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2002 SCHEME

EE752

Seventh Semester B.E. Degree Examination, Dec.08/Jan.09
Fuzzy Logic Control

Time: 3 hrs. Max. Marks:100

Note : ***Answer any FIVE full questions.***

1 a. Compare classical sets and fuzzy sets. **(06 Marks)**

b. Given two fuzzy sets $A = \left\{\frac{1}{2} + \frac{0.5}{3} + \frac{0.3}{4} + \frac{0.2}{5}\right\}$ and $B = \left\{\frac{0.5}{2} + \frac{0.7}{3} + \frac{0.2}{4} + \frac{0.4}{5}\right\}$.

Find $\bar{A}$, $\bar{B}$, $A \cup B$, $A \cap B$ and $\bar{A} \cup \bar{B}$. **(08 Marks)**

c. Describe the extension principle as applied to fuzzy sets. **(06 Marks)**

2 a. Three fuzzy sets are given as

$$A = \left\{\frac{0.3}{30} + \frac{0.7}{60} + \frac{1.0}{100} + \frac{0.2}{120}\right\}$$

$$B = \left\{\frac{0.2}{20} + \frac{0.4}{40} + \frac{0.6}{60} + \frac{0.8}{80} + \frac{1.0}{100} + \frac{0.1}{120}\right\}$$

$$C = \left\{\frac{0.33}{500} + \frac{0.67}{1000} + \frac{1.0}{1500} + \frac{0.15}{1800}\right\}$$

Find R = A x B and S = B x C. Also evaluate T = ROS using max-min composition. **(08 Marks)**

b. Show that a fuzzy set A is convex if and only if $\mu_A[\lambda x_1 + (1-\lambda)\, x_2] \geq \min[\mu_A(x_1), \mu_A(x_2)]$ for all $x_1, x_2 \in \cup$ and $\lambda \in [1,0]$. **(06 Marks)**

c. What are linguistic variables and linguistic hedges? Give examples. **(06 Marks)**

3 a. Define the terms support, α-cut, convexity and height of fuzzy set. **(08 Marks)**

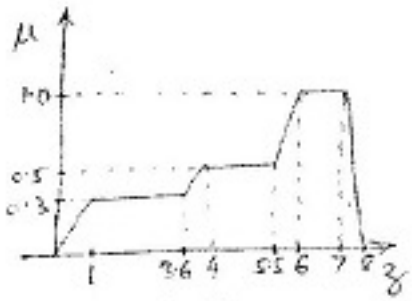
b. What are fuzzy if..... then..... and fuzzy if.....then..... else..... statements? Give example. **(06 Marks)**

c. Given two fuzzy sets

$P = \left\{\frac{0.2}{3} + \frac{0.5}{4} + \frac{0.8}{5}\right\}$ and $Q = \left\{\frac{0.8}{5} + \frac{0.2}{8}\right\}$ Find CON (P), DIL (Q) with diagram. **(06 Marks)**

4 a. With the help of block diagram explain FKBC. **(08 Marks)**

b. The following figure gives the union of three clipped fuzzy sets. Find defuzzified z using COG. **(12 Marks)**



5 a. It is required to design FKBC based controller for washing machine. In order to develop such a controller show the following steps.
   i) Identify the required no. of parameters and indicate the methodology.
   ii) Fuzzification and choice of membership function and the use of linguistic terms.
   iii) Defuzzification method.
   iv) Rule based system. **(20 Marks)**

6 a. Explain i) PI like and ii) PID like fuzzy controllers for nonlinear control systems. **(10 Marks)**

   b. Explain sliding mode FKBC for nonlinear fuzzy control. **(10 Marks)**

7 a. Explain the method of tuning the membership function by performance criteria. **(10 Marks)**

   b. Explain the method of tuning the membership functions using gradient descent method. **(10 Marks)**

8 Write note on (any two)
   i) COG method of defuzzification.
   ii) Self organizing controller.
   iii) Sugeno type FKBC. **(20 Marks)**