No. of Printed Pages : 4

Sl. No.

C9-R4 : SOFT COMPUTING

DURATION : 03 Hours **MAXIMUM MARKS : 100**

Roll No. : | | | | | | |

Answer Sheet No. : | | | | | | |

Name of Candidate : _____ ; **Signature of Candidate :** _____

INSTRUCTIONS FOR CANDIDATES :

- Carefully read the instructions given on Question Paper, Answer Sheet.
- Question Paper is in English language. Candidate has to answer in English Language only.
- **Question paper contains Seven questions. The Question No. 1 is compulsory. Attempt any FOUR Questions from Question No. 2 to 7.**
- **Parts of the same question should be answered together and in the same sequence.**
- **Questions are** to be answered in the **ANSWER SHEET** only, supplied with the Question Paper.
- **Candidate cannot leave the examination hall/ room without signing on the attendance sheet and handing over his/her Answer Sheet to the Invigilator. Failing in doing so, will amount to disqualification of Candidate in this Module/Paper.**
- After receiving the instruction to open the booklet and before answering the questions, the candidate should ensure that the Question Booklet is complete in all respects.

DO NOT OPEN THE QUESTION BOOKLET UNTIL YOU ARE TOLD TO DO SO.

1. (a) Highlight the advantages and disadvantages of Soft Computing.

(b) What is derivative-free optimization ? Briefly discuss.

(c) What is Concurrent Neuro-Fuzzy System ? Briefly discuss.

(d) Compare and contrast the two methods of Fuzzy Inference System :

(i) Mamdani System

(ii) Sugeno Model

(e) Briefly discuss the different functional blocks of Fuzzy Inference System.

(f) Briefly discuss Inverse Learning. Also highlight its limitations.

(g) How does Rule-based system differ from Learning-based system ? **(7x4)**

2. (a) Mention some of the reasons why Soft Computing is needed. Discuss with an example.

(b) Discuss some of the areas in which Genetic Algorithms are frequently used.

(c) Why do we use Fuzzy Logic in Neural Network ? Briefly discuss. What are the difficulties in using Fuzzy Logic in Neural Networks ? **(6+6+6)**

3. (a) Present the state space diagram for Hill Climbing and show following regions in the state space diagram: local maxima, global maxima, plateau, ridge, current state, and shoulder. Explain in brief the problems in different regions in Hill Climbing.

(b) Present some of the most commonly used representations of genetic algorithms. **(9+9)**

4. (a) Briefly discuss mutation operator in Genetic Algorithm. Also discuss following types of mutation algorithm: Bit Flip Mutation, Random Resetting Mutation, Swap Mutation, Scramble Mutation, and Inversion Mutation.

(b) What is Least Squares Method ? Briefly discuss. How does Linear Least Squares differ from Nonlinear Least Squares ? **(9+9)**

5. (a) Find the line of best fit for the following data points using the least squares method :

$(x, y) = (1, 3), (2, 4), (4, 8), (6, 10), (8, 15)$.

(b) Discuss the need of Hybrid System and briefly explain the Neuro-Fuzzy system, its working, advantages, disadvantages, and applications. **(9+9)**

6. (a) Assume that the Fuzzy Inference System under consideration has two inputs x and y and one output z. For a first-order Sugeno fuzzy model, a common rule set with two fuzzy if-then rules is the following :

Rule 1 : If x is A_1 and y is B_1, then $f_1 = p_1x + q_1y + r_1$,

Rule 2 : If x is A_2 and y is B_2, then $f_2 = p_2x + q_2y + r_2$

Draw the Sugeno fuzzy model and the corresponding equivalent ANFIS architecture which illustrates the mentioned reasoning mechanism. Also discuss about the nodes and node function in different layers of the corresponding equivalent ANFIS architecture.

(b) A simple example of a nonlinear feedback control system is the inverted pendulum system. Briefly discuss the inverted pendulum system. **(9+9)**

7. (a) To construct a fuzzy controller, we need to perform knowledge acquisition, which takes a human operator's knowledge about how to control a system. Usually, we can obtain two types of information from a human operator: linguistic information and numerical information. Briefly discuss both linguistic information and numerical information.

(b) Briefly explain the Neuro-Genetic hybrid systems, its working, advantages, disadvantages, and applications. **(9+9)**

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SPACE FOR ROUGH WORK