Roll No											

PRESIDENCY UNIVERSITY
BENGALURU

SCHOOL OF ENGINEERING
MID TERM EXAMINATION - OCT 2023

Semester : Semester V - 2021
Course Code : ECE3030
Course Name : Sem V - ECE3030 - Fuzzy Logic and Its Engineering Applications
Program : B. TECH

Date : 2-NOV-2023
Time : 2:00PM - 3:30PM
Max Marks : 50
Weightage : 25%

Instructions:
(i) Read all questions carefully and answer accordingly.
(ii) Question paper consists of 3 parts.
(iii) Scientific and non-programmable calculator are permitted.
(iv) Do not write any information on the question paper other than Roll Number.

PART A

ANSWER ALL THE QUESTIONS **(5 X 2 = 10M)**

1. When considering the use of Fuzzy logic for a given problem, an engineer or scientist should consider the imprecision and uncertainty to solve the problem. Name the two different types of uncertainty in the situations (a) “The coin toss will result in Heads” and (b) “It is a cloudy day”, and compare the two.
(CO1) [Knowledge]

2. A fuzzyset is generated based on a particular membership function. Develop a reasonable membership function for the following fuzzy sets based on setting times, in minutes, of epoxies: (a) slow (b) fast (c) Extra fast
(CO1) [Knowledge]

3. Fuzzy sets obey number of properties and one of them is DeMorgan's Theorem. Prove any one of DeMorgan’s Theorems.
(CO1) [Knowledge]

4. λ- cut sets are in some sense related to membership functions. Mention Core and Support of a fuzzy set in terms of λ- cut sets
(CO2) [Knowledge]

5. Fuzzy implication is an operation which computes the fulfillment degree of a fuzzy rule using an antecedent and the consequent. Write the Zadeh’s implication relation for the statement IF x is A1 or A2, THEN y is B1 and B2
(CO2) [Knowledge]

PART B

ANSWER ALL THE QUESTIONS **(2 X 10 = 20M)**

6. You are asked to select an implementation technology for a numerical processor. Assume that all implementations will be in the same family (e.g., CMOS). Define the universe of potential clock frequencies as X = {1, 10, 20, 40, 80, 100} MHz, and define MSI, FPGA and MCM as fuzzy sets of clock frequencies that should be implemented in each of these technologies, where the following fuzzy sets define their membership values

$$MSI = M = \left\{\frac{1}{1} + \frac{.7}{10} + \frac{.4}{20} + \frac{0}{40} + \frac{0}{80} + \frac{0}{100}\right\}$$

$$FPGA = F = \left\{\frac{.3}{1} + \frac{1}{10} + \frac{1}{20} + \frac{.5}{40} + \frac{.2}{80} + \frac{0}{100}\right\}$$

$$MCM = C = \left\{\frac{0}{1} + \frac{0}{10} + \frac{.5}{20} + \frac{.7}{40} + \frac{1}{80} + \frac{1}{100}\right\}$$

Compute the appropriate fuzzy sets for each of the following:

(a) Fuzzyset of technologies for which one expects that either MSI or FPGA will be safe

(b) Fuzzyset of technologies for which one expects that both MSI and FPGA are safe

(c) Fuzzy set of technologies for which MCM is safe and (but) FPGA is not safe

(d) Fuzzy set of technologies for which both MSI and MCM are not safe

(CO1) [Comprehension]

7. Music is not a precise science.Tactile movements by musicians on various instruments come from years of practice, and such movements are very subjective and imprecise. When a guitar player changes from A chord to C chord, the fingers have to move some distance measured in terms of frets (e.g. 1fret = 0.1). The finger positions on the guitar strings for the two chords are given in terms of the following membership functions:

$$C\ chord = \left\{\frac{0}{6} + \frac{0.3}{5} + \frac{0.2}{4} + \frac{0}{3} + \frac{0.1}{2} + \frac{0}{1}\right\}$$

$$A\ chord = \left\{\frac{0}{6} + \frac{0}{5} + \frac{0.2}{4} + \frac{0.2}{3} + \frac{0.2}{2} + \frac{0}{1}\right\}$$

Suppose the placement of fingers on the six strings for a G chord is given as

$$G\ chord = \left\{\frac{0.3}{6} + \frac{0.2}{5} + \frac{0}{4} + \frac{0}{3} + \frac{0}{2} + \frac{0.3}{1}\right\}$$

a) Find the relation that expresses moving from an A chord to a G chord; call this R

b) Use max-product composition to determine C o R

(CO2) [Comprehension]

PART C

ANSWER THE FOLLOWING QUESTION **(1 X 20 = 20M)**

8. Fuzzy implication is an operation computing the fulfillment degree of a rule expressed by IF *antecedent* THEN *consequent*, where the antecedent and the consequent are fuzzy. Suppose we are evaluating a new invention to determine its commercial potential. Two metrics ‘uniqueness’ and ‘market size’ are used to make the decisions regarding the innovation of the idea. For uniqueness, X={1, 2, 3, 4, 5, 6}, and for market size Y={1, 2, 3, 4, 5, 6} are the respective universes of discourse. Given the fuzzy sets,

$$A = medium\ uniqueness = \left\{\frac{0}{1} + \frac{0.6}{2} + \frac{1}{3} + \frac{0.2}{4} + \frac{0.3}{5} + \frac{0.2}{6}\right\}$$

$$B = medium\ market\ size = \left\{\frac{0}{1} + \frac{0.4}{2} + \frac{1}{3} + \frac{0.8}{4} + \frac{0.3}{5} + \frac{0}{6}\right\}$$

$$C = diffuse\ market\ size = \left\{\frac{0.3}{1} + \frac{0.5}{2} + \frac{0.6}{3} + \frac{0.6}{4} + \frac{0.5}{5} + \frac{0.3}{6}\right\}$$

Determine the implication relation using Zadeh’s implication for the folowing rules

i) IF x is *medium uniqueness* THEN y is *medium market size*;

ii) IF x is *medium uniqueness* THEN y is *medium market size* ELSE y is *diffuse market size*.

iii) IF x is *medium uniqueness* **and** *medium market size* THEN y is *diffuse market size*

(CO2) [Application]