

Course Type	Course Code	Name of the Course	L	T	P	Credits
OE	CHO404	AI in Process Industries	3	0	0	9

Course Objective
This course aims to serve as an introductory course on the application of artificial intelligence in process engineering for the students of Chemical Engineering department and other allied disciplines. The course will cover various metaheuristics-based approaches as well as different machine learning techniques which have applications in process design and synthesis, planning and scheduling, product engineering, fault diagnosis and control.
Learning Outcome
<p>The students will learn about</p> <ul style="list-style-type: none"> the importance of proper estimation of process parameters and input-output correlations, specifically from process systems engineering perspective for chemical and allied industries the scope and significance of artificial intelligence in process industries, i.e., chemical and allied industries, i.e., petrochemicals, pharmaceuticals, specialty chemicals, coal etc. the basic concepts of various artificial intelligence and machine learning algorithms. detailed understanding (with hands on experience) on some of the popular algorithms, with specific case studies on process industries.

Unit No.	Topics to be Covered	Lecture hours	Learning Outcome
1	Artificial Intelligence in process engineering: Data from process industries and importance of process parameters, input-output correlations, Systems engineering viewpoint of any process, Historical perspective and Introduction to AI, Strengths-Weaknesses-Opportunities-Threats	06	Students will get an introductory idea on systems engineering perspective of process industries and an overview of how the application of AI in process engineering has evolved.
2	Metaheuristics-based approaches and their applications: Overview to knowledge-based systems, Conceptual understanding of various metaheuristics (such as genetic algorithms, simulated annealing, ant colony optimization)	09	It will help develop conceptual understanding of the metaheuristics-based methods with special focus on application in process industries.
3	Supervised Learning and their applications: Exploring relationship between input and output data, Regression problems (learning continuous output) and Classification problems (learning discrete output), Brief understanding on algorithms such as algorithms for Artificial Neural Network (ANN), Support Vector Machine/Regression (SVM/SVR) etc., Decision tree-based learning	12	Students will learn about the supervised learning (of both the types) and application of the corresponding algorithms with case studies, focused on process industries.
4	Unsupervised Learning and their applications: Exploring and extracting hidden patterns within input features, Clustering, and dimensionality reduction through Principal component Analysis (PCA), k-means clustering	09	Students will learn about the concepts of unsupervised learning and corresponding algorithms, with special focus on applications in process industries.

5	Learning Probabilistic Models: Statistical learning, maximum likelihood estimate, Naive Bayes Model, Bayesian parameter learning for discrete and continuous models, learning with hidden variables: EM algorithm	06	Students will learn basic concepts of probabilistic model learning and its applications in process industries.
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Textbooks:

1. Artificial Intelligence - A Modern Approach. Stuart J. Russell and Peter Norvig. Prentice Hall Third Edition (2010).
2. Applied Machine Learning. M Gopal. McGraw Hill (India) Pvt. Ltd. 2018.

Reference Books:

1. Applications of Artificial Intelligence in Process Systems Engineering. Editors: Jingzheng Ren, Weifeng Shen, Yi Man, and Lichun Dong, Elsevier First Edition (2021).
2. Machine Learning. Tom M. Mitchell. McGraw Hill Education Indian edition (2017).
3. Applications of Metaheuristics in Process Engineering. Editors: Jayaraman Valadi and Patrick Siarry. Springer (2014).
4. Pattern Recognition and Machine Learning. Christopher M Bishop. Springer (2006).