Nirma University

Institute:	**Institute of Technology, School of Engineering**
Name of Programme:	**B. Tech.**
Semester:	**VII**
Course Code:	4EE401ME25
Course Title:	**Artificial Intelligence in Electrical Engineering**
Course Type:	**Department Elective-IV**
Year of Introduction:	**2025 – 26**

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Course Learning Outcomes (CLOs):

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

1. acquire knowledge of ANN and clustering techniques (BL2)
2. appraise fuzzy logic to design controllers for electrical engineering problems (BL4)
3. apply meta-heuristic technique for solving optimization problems (BL3)
4. select and implement AI technique for solving problems related to electrical engineering (BL5)

Unit	Contents	Teaching hours (Total 45)
Unit-1	**Introduction** Overview and historical perspective, advantages and disadvantages of AI, need for human intervention, data analytics and present trends	03
Unit-2	**Artificial Neural Network and Clustering Techniques** 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, k-means clustering, Binary Classification, Multi- Class, Classification Techniques, k-nearest neighbours, Support Vector Machines, Naive Bayes	13
Unit-3	**Fuzzy Logic** 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.	08
Unit-4	**Meta-heuristic Techniques** Introduction to meta-heuristic techniques, Genetic Algorithm (GA) - Introduction, fitness function, reproduction, crossover, mutation, Particle Swarm Optimization (PSO) - Introduction, principle, velocity updating, parameter selection, binary version, Hybridisation of optimization techniques, recent techniques	09

Unit-5	**AI Applications in Electrical Engineering** Load/generation forecasting, economic load dispatch, power system fault identification and classification, load frequency control, MPPT algorithms, motor drive applications, power quality issues and classification, etc., recent AI applications in Electrical Engineering	12

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 based on the above syllabus.

Suggested Reading:

1. S. Rajasekaran and G. A. V. Pai, *Neural Networks, Fuzzy logic, Genetic Algorithm: Synthesis and applications*, PHI Publication.
2. N.P. Padhy, *Artificial Intelligence and Intelligent System*, Oxford University Press.
3. D K Chaturvedi, *Soft Computing Techniques and its Applications in Electrical Engineering*, Springer.
4. S. Chakraverty, D.M. Sahoo, N. R. Mahato, *Concepts of Soft Computing: Fuzzy and ANN with Programming*, Springer.
5. B Kosko. *Neural Networks and Fuzzy Systems,* Prentice-Hall.
6. M. T. Hagan, H.B. Demuth, M.H Beale, Orlando De Jesús, *Neural Network Design*, Cengage Learning India.
7. Relevant recent literature, journal articles.

Suggested List of Experiments:

Sr. No.	Name of Experiments/Exercises	Hours
1.	Implementation of ANN using software.	04
2.	Learn fuzzy logic implementation using software.	02
3.	Perform load forecasting using ANN.	02
4.	To control load frequency using fuzzy logic.	02
5.	Execute fault identification and classification using ANN.	02
6.	Carry out economic load dispatch using soft computing techniques.	04
7.	Perform fuzzy logic-based control of the induction motor drive.	02
8.	Implementation of soft-computing technique-based MPPT.	02
9.	To optimize the efficiency of induction motors using soft computing techniques.	02
10.	Analyse the performance of AI for identification of power quality.	02