SIDDHARTH INSTITUTE OF ENGINEERING & TECHNOLOGY:: PUTTUR
(AUTONOMOUS)
Siddharth Nagar, Narayanavanam Road– 517583

QUESTION BANK (DESCRIPTIVE)

Subject with Code: AI TECHNIQUES IN ELECTRICAL ENGINEERING (SE) (25EE2111)

Course & Branch: **M.TECH. IN POWER ELECTRONICS**

Year &Sem: I-M.Tech & I-Sem **Regulation:** R25

UNIT –I
ARTIFICIAL NEURAL NETWORKS

1	**a**	Define Artificial Neural Networks (ANN) and explain their basic structure.	**[L2][CO1]**	**[5M]**
	b	Describe any two common models of neural networks with examples.	**[L2][CO1]**	**[5M]**
2	**a**	Distinguish between single-layer and multi-layer neural network architectures.	**[L2][CO1]**	**[5M]**
	b	What is knowledge representation in neural networks? Give examples.	**[L2][CO1]**	**[5M]**
3	**a**	Explain error-correction learning with a simple numerical example.	**[L3][CO1]**	**[5M]**
	b	Write a short note on Hebbian learning and its principle.	**[L1][CO1]**	**[5M]**
4	**a**	What is competitive learning? Mention any two applications.	**[L2][CO1]**	**[5M]**
	b	Explain the concept of Boltzmann learning.	**[L2][CO1]**	**[5M]**
5	**a**	Differentiate between supervised and unsupervised learning.	**[L4][CO1]**	**[5M]**
	b	List any five learning tasks in neural networks and explain any one of them.	**[L1][CO1]**	**[5M]**
6		Explain the learning process in neural networks and discuss how weight adjustments improve network performance.	**[L2][CO1]**	**[10M]**
7		Examine how neural networks contribute to modern Artificial Intelligence systems with suitable examples.	**[L4][CO1]**	**[10M]**
8		Describe how knowledge is represented in neural networks. Explain distributed representation with examples.	**[L2][CO1]**	**[10M]**
9		Explain Boltzmann learning in detail. Discuss the role of stochastic neurons and energy minimization.	**[L2][CO1]**	**[10M]**
10		Explain the biological inspiration of artificial neural networks and compare them with traditional computational models.	**[L2][CO1]**	**[10M]**

UNIT –II
ANN PARADIGMS

1	**a**	Explain the architecture of a multi-layer perceptron (MLP)	**[L2][CO2]**	**[5M]**
	b	Describe how information flows during forward propagation.	**[L2][CO2]**	**[5M]**
2		Explain the Backpropagation algorithm and show how weights are updated with a numerical example.	**[L2][CO2]**	**[10M]**
3		Describe the major limitations of training MLP networks, with emphasis on local minima, learning-rate selection, and overfitting issues.	**[L2][CO2]**	**[10M]**

4		Compute the forward pass, total error, error signals, weight gradients, and the updated weights for a neural network with inputs x_1= 0.05, and x_2 = 0.10, target outputs t_1= 0.01 and t_2= 0.99, learning rate η=0.5, and sigmoid activation, perform one full Backpropagation cycle.	[L3][CO2]	[10M]
5	a	Illustrate the architecture and working of a self-organizing map.	[L4][CO2]	[5M]
	b	Explain competitive learning and neighborhood updating.	[L2][CO2]	[5M]
6		Explain how a self-organizing map is used for clustering and visualization of high-dimensional data. Give suitable examples.	[L2][CO2]	[10M]
7	a	Describe the structure of a radial basis function network.	[L2][CO2]	[5M]
	b	Explain the role of the radial basis layer and the output layer.	[L2][CO2]	[5M]
8	a	Explain the concept of a functional link neural network.	[L3][CO2]	[5M]
	b	Discuss how functional expansion improves network performance.	[L2][CO2]	[5M]
9	a	Describe the architecture and energy function of a Hopfield network.	[L2][CO2]	[5M]
	b	Explain how Hopfield network performs associative memory.	[L2][CO2]	[5M]
10	a	Discuss the concept of stable and unstable states in Hopfield networks.	[L2][CO2]	[5M]
	b	Explain how convergence to stable states occurs in Hopfield networks.	[L2][CO2]	[5M]

UNIT –III
FUZZYLOGIC

1	a	What is the need for fuzzy logic in real-world applications?	[L1][CO3]	[5M]
	b	Compare fuzzy logic and classical (crisp) logic in terms of uncertainty handling.	[L4][CO3]	[5M]
2	a	Define crisp sets and fuzzy sets with examples. How do they differ?	[L2][CO3]	[5M]
	b	Explain the role of membership functions in fuzzy sets.	[L2][CO3]	[5M]
3	a	Describe the fuzzy set union operation with a numerical example.	[L3][CO3]	[5M]
	b	Explain the fuzzy set intersection operation with an example.	[L3][CO3]	[5M]
4	a	Explain the fuzzy set complement operation with an example.	[L3][CO3]	[5M]
	b	What are membership functions? Describe any two commonly used types.	[L1][CO3]	[5M]
5	a	Explain the triangular and trapezoidal membership functions with applications.	[L3][CO3]	[5M]
	b	What are normality and convexity in fuzzy sets? Illustrate with examples.	[L2][CO3]	[5M]
6		Define fuzzy Cartesian product. Explain how fuzzy relations are constructed and represented using membership matrices.	[L2][CO3]	[10M]
7		Using the fuzzy set $A = [0.2, 0.6, 0.9]$ and fuzzy relation $R = \begin{bmatrix} 0.5 & 0.3 \\ 0.8 & 0.6 \\ 0.4 & 0.9 \end{bmatrix}$ determine the resulting fuzzy output using both the max–min and max–product composition rules.	[L3][CO3]	[10M]
8		Describe fuzzy logic and the role of linguistic variables in representing human reasoning. with suitable examples.	[L2][CO4]	[10M]
9		Explain the structure of a fuzzy rule-based system and describe the fuzzy inference process (Mamdani or Sugeno) with examples.	[L3][CO4]	[10M]
10		For the fuzzy set defined by the points (2,0.2), (4,0.5), (6,0.7), (8,0.5), and (10,0.3), Determine the defuzzified output using the center-of-gravity formula.	[L3][CO4]	[10M]

