

Course Type	Course Code	Name of Course	L	T	P	Credit
AEC/SEC	NPEA201	AI/ML FOR PETROLEUM ENGINEERING	3	0	0	3
Course Objective						
1. Impart knowledge to implement Artificial Intelligence (AI) and Machine Learning (ML) techniques to solve real-world challenges in the oil and gas industry.						
Learning Outcomes						
1. Understand AI/ML fundamentals. 2. Work with petroleum engineering data. 3. Apply AI/ML techniques to real-time problems.						
Unit No.	Topics to be Covered	Contact Hours	Learning Outcome			
1.	Introduction to AI/ML in Petroleum Engineering: Overview of AI/ML, role of AI/ML in petroleum industry, problem solving cycle.	4L	Students will get an overview of structured approaches to tackle real-world challenges and implementation of data-driven models to produce reliable and actionable insights in the petroleum industry.			
2.	Data science fundamentals: Understanding of petroleum engineering data (for ex. structure vs. unstructured), data cleaning and pre-processing, exploratory data analysis, feature engineering.	10L	Students will understand petroleum engineering data sources and types. They will be able to perform data pre-processing and cleaning (convert raw field data into structured format). They will learn how to use statistical techniques to identify patterns, correlations, trends, and outliers.			
3.	Supervised machine learning techniques (regression and classification): Linear and polynomial regression, decision tree and random forest, support vector machines.	8L	This unit will make the students ready to implement different supervised machine learning techniques to solve petroleum industry problems.			
4.	Unsupervised machine learning techniques (clustering and anomaly detection): K-means, density-based clustering of applications with noise (DBSCAN), principal component analysis.	8L	Students will learn application of clustering and anomaly detection for implementation in oil and gas industry.			
5.	Neural networks: Basics of artificial neural networks (ANNs)	6L	Students will get exposure to basic architecture of artificial neural networks and its implementations.			
6.	Application of AI/ML techniques for reservoir and production engineering applications: prediction of reservoir properties, digital rock-physics, data-driven history matching, production forecasting.	3L	Students will gain the ability to implement data-driven approaches for solving reservoir and production engineering problems.			
7.	Application of AI/ML techniques for drilling engineering applications: prediction of subsurface properties using real-time drilling data and problem detection.	3L	Students will gain the ability to address drilling issues using data science.			
Total		42L				

Textbooks:

- Pandey, Y. N., Rastogi, A., Kainkaryam, S., Bhattacharya, S., Saputelli, L. (2020). Machine Learning in the Oil and Gas Industry: Including Geosciences, Reservoir Engineering, and Production Engineering with Python. United States: Apress.
- Hemmati-Sarapardeh, A., Larestani, A., Menad, N. A., Hajirezaie, S. (2020). Applications of Artificial Intelligence Techniques in the Petroleum Industry. United Kingdom: Gulf Professional Publishing.
- Machine Learning and Data Science in the Oil and Gas Industry: Best Practices, Tools, and Case Studies. (2021). Netherlands: Gulf Professional Publishing. (Edited by Patrick Bangert)

Reference Books:

- VanderPlas, J. (2016). Python Data Science Handbook: Essential Tools for Working with Data. United States: O'Reilly Media.
- Severance, C. R. (2016). Python for Everybody: Exploring Data Using Python 3. Poland: Charles Severance.
- Géron, A. (2019). Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems. United States: O'Reilly Media.
- Misra, S., Li, H., He, J. (2019). Machine Learning for Subsurface Characterization. United States: Gulf Professional Publishing.