

NOTE:

1. Answer question 1 and any FOUR from questions 2 to 7.
2. Parts of the same question should be answered together and in the same sequence.

Time: 3 Hours

Total Marks: 100

1.

- a) What is aim of Soft Computing? Write down premises of Soft Computing? Write down application area for Soft Computing. Justify the statement:
'*Soft Computing is the fusion of methodologies designed to model and enable solutions to real world problems, which are not modeled or too difficult to model mathematically.*'
- b) Define following terms: i) Fuzzy Logic; ii) Crisp Logic, and iii) Rough Logic. Explain similarity between Fuzzy Logic and Neural Network.
- c) Explain important of hybridization/Mixing for various Soft Computing techniques. Write down at least three application areas of Genetic-Fuzzy system.
- d) How can Genetic Algorithm solve the weight determination problem of Neural Network?
- e) How Hill Climbing gradually improves the solution? What is the idea behind Simulated Annealing?
- f) Write down the evolution techniques used in a Neuro Fuzzy System for the evolution of antecedents and consequents.
- g) Define Hard computing and Soft computing. Differentiate them.

(7x4)

2.

- a) Define Genetic Algorithm (GA). Write down at least three drawback of GA. When GA should be used? What are the limitations of GA? State various application areas of GA. Broadly classify search techniques in GA.
- b) Write down principal constituents of Soft Computing. Explain in detail.
- c) What do you mean by Reinforcement Learning Control? Explain Neuro-Fuzzy Reinforcement controller.
- d) With respect to Genetic Algorithm, what is represented by genes? How population is formed? How generation is created? How the member of population is evaluated? Which chromosomes are allowed to reproduce to create the next generation of solutions through *crossover* and *mutation*? When will be the process of Genetic Algorithm will be stopped?

(5+4+4+5)

3.

- a) Suppose a Genetic Algorithm uses chromosomes of the form $x = a b c d e f g h$ with a fixed length of eight genes. Each gene can be any digit between 0 and 9. Let the fitness of individual x be calculated as:

$$f(x) = (a + b) - (c + d) + (e + f) - (g + h),$$

and let the initial population consist of four individuals with the following chromosomes:

$$x_1 = 6 5 4 1 3 5 3 2$$

$$x_2 = 8 7 1 2 6 6 0 1$$

$$x_3 = 2 3 9 2 1 2 8 5$$

$$x_4 = 4 1 8 5 2 0 9 4$$

- i) Evaluate the fitness of each individual, showing all your workings, and arrange them in order with the fittest first and the least fit last.
- ii) Perform the following crossover operations:
 1. Cross the fittest two individuals using one-point crossover at the middle point.
 2. Cross the second and third fittest individuals using a two-point.

- b) State different chromosome selection techniques in Genetic Algorithm? Explain Roulette Wheel Selection with example. Explain in detail architecture of Genetic Algorithm. What is mutation? How mutation can be performed?
(9+9)
- 4.**
- a) Define System Identification. Also explain purpose of System Identification. Explain Least Square Methods for System Identification. Solve linear equations of each data pair by using matrix multiplication.
- b) Explain Derivative-based Optimization in detail. Explain Steepest descent method in detail.
(9+9)
- 5.**
- a) Explain following Neuro-Fuzzy Modeling approaches:
i) Concurrent Neuro-fuzzy approach
ii) Cooperative Neuro-fuzzy approach.
- b) Explain with neat sketch Hybrid Neuro-fuzzy architecture. State different Hybrid Neuro-fuzzy architectures.
(9+9)
- 6.**
- a) Draw and explain Architecture of Adaptive Neuro-Fuzzy Inference System (ANFIS). Draw ANFIS architecture that is equivalent to a two-input first-order Sugeno Model, where weight normalization is performed at the very last layer.
- b) Draw and Explain block diagram for the Inverse Learning method using
i) Plant block; ii) training phase; iii) application phase.
(9+9)
- 7.**
- a) Explain Neuro-Genetic systems. Write down challenges with Neuro-evolution method.
- b) Explain Neuro-fuzzy spectrum in terms of the tradeoffs between input-output mapping precision and membership function (MF). What do you mean by dilemma between interpretability and precision? Explain impact of linguistic interpretability on Neuro-fuzzy model. Write down different approaches to alleviating the dilemma.
- c) Explain with flowchart how can Genetic Algorithms be controlled by Fuzzy logic.
(6+6+6)