B.E. Instrumentation Engineering (Model Curriculum) Semester - VII

IN703M - Artificial Intelligence in Instrumentation

P. Pages : 2 **GUG/S/23/14258**

Time : Three Hours * 2 9 7 4 * Max. Marks : 80

Notes : 1. All questions carry marks as indicated.
2. Due credit will be given to neatness and adequate dimensions.
3. Assume suitable data wherever necessary.

1. a) List out the different industrial applications of fuzzy logic based system. Discuss any one application in detail. **8**

b) Fuzzy sets $A=\{0.6/1+0.5/2+0.1/3+0.2/4\}$ and $B=\{0.5/1+0.7/2+0.9/3+0.7/4\}$ **8**
Calculate the following Set Theoretic Operations on Fuzzy Sets.
a) $\bar{A}\cup B$
b) $\bar{B}\cap A$
c) $\bar{A}\,|\,B$
d) $\bar{B}\,|\,A$

OR

2. a) Define the following nomenclatures used in fuzzy set theory: **8**
1) Support
2) Core
3) Cross-over points
4) Height
5) Normality
6) Fuzzy singleton
7) Cardinality
8) Fuzzy Number

b) How fuzzy sets are represented mathematically? Illustrate with an example. Distinguish between crisp logic and fuzzy logic. **8**

3. a) Two fuzzy relations $R_1(x,y)$ and $R_2(y,z)$ are defined on the space X * Y and Y * Z respectively defined as below: **8**

$$R_1(x,y)=\begin{array}{c} \\ x_1 \\ x_2 \\ x_3 \end{array}\begin{array}{c} \begin{array}{cccc} y_1 & y_2 & y_3 & y_4 \end{array} \\ \begin{bmatrix} 0.7 & 0.6 & 0.3 & 0.4 \\ 0.9 & 0.4 & 0.2 & 0.7 \\ 0.1 & 0.9 & 0.5 & 0.6 \end{bmatrix} \end{array} \qquad R_2(y,z)=\begin{array}{c} \\ y_1 \\ y_2 \\ y_3 \\ y_4 \end{array}\begin{array}{c} \begin{array}{cc} z_1 & z_2 \end{array} \\ \begin{bmatrix} 0.6 & 0.7 \\ 0.9 & 0.3 \\ 0.4 & 0.8 \\ 0.2 & 0.5 \end{bmatrix} \end{array}$$

Find the following:
i) Max-min composition of R_1 and R_2
ii) Max-product composition of R_1 and R_2

b) Define fuzzy number. Fuzzy sets A and B with universe of discourse $X \in [-20, 20]$ as given below. **8**

$A = 0.3/1 + 0.6/2 + 1.0/3 + 0.7/4 + 0.2/5$

$B = 0.5/10 + 1.0/11 + 0.5/12$

Find Addition, Subtraction and Multiplication of fuzzy numbers A & B.

OR

4. a) Find Sugeno's class of complement of fuzzy set A given below for the value of $\lambda = \{-0.8, 0, 1, 2\}$. **8**

$A = 0.7/1 + 0.5/2 + 0.1/3 + 0.6/4$

b) Define and state the properties of **8**
1) T-norm
2) S-norm

5. a) Define activation function and its role in ANN. Discuss different types of activation functions. **8**

b) Draw and discuss the architecture of feed-back neural network. **8**

OR

6. a) Illustrate general learning rule for updating the weight parameter in ANN. **8**

b) Difference between: **8**
1) Hebbian Vs Perceptron learning rule
2) Supervised Vs Unsupervised learning

7. a) State the perceptron convergence theorem and discuss the limitations of single layer perceptron as a pattern classifier with an example. **8**

b) Elaborate the step-wise procedure for single discrete perceptron training algorithm to classify the given unknown patterns. **8**

OR

8. a) Design and demonstrate a perceptron for performing "AND" function. Also state the limitations single layer perceptron. **8**

b) Derive a general expression for the weight adjustment for hidden as well as input layer using generalized delta learning rule using error back propagation training algorithm for feed forward neural network with two continuous perceptron layers. **8**

9. a) Illustrate with an example the concepts of deep learning with neural networks. **8**

b) Discuss with an example the principle of unsupervised learning with respect to machine learning. **8**

OR

10. a) Discuss the types of machine learning with suitable example. **8**

b) Discuss the learning of multilayer perceptron using deep neural network. **8**

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