Manufacturing Technology Training
An IMTMA initiative

AI / ML For Smart Manufacturing (Project Based Course)

Date : 7 July to 8 August, 2025
Time : 1800 Hrs to 2100 Hrs (Online Mode)

INTRODUCTION

Machine Learning & AI for Mechanical Engineers is a comprehensive and application-oriented program designed to equip mechanical engineering professionals with the foundational and advanced skills required to integrate data-driven methodologies into engineering practice. As the field evolves toward intelligent systems and Industry 4.0, the ability to analyze data, develop predictive models, and apply machine learning techniques has become increasingly essential.

This structured five-week curriculum covers a progression from core programming and data science fundamentals to advanced machine learning concepts tailored for mechanical engineering use cases. Participants will explore practical applications such as predictive maintenance, anomaly detection, quality control, and energy system optimization—leveraging real-world datasets and industry-relevant scenarios.

By the end of the program, learners will not only understand the theoretical underpinnings of modern machine learning but will also be capable of deploying end-to-end solutions that enhance operational efficiency, reduce downtime, and enable data-informed decision-making in mechanical systems. This program is ideal for engineers seeking to stay at the forefront of technological innovation in design, manufacturing, automation, and maintenance.

FOCUS AREAS

The program comprehensively addresses the key areas of machine learning and AI in the context of mechanical engineering, enabling professionals and entry-level candidates to apply advanced techniques to real-world challenges in manufacturing and related fields.

Week 1: Python & Data Science Fundamentals

- Python Programming Basics: Data structures, control flow, functions
- NumPy for Numerical Computing: Arrays, vectorization, matrix operations
- Pandas for Data Analysis: DataFrames, GroupBy, data wrangling, merging
- Data Visualization with Matplotlib & Seaborn: Plots, exploratory data analysis (EDA)

Week 2: Mathematical Foundations for Machine Learning

- Linear Algebra: Vectors, matrices, transformations
- Eigenvalues and Eigenvectors: Dimensionality reduction
- Multivariable Calculus: Gradients, partial derivatives, optimization
- Probability & Statistics: Probability distributions, central limit theorem (CLT), hypothesis testing

Week 3: Regression & Supervised Learning

- Simple & Multiple Linear Regression: Model building, multicollinearity
- Model Evaluation Metrics: R^2, RMSE, and other performance measures
- Logistic Regression: Classification and decision boundaries
- Predictive Maintenance Case Study: Regression models on sensor data

Week 4: Advanced Machine Learning Techniques

- Decision Trees & Random Forests: Non-linear models, feature importance
- Support Vector Machines (SVM): Hyperplanes, kernel tricks
- Clustering Algorithms: k-Means, Hierarchical Clustering
- Dimensionality Reduction: Principal Component Analysis (PCA)
- Fault Detection in Manufacturing: Case study using anomaly detection techniques

Week 5: Industry Applications & Capstone

- Problem Definition + Data Collection
- Exploratory Data Analysis (EDA)
- Model Building & Training
- Model Evaluation & Optimization
- Presentation (Insights, Visualizations, Demo)

Capstone project:

- Predictive Maintenance for Rotating Machinery
- HVAC System Optimization using Machine Learning
- Anomaly Detection in CNC Machines
- Material Property Prediction for Mechanical Components
- Fault Detection in Manufacturing Systems using Anomaly Detection

KEY TAKE AWAYS

- Upon completing the **Machine Learning & AI for Mechanical Engineers** program, participants will:
- **Master Python Programming**
  Gain expertise in Python, focusing on data manipulation, modeling, and visualization using essential libraries like NumPy, Pandas, and Matplotlib.
- **Understand Core Machine Learning Techniques**
  Develop hands-on experience with regression, classification, and advanced algorithms like decision trees, random forests, and SVMs.
- **Apply Mathematical and Statistical Concepts**
  Use linear algebra, calculus, and statistics to address engineering challenges and optimize mechanical systems.
- **Acquire Practical Data Science Skills**
  Analyze sensor data, apply time-series forecasting, and implement anomaly detection for predictive maintenance and system optimization.
- **Solve Real-World Engineering Problems**
  Apply machine learning techniques to solve practical mechanical engineering issues, including predictive maintenance, fault detection, and operational efficiency.

FEE PER PARTICIPANT (PER LOGIN)

Rs. 25000/-	Rs. 15000/-	USD 1000/-
+18% GST	+18% GST	Overseas Participants
IMTMA Members/ Micro Companies/ IMTMA Non Members/ Others	Individuals	

Group Concession : 10% for 3 to 5 and 30% for 6 and more delegates being nominated from the same company

For Registration Contact

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REGISTRATION : Prior registration with an online advance payment is must. Number of participants is limited and will be accepted on 'First Come First Serve' basis. A Certificate of participation will be issued to participants.