Enrollment No......................................

Faculty of Engineering

End Sem Examination Dec 2024

EE3EI04 AI Applications to Electrical Engineering

Programme: B.Tech.   Branch/Specialisation: EE

Duration: 3 Hrs.   **Maximum Marks: 60**

Note: All questions are compulsory. Internal choices, if any, are indicated. Answers of Q.1 (MCQs) should be written in full instead of only a, b, c or d. Assume suitable data if necessary. Notations and symbols have their usual meaning.

			Marks	BL	PO	CO	PSO
Q.1	i.	Which of the following learning processes involves updating weights to minimize errors between actual and desired outputs? (a) Hebbian learning (b) Error correction learning (c) Competitive learning (d) Boltzmann learning	1	01	01	01, 02, 03, 04	01, 02, 03, 04
	ii.	In reinforcement learning, the system learns by- (a) Comparing output with desired output (b) Receiving rewards and penalties based on actions (c) Mimicking human reasoning (d) Randomly updating network weights	1	01	01	01, 02, 03, 04	01, 02, 03, 04
	iii.	The backpropagation algorithm is typically used in which of the following neural network paradigms? (a) Radial Basis Function Network (b) Self-Organizing Map (SOM) (c) Multi-Layer perceptron (MLP) (d) Hopfield Network	1	01	01	01, 02, 03, 04	01, 02, 03, 04
	iv.	Which neural network is known for its ability to organize and represent input data in a topological manner? (a) Radial Basis Function Network (b) Hopfield Network (c) Self-Organizing Map (SOM) (d) Functional Link Network (FLN)	1	01	01	01, 02, 03, 04	01, 02, 03, 04

P.T.O.

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OR	iii.	Draft a flow chart to explain convergence of genetic algorithm.	6	03	03	01, 02, 03, 04	01, 02, 03, 04
Q.6		Write a short note on any two:					
	i.	Significance of AI techniques for load flow studies	5	02	02	01, 02, 03, 04	01, 02, 03, 04
	ii.	AI Techniques for load forecasting	5	02	02	01, 02, 03, 04	01, 02, 03, 04
	iii.	Artificial neural networks approach for controlling speed of a DC motor	5	02	02	01, 02, 03, 04	01, 02, 03, 04

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v. In fuzzy logic, a fuzzy set is characterized by- **1** 01 01 01, 02, 03, 04   01, 02, 03, 04
(a) Discrete binary values
(b) Degrees of membership
(c) Strict boundaries
(d) A single truth value

vi. Which of the following methods is used to convert a fuzzy set into a crisp value? **1** 01 01 01, 02, 03, 04   01, 02, 03, 04
(a) Membership function   (b) Defuzzification
(c) Fuzzy inference   (d) Fuzzy quantifiers

vii. In genetic algorithms, what is the purpose of the crossover operation? **1** 01 01 01, 02, 03, 04   01, 02, 03, 04
(a) To select the best individuals from the population
(b) To combine genetic information from two parents
(c) To introduce random changes in genes
(d) To determine fitness values

viii. Mutation in genetic algorithms is used to- **1** 01 01 01, 02, 03, 04   01, 02, 03, 04
(a) Preserve the best solutions
(b) Alter gene values and introduce diversity
(c) Increase the crossover rate
(d) Minimize the fitness function

ix. Which AI technique is commonly used for load forecasting in power systems? **1** 01 01 01, 02, 03, 04   01, 02, 03, 04
(a) Neural networks   (b) Fuzzy logic
(c) Genetic algorithms   (d) All of these

x. Economic load dispatch is primarily concerned with- **1** 01 01 01, 02, 03, 04   01, 02, 03, 04
(a) Optimizing the allocation of power generation resources
(b) Regulating power consumption
(c) Controlling load frequency
(d) Minimizing the cost of power transmission

Q.2 i. Differentiate between supervised and unsupervised learning. **4** 02 02 01, 02, 03, 04   01, 02, 03, 04

ii. Illustrate single layer, multilayer and recurrent architectures of neural network using a signal flow diagram. **6** 03 03 01, 02, 03, 04   01, 02, 03, 04

OR iii. Describe the principal, learning rule and characteristics of competitive learning methods to train a neural network. **6** 03 03 01, 02, 03, 04   01, 02, 03, 04

Q.3 i. Discuss the role of the Back Propagation Algorithm (BPA) in training a multi-layer perceptron (MLP). **4** 03 03 01, 02, 03, 04   01, 02, 03, 04

ii. Demonstrate the working and applications of a Self-Organizing Map (SOM) using a suitable example. **6** 04 04 01, 02, 03, 04   01, 02, 03, 04

OR iii. Perform forward and backward pass to design a neural network with 2 input neurons, 2 hidden neurons, and 1 output neuron for binary classification. Assume the following: **6** 04 04 01, 02, 03, 04   01, 02, 03, 04
Input data: $x_1=0.5$, $x_2=0.8$, Target output: $y=1$, Initial weights: $w_{11}=0.1$, $w_{12}=0.4$, $w_{21}=0.2$, $w_{22}=0.3$, Hidden to output weights: $wh_1\_out=0.7$, $wh_2\_out=0.5$, Learning rate $\eta=0.1$, Sigmoid function $\sigma(x)=1/(1+e^{-x})$.

