CLO2 *Skill*: Apply basic AI and ML techniques such as linear regression, logistic regression, decision trees, and K-means clustering to analyze engineering data.

CLO3 *Skill*: Analyze and compare different machine learning models and algorithms to select the most suitable for mechanical engineering problems.

CLO4 *Skill*: Measure and evaluate model performance, identify overfitting or underfitting, and improve accuracy using methods like ensemble learning (AdaBoost, Gradient Boosting).

CLO5 *Values*: Reveal (critically assess) the practical impact, limitations, and ethical considerations of AI applications in mechanical engineering practice.

References:

Text book: Theobald, Oliver. *Machine learning for absolute beginners: a plain English introduction*. London, UK: Scatterplot press, 2021.

Kumar, Kaushik, Divya Zindani, and J. Paulo Davim, eds. *Artificial intelligence in mechanical and industrial engineering*. CRC Press, 2021.

Pham, Duc Truong, ed. *Artificial intelligence in design*. Springer Science & Business Media, 2012.

JAYARAM, MA. *ARTIFICIAL INTELLIGENCE AND APPLICATIONS IN CORE ENGINEERING*. PHI Learning Pvt. Ltd., 2026.

Grading Policy

Homework [2*5] ---------- 10
Two Major Exams [15*2] ---------- 30
Project report and presentation---------- 20
Final Exam ---------- 40

Exam schedule: Closed book

Week	Topics	Learning Activities	CLOs Addressed
1	Introduction to AI and Machine Learning	Lecture, discussion	CLO1
2	Role of AI in Mechanical Engineering	Lecture, case studies	CLO1, CLO5
3	Types of Machine Learning: Supervised vs Unsupervised	Lecture + examples	CLO1
4	Data Preprocessing and Feature Selection	Lab exercises	CLO2
5	Linear Regression and Logistic Regression	Lecture + simple coding exercises	CLO2
6	Overfitting, Underfitting, and Model Evaluation	Lecture + hands-on examples	CLO4
7	Decision Tree Algorithm	Lecture + coding practice	CLO2, CLO3
8	Random Forest Algorithm	Lecture + lab exercises	CLO2, CLO3
9	Support Vector Machine (SVM) & K-Nearest Neighbors (KNN)	Lecture + examples	CLO2, CLO3
10	K-Means Clustering and Unsupervised Learning	Lecture + lab	CLO2, CLO3
11	Ensemble Techniques: AdaBoost & Gradient Boosting	Lecture + coding	CLO4

12	Applications in Mechanical Engineering: Predictive Maintenance, Fault Detection	Case studies + project	CLO5
13	Applications in Design Optimization, Robotics, and Smart Manufacturing	Case studies + research paper	CLO5
14	Ethics, Limitations, and Future Trends of AI in Mechanical Engineering	Discussion + presentations	CLO5

Mid-term exam 1: 2nd April, 2026.

Midterm exam 2: 7th May,2026.