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**Presidency University**

**Bengaluru**

 **SCHOOL OF ENGINEERING**

**SUMMER TERM END TERM** **EXAMINATION, AUGUST 2024**

**Winter Semester**: 2023-24

**Course Code**: ECE 3030

**Course Name**: Fuzzy Logic and it’s Engineering Applications

**Program & Sem**: B. Tech.

**Date**: 6-8-2024

**Time**: 9:30am to 12:30pm

**Max Marks**: 100

**Weightage**: 50%

 **Instructions:**

1. *Read the all questions carefully and answer accordingly.*

**Part A [Memory Recall Questions]**

**Answer all the Questions. Each question carries 2 marks. (5x2M= 10M)**

1) Given a fuzzy relation R(A, B), compute it’s Height. CO2 [[knowledge]

$$R\left(A, B\right)=\left[\begin{array}{c}0.7 0.2 03\\0.1 0.4 0.6\end{array}\right]$$

 2) What do you mean by fuzzification and defuzzification. CO1 [knowledge]

 3) What are the conditions for a given fuzzy relation to be reflexive and symmetric?

 CO3 [knowledge]

 4) Fuzzy sets obey number of properties and one of them is DeMorgan,s Theorem. Prove any one of DeMorgan’s Theorems. CO1 [knowledge]

5. Given fuzzy set $T=\left\{\frac{0}{0}+\frac{.3}{1}+\frac{.7}{2}+\frac{.8}{3}+\frac{.9}{4}+\frac{1}{5}\right\}$. Find two α cut sets with α = 0.1 and 0.5.

 CO1[knowledge]

 **Part B [Thought Provoking Questions]**

**Answer all the Questions. Each question carries 10 marks. ( 5Qx10 M=50M)**

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 either 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

 CO2 [Comprehension]

7) Explain the function of each block in a typical fuzzy logic control system with a neat block diagram CO1 [Comprehension]

 8).For research on the human visual system, it is sometimes necessary to characterize the strength of response to a visual stimulus based on a magnetic field measurement on electrical potential measurement. The inputs are defined on the universe X = [0, 50, 100, 150, 200] femtotesla, and outputs on the universe Y = [0, 50, 100, 150, 200] femtotesla. Consider the fuzzy sets (C.O.No 2) [Comprehension]

 $W=weak stimulus= \left\{\frac{1}{0}+\frac{0.9}{50}+\frac{0.3}{100}+\frac{0}{150}+\frac{0}{200}\right\} $ $ $

$$M=medium stimulus= \left\{\frac{0}{0}+\frac{0.4}{50}+\frac{1}{100}+\frac{0.4}{150}+\frac{0}{200}\right\}$$

$$S=severe response= \left\{\frac{0}{0}+\frac{0}{50}+\frac{0.5}{100}+\frac{0.9}{150}+\frac{1}{200}\right\}$$

 Determine the implication relation R using Zadeh’s implication

 IF “weak stimulus” THEN not “severe response”;

 Now, using a new antecedent (IF part) for the input M = medium stimuli and a max-min

 composition, Find another response on the Y universe to relate approximately to the new stimulus M

 9) Let the Relational Matrix R is given as CO2 [comprehension]

 R =$\left[\begin{matrix}.1&.3&.5\\.1&.5&.1\\ .3&.9&.5\end{matrix}\right]$

Find Domain, Range and Height of R. Check for Reflexive, Symmetric and Max-min Transitive

 10) Fuzzy sets A and B are defined over the Universe of discourse

 $X=\{1,2,3,4,5,6,7,8,9,10\}$.

 Membership functions are given by $μ\_{A}$($x$) = $\frac{x}{x+2}$ and $ μ\_{B}$($x$) = $2^{-x}$.

 $ $Find (i) $\overline{A} ∪ \overline{B}$ (ii) $A ∪ \overline{B}$

 (iii) $Prove DeMorgan^{'}s laws for the above fuzzy sets.$

 CO1 [Comprehension]

**Part C [Problem Solving Questions]**

**Answer all the Questions. Each question carries 20 marks. (2Qx20M=40M)**

11) A problem in IC manufacturing management is to allocate four different job sites to two different teams. Let the job sites be designated as $x\_{i}$ and combined to give a universe universe, $X=\{x\_{1}$, $x\_{2}$,$x\_{3}$,$x\_{4}$}. The following vectors give the locations of the four job sites:

 $x\_{1}=\{5, 5\}$; $x\_{2}=\{6, 8)$; $x\_{3}=\{8, 10\}$; $x\_{4}=\{9, 12\}$. Apply Hard c Means (HCM) algorithm to determine optimum partition, $U^{\*}$. Start with the initial 2-partition

 $U^{(0)}= \left[\begin{array}{c}1 1 0 0\\0 0 1 1\end{array}\right]$

 CO3 [Application]

12) Most control systems are more complex than we can deal with, mathematically. In this situation, fuzzy control can be developed, provided a knowledge base about the control process exists and formed into a number of fuzzy rules. Design a fuzzy logic Air conditioner controller to turn the dial Z to control the flow of warm/hot or cool/cold air based on change in room temperature, ∆T°C, and the rate of change of temperature$\frac{d∆T}{dt}$. Consider ∆T = 3°C and $\frac{d∆T}{dt}$ = -2°C/min. Assume appropriate membership functions for the input and output variables.

 CO4 [Application]

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