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P.E.S. College of Engineering, Mandya - 571 401

(An Autonomous Institution affiliated to VTU, Belagavi)

Fifth Semester, B.E. - Electrical and Electronics Engineering

Semester End Examination; Dec - 2017 / Jan - 2018

Fuzzy Logic

Time: 3 hrs *Max. Marks: 100*

***Note**: Answer **FIVE** full questions, selecting **ONE** full question from each unit.*

UNIT - I

1 a. Define the operations performed on fuzzy sets. Give suitable example for each type of operation. 6

b. For the given two fuzzy sets : 8

$$A=\left\{\frac{1}{2}+\frac{0.5}{3}+\frac{0.3}{4}+\frac{0.2}{5}\right\} \qquad B=\left\{\frac{0.5}{2}+\frac{0.7}{3}+\frac{0.2}{4}+\frac{0.4}{5}\right\}$$

Find; i) $A\cup B$ ii) $A\cap B$ iii) $A\cap \overline{B}$ iv) $B\cap \overline{A}$.

c. Discuss the various properties of classical sets. 6

2 a. Given two fuzzy sets: 6

$$A=\left\{\frac{0.2}{1}+\frac{0.3}{2}+\frac{0.4}{3}\right\} \qquad B=\left\{\frac{0.1}{1}+\frac{0.2}{2}+\frac{0.2}{3}\right\}$$

Find the algebraic sum, algebraic product of the given fuzzy sets.

b. Define the different operations on classical sets. Give suitable example for each type of operations. 6

c. For the given fuzzy sets, verify DeMorgan theorem: 8

$$A=\left\{\frac{0.1}{0}+\frac{0.4}{1}+\frac{1}{2}+\frac{0.3}{3}+\frac{0.2}{4}\right\} \quad \text{and} \quad B=\left\{\frac{0.2}{0}+\frac{0.5}{1}+\frac{1}{2}+\frac{0.4}{3}+\frac{0.1}{5}\right\}.$$

UNIT - II

3 a. With suitable illustration, explain briefly the operations, projection and cylindrical extension. 6

b. For speed control of DC motor, the membership function of series resistance R_{se}, armature current I_a and speed N are given as follows: 8

$$R_{se}=\left\{\frac{0.3}{30}+\frac{0.7}{2}+\frac{1}{100}+\frac{0.2}{120}\right\} \qquad I_a=\left\{\frac{0.2}{20}+\frac{0.4}{40}+\frac{0.6}{60}+\frac{0.8}{80}+\frac{1}{100}+\frac{0.2}{120}\right\}$$

and $N=\left\{\frac{0.33}{500}+\frac{0.67}{1000}+\frac{1}{1500}+\frac{0.15}{1800}\right\}$

Find;

i) Fuzzy Cartesian Product, R = R_{se} x I_a ii) Fuzzy Cartesian Product, S = I_a x N

iii) Evaluate T= R·S, using max-min composition.

c. Explain briefly the composition of fuzzy relation. 6

Contd…2

4 a. Briefly explain extension principle as applied to fuzzy sets. 6

b. Explain with suitable examples fuzzy tolerance and equivalence relations. 6

c. Given mapped ordered pairs from input universe $X_1 = \{a, b\}$, $X_2 = \{x, y, z\}$ to an output universe, $Y = \{1, 2, 3\}$ The mapping is given by crisp relation,

$$R = \begin{array}{c} \\ x \\ y \\ z \end{array} \begin{array}{c} \begin{array}{cc} a & b \end{array} \\ \begin{bmatrix} 1 & 2 \\ 3 & 1 \\ 2 & 3 \end{bmatrix} \end{array}$$

8

Two fuzzy sets A on Universe X_2 and fuzzy set B on universe X_1 are defined as

$$A = \left\{ \frac{0.2}{x} + \frac{0.8}{y} + \frac{0.4}{z} \right\};\ B = \left\{ \frac{0.6}{a} + \frac{1}{b} \right\}$$

Determine the membership function of the output $C = f(A, B)$ whose relational mapping f is described by R.

UNIT - III

5 a. Explain briefly core, support, boundary, α-cut, normal and subnormal with reference to membership function. 8

b. Describe the different membership functions used in fuzzy system analysis. Explain the parameters that characterise the membership function. 6

c. Given two fuzzy sets, find Z* using COG method and COS method (Refer Fig. 5C) 6

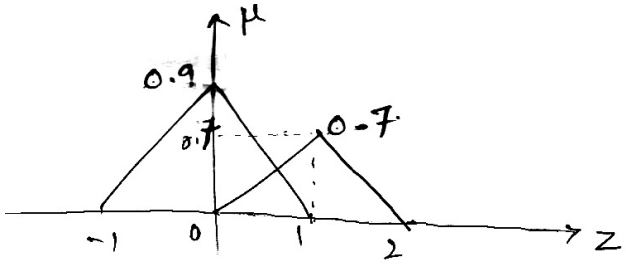

fig. 5 (c).

6 a. Define defuzzification. Explain the following methods : 6

i) Centre of gravity (COG) defuzzification method ii) Centre of Sum (COS).

b. Determine the defuzzification output by centre of sums and height method for the given fuzzy sets shown in Fig. 6(b). 8

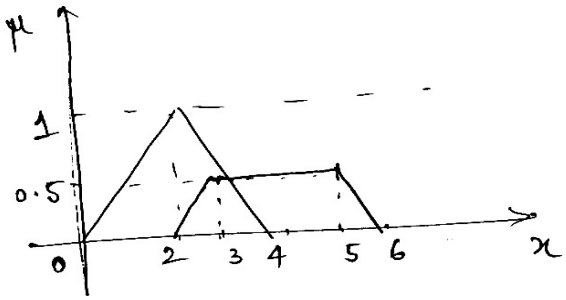

fig. 6(b).

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c. Explain the different ways of assigning membership values. 6

UNIT - IV

7 a. What are linguistic values and linguistic hedges? Explain with examples. 6

b. Explain how fuzzy conditional if-then rules are interpreted? Illustrate with suitable examples. 6

c. Differentiate between generalized modus Ponen rule of inference and compositional rule of inference with examples. 8

8 a. What is approximate reasoning? With examples, discuss the fuzzy logic propositions. 6

b. Two fuzzy membership functions are defined as:

$$A = \left\{ \frac{0.1}{x_1} + \frac{0.9}{x_2} + \frac{0}{x_3} \right\} \text{ and } B = \left\{ \frac{0}{y_1} + \frac{1}{y_2} + \frac{0}{y_3} \right\}$$

i) Find the fuzzy relation R for the rule if 'x' is A then 'y' is B using classical implication. 8

ii) A new fuzzy set 'A' is defined as

$$A' = \left\{ \frac{0.3}{x_1} + \frac{1}{x_2} + \frac{0}{x_3} \right\} \text{ Find } B' = A' \circ R \text{ using max-min composition.}$$

c. With a block diagram, explain the features of Fuzzy Inference System (FIS). 6

UNIT - V

9 a. With a block diagram, explain the structure of fuzzy logic controller. 8

b. What are the steps involved in designing a fuzzy logic controller? 6

c. What are the special forms of FLC system models? Explain. 6

10 a. With a suitable case study, explain the fuzzy logic controller. 10

b. List the various applications of fuzzy login controller. 5

c. Give the design elements that are adopted for the design of general FLC system. 5

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