Q.4 i. What are the key differences between fuzzy logic and crisp logic? **4** 02 02 01, 02, 03, 04   01, 02, 03, 04

ii. Explain the concept of fuzzy Cartesian product and describe the steps involved in a fuzzy rule-based system. **6** 03 03 01, 02, 03, 04   01, 02, 03, 04

OR iii. Following two fuzzy sets A and B with membership functions are given: **6** 03 03 01, 02, 03, 04   01, 02, 03, 04
$A=\{(x_1,0.4), (x_2,0.7), (x_3,0.9), (x_4,0.5), (x_5,0.2)\}$
$B=\{(x_1,0.6), (x_2,0.3), (x_3,0.8), (x_4,0.7), (x_5,0.4)\}$
Perform Union, Intersection, Fuzzy Complement of set A, Fuzzy Complement of set B, Disjunctive sum, Algebraic product.

Q.5 i. Define the fitness function in genetic algorithms. Why is it crucial for solving optimization problems? **4** 02 02 01, 02, 03, 04   01, 02, 03, 04

ii. Discuss the types of crossover operations used in genetic algorithms and their importance in genetic modelling. **6** 03 03 01, 02, 03, 04   01, 02, 03, 04

			Marks
Q.1	i)	B. **Error correction learning**	1
	ii)	B. **Receiving rewards and penalties based on actions**	1
	iii)	C. **Multi-Layer perceptron (MLP)**	1
	iv)	C. **Self Organizing Map (SOM)**	1
	v)	B. **Degrees of membership**	1
	vi)	B. **Defuzzification**	1
	vii)	B. **To combine genetic information from two parents**	1
	viii)	B. **Alter gene values and introduce diversity**	1
	ix)	D. **All of the above**	1
	x)	A. **Optimizing the allocation of power generation resources**	1

Q.2	i.	Differentiate between supervised and unsupervised learning. **1 mark for each point**	4
	ii.	Illustrate single layer, multilayer and recurrent architectures of neural network using a signal flow diagram. **2 marks for each architecture**	6
OR	iii.	Describe the principal, learning rule and characteristics of competitive learning methods to train a neural network. **2 marks for each section**	6

Q.3	i.	Discuss the role of the Back Propagation Algorithm (BPA) in training a multi-layer perceptron (MLP). **4 Marks**	4
	ii.	Demonstrate the working and applications of a Self-Organizing Map (SOM) using a suitable example. **1 x5 step=5M, 1 Marks for 2 Applications**	6
OR	iii.	Perform forward and backward pass to design a neural network	6

with 2 input neurons, 2 hidden neurons, and 1 output neuron for binary classification. Assume the following:
Input data: x1=0.5, x2=0.8, Target output: y=1, Initial weights: w11=0.1, w12=0.4, w21=0.2, w22=0.3, Hidden to output weights: wh1_out=0.7, wh2_out=0.5, Learning rate η=0.1, Sigmoid function $\sigma(x)=1/(1+e^{-x})$.
Forward Pass=3M
Backward Pass=3M

Q.4	i.	What are the key differences between fuzzy logic and crisp logic? **1 mark for each point**	4
	ii.	Explain the concept of fuzzy Cartesian product **2M** describe the steps involved in a fuzzy rule-based system. **4M**	6
OR	iii.	Following two fuzzy sets A and B with membership functions are given: A={(x1,0.4), (x2,0.7), (x3,0.9), (x4,0.5), (x5,0.2)} B={(x1,0.6), (x2,0.3), (x3,0.8), (x4,0.7), (x5,0.4)} Perform Union, Intersection, Fuzzy Complement of set A, Fuzzy Complement of set B, Disjunctive sum, Algebraic product. **1 mark for each operation**	6

Q.5	i.	Define the fitness function in genetic algorithms. **2M** Why is it crucial for solving optimization problems? **2M**	4
	ii.	Discuss the types of crossover operations used in genetic algorithms and their importance in genetic modelling. **2 marks for each type**	6
OR	iii.	Draft a flow chart to explain convergence of genetic algorithm. **chart – 3 M** **explain – 3M**	6

Q.6		Write a short note (Attempt any two):	
	i.	Significance of AI techniques for load flow studies **5M**	5
	ii.	AI Techniques for Load Forecasting **5M**	5
	iii.	Artificial Neural Networks approach for controlling speed of a DC motor **5M**	5

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