

BIEE 3rd Year, 2nd Semester Examination, 2025

Intelligent Control Systems

Time : 3 Hours

Full Marks : 100

[CO1] :

1. a) What are meant by Intelligent Control systems ? [6]
 b) Why is Intelligent Control needed ? [4]
 c) What are the various objectives of an ideal Expert control system ? [6]
 d) What are the basic steps for implementation of Learning control systems ? [4]

[CO2] : Answer any TWO Questions of [CO2].

2. a) What are the differences between a Fuzzy set and a Crisp set ? Crisp set is a special case of fuzzy set – Justify. [4+3]
 b) What is meant by a convex fuzzy set ? [3]
 c) Distinguish between fuzzy and probability. [3]
 d) Define the various forms of parametric membership functions usually used in fuzzy decision making systems. [7]
3. a) Using your own definition of the universe of discourse, draw the symmetric fuzzy Triangular Membership functions (MFs) having 50% overlap with their adjacent MFs for the following linguistic values of the liquid level in a tank: (a) Low, (b) Medium, (c) Empty, (d) Full. [4]
 b) With examples, mention the differences between crisp and fuzzy relations. [4]
 c) What is meant by compositional rule of inference ? [4]
 d) 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). [8]
4. a) What are the advantages of fuzzy logic controllers (FLCs) over traditional model based controllers. [2]
 b) Providing the block diagram of a simple fuzzy logic controller (FLC) explain the role of its various computational blocks. [8]
 c) Discuss about the tuning of various FLC parameters. [4]
 d) Mention the flexibilities and limitations of FLC design. [4]

[CO3] : Answer any ONE Question of [CO3].

5. a) What are the benefits of Artificial Neural Networks (ANN) ? [2]
 b) Using Back-propagation algorithm derive the update equation for the synaptic weights of a Multi-layer Feed-forward neural networks. [12]
 c) Describe the computational steps of a five-layer hybrid neuro-fuzzy control system. [8]

[Turn over

6. 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. [12]
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. [6]

[CO4]:

7. 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) Discuss how GA based optimal fuzzy controller is designed. [6]