|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Roll No |  |  |  |  |  |  |  |  |  |  |  |

PRESIDENCY UNIVERSITY BENGALURU

 SCHOOL OF ENGINEERING

 MAKE UP EXAMINATION - JULY 2024

|  |  |
| --- | --- |
| **Semester : V** | **Date : 10 July 2024** |
| **Course Code : ECE3030** | **Time : 9.30 AM – 12.30 PM** |
| **Course Name : Fuzzy Logic and It’s Engineering Applications** | **Max Marks : 100** |
| **Program : B TECH** | **Weightage : 50%** |

**Instructions:**

1. *Read all questions carefully and answer accordingly.*
2. *Question paper consists of 3 parts.*
3. *Scientific and non-programmable calculator are permitted.*
4. *Do not write any information on the question paper other than Roll Number.*

|  |
| --- |
| **PART A** |
|  **ANSWER ANY 5 QUESTIONS 5Q X 2M=10M** |
| 1 | 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) medium (c) fast | (CO 1) | [Knowledge] |
|  |
| 2 | Given a fuzzy relation R(A, B), compute it’s Height. $$R\left(A, B\right)=\left[\begin{array}{c}0.9 0.7 03\\0.5 0.4 0.6\end{array}\right]$$ | (CO2) | [Knowledge] |
|  |
| 3 | In many cases, the number c of clusters in the data is known. In other cases, c may take more than one value. In this situation it is necessary to identify the value of c that gives the number of clusters in the data for the analysis at hand. This problem is known as \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ | (CO3) | [Knowledge] |
|  |
| 4 | There are two poular methods, among many others, to defuzzify fuzzy partitions. The defuzzification may be required in the ultimate assignment of data to a particular class. Consider the partition matrix U given below and harden it using *maximum membership method.*$U= \left[\begin{array}{c}0.991 0.986 0.993 0\\0.009 0.014 0.007 1\end{array}\right]$  | (CO3) | [Knowledge] |
|  |
| 5 | Control systems are some times divided into two classes. Mention these control systems with examples. | (CO4) | [Knowledge] |
|  |
| 6 |  The concept of control surface, or decision surface, is central in fuzzy control systems methodology. Describe the control surface with reference to fuzzy logic control system.  | (CO4) | [Knowledge] |
|  |  |  |  |
| 7 | Hard c Means is one of the methods used for the classification of data. If the first row of Hard 2-partition is [1 0 0 1 1 0 1], Find it’s second row. | (CO3) | [Knowledge] |
|  |