UNIT –IV
GENETIC ALGORITHMS

1	**a**	Explain the basic working principles of Genetic Algorithms	**[L2][CO5]**	**[5M]**
	b	Describe how Genetic Algorithms mimic natural evolution for solving optimization problems.	**[L2][CO5]**	**[5M]**
2	**a**	Explain binary encoding in Genetic Algorithms with a suitable example.	**[L3][CO5]**	**[5M]**
	b	Describe floating-point encoding with an example.	**[L2][CO5]**	**[5M]**
3	**a**	Explain permutation encoding and mention its applications.	**[L2][CO5]**	**[5M]**
	b	What is a fitness function in Genetic Algorithms? Explain the essential properties of a good fitness function.	**[L2][CO5]**	**[5M]**
4		Explain the selection and reproduction operators in Genetic Algorithms, and compare their advantages.	**[L2][CO5]**	**[10M]**
5	**a**	Explain genetic modeling in Genetic Algorithms and its role in optimization.	**[L2][CO5]**	**[5M]**
	b	Describe how genetic representations and operators influence the performance of a Genetic Algorithm.	**[L2][CO5]**	**[5M]**
6	**a**	Explain single-site and two-point crossover methods with suitable examples.	**[L3][CO5]**	**[5M]**
	b	Describe multipoint, uniform, and matrix crossover techniques and mention situations where they are preferred.	**[L3][CO5]**	**[5M]**
7		Explain the importance of crossover rate in GA performance and discuss inversion and deletion operators and their role in maintaining genetic diversity.	**[L3][CO5]**	**[10M]**
8		Describe mutation in Genetic Algorithms and explain how mutation rate affects convergence. Discuss bit-wise mutation and real-valued mutation.	**[L2][CO5]**	**[10M]**
9	**a**	Explain the generational cycle of a Genetic Algorithm with neat steps.	**[L2][CO5]**	**[5M]**
	b	Discuss the conditions required for GA convergence and the factors that influence convergence speed.	**[L4][CO5]**	**[5M]**
10		For the parent chromosomes P_1 = 11001110 and P_2 = 10101001: (a) Carry out a single-point crossover at position 4. (b) Then perform bit-wise mutation at a 0.1 rate by flipping one random bit in each child. Show the resulting offspring.	**[L3][CO5]**	**[10M]**

UNIT –V
APPLICATIONS OF AI TECHNIQUES

1	**a**	Define load forecasting and list the major types of forecasting used in power systems.	**[L1][CO6]**	**[5M]**
	b	Explain how AI-based methods (ANN, Fuzzy, GA) improve the accuracy of short-term load forecasting.	**[L2][CO6]**	**[5M]**
2	**a**	Describe the role of Artificial Intelligence in power system load flow studies.	**[L2][CO6]**	**[5M]**
	b	Apply fuzzy logic to explain how uncertainty in load demand can be handled in economic load dispatch.	**[L3][CO6]**	**[5M]**
3	**a**	Explain how an ANN model can be applied to predict optimal generator scheduling in economic load dispatch.	**[L3][CO6]**	**[5M]**

	b	Compare conventional and AI-based Load Frequency Control methods for a single-area system.	**[L4][CO6]**	**[5M]**
4	**a**	Analyze the differences in control strategy for single-area and two-area LFC using AI techniques.	**[L4][CO6]**	**[5M]**
	b	Discuss how AI helps in improving small signal stability (dynamic stability) under different disturbances.	**[L4][CO6]**	**[5M]**
5	**a**	Evaluate the performance of reactive power control using expert systems versus neural network controllers.	**[L5][CO6]**	**[5M]**
	b	Design a simple ANN-based speed control strategy for a DC or AC motor and mention its advantages.	**[L5][CO6]**	**[5M]**
6		Explain the complete process of applying AI-based techniques for short-term and long-term load forecasting. Include data preprocessing, model training, testing, and performance evaluation.	**[L3][CO6]**	**[10M]**
7		Explain how AI-driven load flow studies differ from Newton–Raphson and Gauss-Seidel methods. Discuss their advantages, limitations, and applications.	**[L3][CO6]**	**[10M]**
8		Evaluate the effectiveness of Genetic Algorithms, Particle Swarm Optimization, and Fuzzy Logic in solving the Economic Load Dispatch (ELD) problem.	**[L5][CO6]**	**[10M]**
9		Evaluate the role of AI controllers in Load Frequency Control for a two-area system, focusing on tie-line power control, damping, and dynamic response improvement.	**[L5][CO6]**	**[10M]**
10		Design a complete AI-based control scheme for speed control of DC or AC motors. Explain architecture, inputs/outputs, rule base (if any), and expected performance improvements.	**[L4][CO6]**	**[10M]**

PREPARED BY: **Dr Devalraju Prasad**
Associate Professor
Dept. of EEE
SIETK, PUTTUR