NIRMA UNIVERSITY

Institute:	**Institute of Technology**
Name of Programme:	**M. Tech. in Electrical Engineering (Electric Vehicular Technology)**
Semester:	**II**
Course Code:	**3EE32D21**
Course Title:	**Artificial Intelligence and Algorithms**
Course Type:	(□ Core/ □ Value Added Course / √ **Department Elective** / □ Institute Elective/ □ University Elective/ □ Open Elective / □ Any other)
Year of Introduction:	**2022 – 23**

L	**T**	**Practical component**				**C**
		LPW	**PW**	**W**	**S**	
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Course Learning Outcomes (CLOs):

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

1. make use of basic techniques of AI / optimization **(BL6)**
2. identify AI/ optimization related complex problems of electric vehicle systems **(BL5)**
3. apply knowledge of various AI / optimization techniques in electric vehicle technology **(BL4)**
4. develop AI / optimization-based solutions **(BL6)**

Syllabus **Teaching Hours: 30**

Unit-1: Search techniques, clustering algorithms, decision trees **06**

Basic search techniques, uninformed and informed searches, adversary search; clustering algorithms: hierarchical and partitional algorithms, agglomerative and k-means, Numerical; basics of decision trees. Applications of clustering algorithms in electric vehicle technology

06

Unit-2: Expert systems (ES)

Characteristics of expert systems, first order logic, rule based expert systems, knowledge acquisition and representation, problems associated to ES, Implementations of ES

05

Unit-3: Fuzzy Logic and Multi-criteria decision making

Introduction, types of uncertainties, fuzzy set theory, approaches and types of fuzzy logic systems, typical actions in Fuzzy systems, Numerical; Multi-criteria decision making (MCDM): weighted sum model, weighted product model, analytic hierarchy process. Numerical associated to MCDM techniques. Uses of Fuzzy systems

Unit-4: Artificial Neural Network Approaches (ANN) **05**

Introduction to artificial neural networks, artificial neuron model, and types of activation functions. Learning in neural networks: error correction learning, memory based learning, Hebbian learning, competitive learning, Boltzman learning, feed forward and feedback neural networks, backpropagation training algorithm, Hopfield network. Applications of ANN

Unit-5: Soft computing techniques **08**

An overview of Evolutionary Algorithms, Simulated Annealing algorithm, Genetic Algorithm, Particle Swarm Optimization, Advantages and Disadvantages of different Evolutionary Algorithms. Utilizations of soft computing techniques in electric vehicle technology.

Self-Study Component:

The self-study content(s) 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 08 simulations / laboratory experiments based on the syllabus.

Suggested Readings:

1. S. S. Rao, Engineering Optimization Theory and Practice, John Wiley & Sons
2. K. Y. Lee and M.A. El-Sharkawi (eds.), Modern Heuristic Optimization Techniques with Applications to Power Systems, IEEE Press
3. D. E. Goldberg, Genetic Algorithm in Search, Optimization and Machine Learning, Wesley Longman Publishing Co., Inc. Boston, MA, USA
4. S.N. Sivanandam, S. N. Deepa, Principles of Soft Computing, Wiley India Pvt. Ltd.
5. ChaturvediDevendra K., Soft Computing Techniques and Applications in Electrical Engineering, Springer-Verlag Berlin Heidelberg
6. Jizhong Zhu, Optimization of Power System Operation, John Wiley & Sons
7. Edwin K. P. Chong, Stanislaw H. Zak, An Introduction to Optimization, John Wiley & Sons
8. M Negnevitsky, Artificial Intelligence: A guide to Intelligent Systems by Michael Negnevitsky (Oxford University Press)
9. Timothy J. Ross, Fuzzy Logic with Engineering Applications, Wiley.

Suggested List of Experiments (not restricted to the following):
(Only for Information)(04 hours each)

1. To develop a program code for finding the solution using the search technique.
2. To determine the number of clusters using K-means algorithm.
3. To design a fuzzy logic controller
4. To develop a solution for electric vehicle selection using analytical hierarchy process
5. To evaluate the optimal solution for a given objective function using soft computing technique
6. To compare the performance of different meta-heuristic techniques
7. To design artificial neural network to predict the performance of electric vehicles
8. To develop back-propagation training algorithm.

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