SOFT COMPUTING
(AEIE 4132)

Time Allotted : 2½ hrs **Full Marks : 60**

Figures out of the right margin indicate full marks.

Candidates are required to answer Group A and any 4 (four) from Group B to E, taking one from each group.

Candidates are required to give answer in their own words as far as practicable.

Group – A

1. Answer any twelve: **12 × 1 = 12**

Choose the correct alternative for the following

(i) The truth values of traditional set theory can be defined as _____ and that of fuzzy logic is termed as _____.
(a) Either 0 or 1, either 0 or 1. (b) Between 0 & 1, either 0 or 1.
(c) Either 0 or 1, between 0 & 1. (d) Between 0 & 1, between 0 & 1

(ii) _____ represents the fuzzy logic.
(a) IF-THEN rules (b) IF-THEN-ELSE rules
(c) Both a & b (d) None of the above

(iii) Which of the following is associated with fuzzy logic?
(a) Crisp set logic (b) Many-valued logic
(c) Two-valued logic (d) Binary set logic

(iv) In a fuzzy controller, if the error is negative and the change of error is negative, the control output should be
(a) Positive (b) Negative
(c) Zero (d) It can be any value

(v) When the controlled variable is trying to reach the set-point, then the change in controller output should be
(a) No or very low change
(b) Very high
(c) Negative
(d) The controller output does not depend on the controlled variable

(vi) An automated vehicle is an application of
(a) Unsupervised learning (b) Supervised learning
(c) Reinforcement learning (d) Active learning

(vii) Swimming of tadpole is an example of _____ learning.
(a) Unsupervised (b) Reinforce
(c) Supervised (d) Competitive

(viii) The number of hidden layers that can be present between the input and output layers in BPNN is

(a) 2 (b) Any numbers
(c) 5 (d) 1

(ix) Genetic algorithms are an example of

(a) Heuristic (b) Evolutionary algorithm
(c) Particle swarm optimization (d) Ant colony optimization

(x) Produces two new offspring from a two-parent string by copying selected bits from each parent is called

(a) Mutation (b) Inheritance
(c) Crossover (d) None of these

Fill in the blanks with the correct word

(xi) In ANN, Neurons interconnected among multiple network layers are referred to as _____

(xii) MLP in neural network stands for _____.

(xiii) The complexity of ANN is dependent upon _____

(xiv) Chromosomes are basically the strings of _____.

(xv) BPNN is a _____ learning network

Group - B

2. (a) Demonstrate the Pie-type membership function with an appropriate sketch and mathematical formulation. *[(CO1)(Understand/LOCQ)]*

(b) Represent the following membership functions both graphically and logically
(i) Set of small numbers in set A, consisting of natural numbers ≤8.
(ii) Comfortable temperature in room air-conditioner. *[(CO1)(Analyse/IOCQ)]*

(c) How is a fuzzy set different from a conventional set? *[(CO1)(Understand/LOCQ)]*

(2 + 2) + (3 + 3) + 2 = 12

3. (a) What is soft computing? Write the main goal of soft computing. *[(CO1)(Understand/LOCQ)]*

(b) List 4 merits and 2 demerits of Fuzzy logic. *[(CO1)(Remember/LOCQ)]*

(c) Estimate the membership function for children aged 5 to 12 years. Consider the average life span of human beings is 100 years. *[(CO2)(Apply/IOCQ)]*

(d) How are pie MFs different from triangular MFs? Explain logically. *[(CO1)(Understand/LOCQ)]*

(1 + 1) + 3 + 3 + 4 = 12

Group - C

4. (a) When should you use fuzzy controllers in place of conventional controllers? *[(CO3)(Understand/LOCQ)]*

(b) What are normalization and denormalization in fuzzy controller design? *[(CO3)(Remember/LOCQ)]*

(c) Evaluate the mathematical expression of the fuzzy PD controller. Apply the equation of the fuzzy PD controller to derive the expression of the fuzzy PI controller. *[(CO3)(Evaluate/HOCQ)]*

(d) Explain the Centre of Area defuzzification procedure. *[(CO3)(Understand/LOCQ)]*

2 + 3 + (2 + 3) + 2 = 12

5. Develop a fuzzy PD controller through the following steps:
   (i) Evaluate two inputs: error and change of error from a temperature process.
   (ii) Apply normalization.
   (iii) Design a fuzzification module for two-input systems.
   (iv) Develop a rule matrix for the 2nd order underdamped temperature system.
   (v) Choose any suitable defuzzification method to calculate the output.

[(CO3)(Evaluate/HOCQ)]

(2 + 1 + 3 + 3 + 3) = 12

Group - D

6. (a) Apply the McCulloch–Pitts neuron model to realize the NAND and OR functions. *[(CO4)(Apply/IOCQ)]*

   (b) Explain the Hebbian and modified Hebbian learning rules with equations. *[(CO5)(Understand/LOCQ)]*

   (c) Show the operation of the Hopfield neural network with a diagram. *[(CO5)(Understand/LOCQ)]*

(2 + 2) + 4 + 4 = 12

7. (a) Outline the differences between BPNN and RBFN by drawing their architecture. *[(CO5)(Understand/LOCQ)]*

   (b) Demonstrate the steps of the back propagation neural network (BPNN) to notice the weight change in the network in the presence of error. *[(CO5)(Analyse/IOCQ)]*

   (c) Inspect the importance of the learning rate in backpropagation neural networks. *[(CO5)(Understand/LOCQ)]*

(2 + 2) + 6 + 2 = 12

Group - E

8. (a) Explain the local optimum problem in a genetic algorithm. *[(CO6)(Understand/LOCQ)]*

   (b) Explain the following steps in the genetic algorithm with example:
   (i) Initialization
   (ii) Fitness function
   (iii) Selection
   (iv) Crossover
   (v) Mutation. *[(CO6)(Understand/LOCQ)]*

2 + (2 × 5) = 12

9. (a) Using an example, explain the importance of mutation operator in genetic algorithm. *[(CO6)(Understand/LOCQ)]*

   (b) A person is going to spend a month in the wilderness. He only carries the backpack, which can hold a maximum weight of 30 kg. Now there are different

survival items, each having its own "Survival Points" as shown in the table below. The objective of the problem is to maximize the survival points. Solve this problem using a Genetic algorithm.

Item	Weight	Survival Points
Sleeping Bag	15	15
Rope	3	7
Pocket Knife	2	10
Torch	5	5
Bottle	9	8
Glucose	20	17

[(CO6)(Evaluate/HOCQ)]

3 + 9 = 12

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	53.13	19.79	27.08