|  |
| --- |
| **PART B** |
|  **ANSWER ANY 5 QUESTIONS 5Q X 10M=50M** |
| 8 | 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 | (CO1) | [Comprehension] |
|  |
| 9 | Three variables of interest in power Transistors are the amount of current that can be switched, the voltage that can be switched and the cost. The following membership functions are developed:$$Average current \left(in amperes\right)=I = \left\{\frac{0.4}{0.8}+\frac{0.7}{0.9}+\frac{1}{1}+\frac{0.8}{1.1}+\frac{0.6}{1.2}\right\}$$$$Average voltage \left(in volts\right) =V = \left\{\frac{0.4}{30}+\frac{0.7}{45}+\frac{1}{60}+\frac{0.8}{75}+\frac{0.6}{90}\right\}$$$$Cost of a transistor \left(in rupees\right) =C = \left\{\frac{0.4}{0.5}+\frac{1}{0.6}+\frac{0.8}{0.7}\right\}$$(a)Find the fuzzy Cartesian product $P=V ×I;T=I ×C.$ What would this relation, T represent physically?(b)Using max-min composition, find $E=P o T$. What would this relation, E represent physically?(c) Using max-product composition, find $E=P o T$. What would this relation, E represent physically? | (CO2) | [Comprehension] |
|  |
| 10 | For For all fuzzy equivalence relations, their λ-cuts are equivalent ordinary relations. Hence, to classify the data points using fuzzy relations, we need to find the associated fuzzy equivalence relation. Consider five data points in a universe, $X=\{x\_{1}$, $x\_{2}$,$x\_{3}$,$x\_{4}$,$x\_{5}$} and the following fuzzy equivalence relation$$R= \left[\begin{array}{c} 1 0.8 0.4 0.5 0.8\\0.8 1 0.4 0.5 0.9\\0.4 0.4 1 0.4 0.4\\0.5 0.5 0.4 1 0.5\\0.8 0.9 0.4 0.5 1\end{array}\right]$$ Form the clusters for the five datapoints in X based on λ-cut relations for λ = 0.5, 0.8, 0.9   | (CO3) | [Comprehension] |
|  |
| 11 | For the ultimate assignment of data to a particular class, the fuzzy partitions are converted to hard c partitions. Consider the fuzzy c partition matrix U given below and harden it using Nearest centre classifier(minimum distance) method. Assume weighting parameter $m^{'}=2$ and criterion for convergence, $ε\_{L}\leq 0.01$ $U= \left[\begin{array}{c}0.991 0.986 0.007 0\\0.009 0.014 0.993 1\end{array}\right]$   | (CO3) | [Comprehension] |
|  |
| 12 | Fuzzy logic control is extensively used in many applications such as Washing machines, Traffic light control, weather monitoring etc. Mr. Alex is heading team in Samsung to design a Washing machine using fuzzy logic. The team has decided to use two input variables, namely, Dirtiness level and Load size and the output variable as Water amount. Considering the appropriate membership functions and fuzzy rules, design the the fuzzy logic controller for the washing machine to find the amount of water required for the Medium Dirtiness level =70 and the load size =8 Kg. | (CO4) | [Comprehension] |
|  |
| 13 | A number of assumptions are implicit in a fuzzy control system design. Explain the function of each block in a typical fuzzy logic control system with a neat block diagram and list out all six basic assumptions that are commonly made whenever a fuzzy rule based control policy is selected. | (CO4) | [Comprehension] |
|  |  |  |  |
| 14 | Three families exists, which have a total of 8 people, all of whom are related with some similarity measure. A person not familiar with the members of the three families is asked to grade their resemblance to one another. In conducting this study, the person assigns the similarity level in the equivalence relation matrix R as shown below. Classify the three families using R according to λ-cut levels = 0.4, 0.6 $R= \left[\begin{array}{c}1.0 0.4 0.4 0.5 0.4 0.6 0.4 0.6\\0.4 1.0 0.4 0.4 0.8 0.4 0.8 0.4\\0.4 0.4 1.0 0.4 0.4 0.4 0.4 0.4\\0.5 0.4 0.4 1.0 0.4 0.5 0.4 0.5\\0.4 0.8 0.4 0.4 1.0 0.4 0.8 0.4 \\0.6 0.4 0.4 0.5 0.4 1.0 0.4 0.8\\0.4 0.8 0.4 0.4 0.8 0.4 1.0 0.4\\0.6 0.4 0.4 0.5 0.4 0.8 04 1.0\end{array}\right]$  | (CO3) | [Comprehension] |
|  |

|  |
| --- |
| **PART C** |
|  **ANSWER ANY 2 QUESTIONS 2Q X 20M=40M** |
| 14 | a) The fuzzy sets A, B and C are all defined on the universe X = [0, 5] with the following membership functions:$μ\_{A}\left(x\right)=\left[\frac{1}{1+5(x-5)^{2}}\right]$, $μ\_{B}\left(x\right)= 2^{-x}$, and $μ\_{C}\left(x\right)=\left[\frac{2x}{x+5}\right]$Find the λ-cut sets for each of the fuzzy sets A, B and C for λ = 0.2, 0.6, 0.9, 1,$0^{+}$ 10M b) Consider fuzzy sets A and B. If   $Slow (A) = \left\{\frac{.5}{1}+\frac{.4}{2}+\frac{.3}{3}+\frac{.9}{5}+\frac{.1}{6}\right\}$   $Fast (B) = \left\{\frac{1}{2}+\frac{.1}{3}+\frac{.4}{5}+\frac{.4}{6}\right\}$ Find the fuzzy set corresponding to  (i) “very very slow and not fast” (ii) “ very very slow or not fast” 10M | (CO1, CO2) | [Application] |
|  |
| 15 | 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: $x\_{1}=\{4, 4\}$; $x\_{2}=\{6, 7)$; $x\_{3}=\{7, 10\}$; $x\_{4}=\{9, 12\}$. 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] |
|  |
| 16 | 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] |
|  |
|  |