

M. Tech. IEE 1st Year, 1st Semester Examination, 2025

Soft-Computing

Time : 3 Hours

Full Marks : 100

Answer any Five questions

1. a) What is meant by soft-computing ? How it is different from hard-computing ? [3+2]
 b) What are the differences between a Fuzzy set and a Crisp set ? Crisp set is a special case of fuzzy set – Justify. [3+3]
 c) Distinguish between fuzzy and probability. [3]
 d) Define the various forms of parametric membership functions usually used in fuzzy decision making systems. [6]
2. a) With examples, explain the union and intersection operations of two binary fuzzy relations. [5]
 b) What is meant by compositional rule of inference ? [3]
 c) Consider two sets of variables x and y be $X = \{x_1, x_2, x_3, x_4\}$ and $Y = \{y_1, y_2, y_3\}$. Assume the proposition **If x is A Then y is B** , where $A = \{(x_1, 0.5), (x_2, 1.0), (x_3, 0.6), (x_4, 0.4)\}$ and $B = \{(y_1, 0.6), (y_2, 0.4), (y_3, 0.2)\}$. Then, given a fact expressed by the proposition **x is A'** , where $A' = \{(x_1, 0.6), (x_2, 0.9), (x_3, 0.7), (x_4, 0.3)\}$. Using the Generalized Modus Ponens (GMP) rule derive a conclusion in the form **y is B'** (apply Zadeh's Max-Min rule for the fuzzy implication function and Max-Min composition rule). [12]
3. a) What are the benefits of Artificial Neural Networks (ANN) ? [2]
 b) Describe the Back-propagation algorithm to derive the update equation for the synaptic weights of a Multi-layer Feed-forward networks. [12]
 c) What is the purpose of Cross-Validation? Explain different variants of Cross-Validation for ANN learning. [2+4]
4. a) What is meant by self-organizing map (SOM) ? [2]
 b) Describe in details the computational steps involved in the formation of the self-organizing map for the Kohonen model. [14]
 c) Give an idea how SOM can be used in designing a fuzzy rule based model for an unknown plant from its input-output data. [4]
5. a) Define Genetic algorithm (GA). [2]
 b) How GA differs from the conventional Gradient based and Random search based optimization techniques ? [4]
 c) Providing a flowchart of a simple GA (SGA), briefly discuss about the genetic operations involved in it. [8]
 d) Clearly explain the Roulette Wheel selection and Rank based selection methods to create offspring for the next generation in a SGA. [6]
6. Write short notes on any TWO : [10+10]
 - a) Design of a fuzzy logic controller.
 - b) Neuro-Fuzzy control and decision making systems.
 - c) GA based optimal fuzzy controller design.
 - d) Interval Type-2 Fuzzy systems.