NIRMA UNIVERSITY

Institute:	**Institute of Technology**
Name of Programme:	**BTech in Electrical Engineering**
Semester:	**VI**
Course Code:	**3EE403DC24**
Course Title:	**Applications of AI in Power Systems and Renewables**
Course Type:	**Disciplinary Minor (Core Course-III)**
Year of Introduction:	**2024 – 25**

L	T	Practical component				C
		LPW	PW	W	S	
3	0	2	-	-	-	4

Course Learning Outcomes (CLOs):

At the end of the course, the students will be able to –

1. comprehend various techniques of ANN and fuzzy logic **(BL2)**
2. infer various meta-heuristic techniques for optimization **(BL3)**
3. apply appropriate soft computing technique for applications related to power systems and renewables **(BL5)**
4. implement ANN and fuzzy logic techniques to solve power systems and renewable energy problems. **(BL5)**

Contents: **Teaching Hours: 45**

Unit I **Introduction of Artificial Intelligence** **03**

History of AI, agent and environment, advantages and disadvantages of AI, need for human intervention, data analytics and present trends.

Unit II **Artificial Neural Network and Fuzzy Logic** **17**

Introduction to artificial neural networks, basic models and activation functions, learning in neural networks, single layer and multi-layer feed-forward and feedback neural networks, backpropagation algorithm, factors affecting the performance of artificial neural network, Introduction, fuzzy Sets, operations and properties of fuzzy sets, membership functions, fuzzy relations, fuzzy logic and rule based system, fuzzification and defuzzification methods, fuzzy logic modelling and controller design.

Unit III **Genetic algorithms and Evolutionary Programming** **07**

Genetic Algorithm (GA) - Introduction, fitness function, reproduction, crossover, mutation, Particle Swarm Optimization (PSO) - Introduction, principle, velocity updating, parameter selection, binary version, Symbiotic organisms search (SOS)- Introduction, phases of SOS, recent techniques.

Unit IV **AI Applications in Power System and Renewables** **18**

Applications of AI in-economic load dispatch, fault identification and classification in power system and renewables, load frequency control, optimal power flow, MPPT, optimal PMU placement, impact of weather forecasting on renewables, load and generation forecasting for renewable integrated power system: data-driven approaches, optimal location and sizing of renewable

energy based generation.

Self-Study:
The self-study contents will be declared at the commencement of semester. Around 10% of the questions will be asked from self-study contents.

Laboratory Work:

This shall consist of at least 10 laboratory experiments / simulations based on the syllabus.

Suggested Readings:

1. B Kosko, Neural Networks and Fuzzy Systems; Prentice-Hall
2. S. Rajasekaran and G.A.V. Pai, Neural Networks, Fuzzy logic, Genetic Algorithm: Synthesis and applications, PHI Publication
3. N.P. Padhy, Artificial Intelligence and Intelligent System, Oxford University Press
4. D K Chaturvedi, Soft Computing Techniques and its Applications in Electrical Engineering, Springer
5. Suman Lata Tripathi, Mithilesh Kumar Dubey, Vinay Rishiwal, Sanjeevikumar Padmanaban, Introduction to AI Techniques for Renewable Energy System, CRC Press.
6. S. Chakraverty, D.M. Sahoo, N. R. Mahato, Concepts of Soft Computing: Fuzzy and ANN with Programming, Springer
7. M.T. Hagan, H.B. Demuth, Orlando De Jesús, Neural Network Design, Cengage India
8. D. P. Kothari, J. S. Dhillon, Power System Optimization, PHI.
9. Recent publications from referred journals and relevant standards

Suggested List of Experiments:

	Title of Experiment	Hrs.
1.	Implementation of ANN using software.	4
2.	Learn fuzzy logic implementation using software.	2
3.	To control load frequency using fuzzy logic.	2
4.	Execute fault identification and classification using ANN.	2
5.	Carry out economic load dispatch using Genetic algorithm.	2
6.	To determine optimal scheduling of economic load dispatch using particle swarm optimization.	4
7.	To determine optimal scheduling of optimal power flow using particle swarm optimization.	2
8.	load frequency control using particle swarm optimization.	2
9.	load frequency control using genetic algorithm.	2
10.	Implementation of soft-computing technique-based MPPT.	2

L = Lecture, T = Tutorial, P = Practical, C = Credit