

IV B.Tech II Semester Regular Examinations, Apr/May 2008
FUZZY LOGIC AND APPLICATION
(Electrical & Electronic Engineering)

Time: 3 hours

Max Marks: 80

Answer any FIVE Questions
 All Questions carry equal marks

1. For the cylindrical shapes shown in Figure 1. Develop a membership functions for each of the following shapes using the ratio d/h . and discuss the reason for any overlapping among the three membership functions. [16]

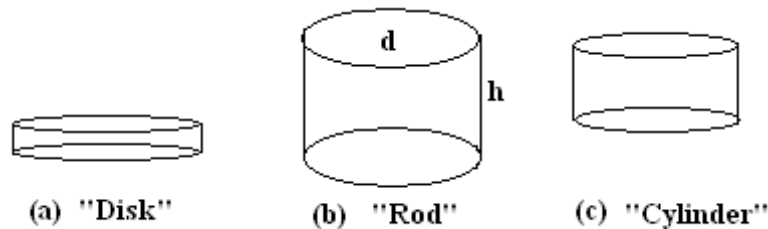


Figure 1

2. Write a short note on fuzzy relations? [16]
3. Write a note on futures of the fuzzy membership function? [16]
4. These exercises use Zadeh's extension principle

$\mu(x_i)$	0	1	2	3	4	5	6	7
$\underline{A}$	0.0	0.1	0.6	0.8	0.9	0.7	0.1	0.0
$\underline{B}$	0.0	1.0	0.7	0.5	0.2	0.1	0.0	0.0

If x and y are real numbers defined by sets $\underline{A}$ and $\underline{B}$ respectively.
 Calculate the fuzzy set $\underline{C}$ representing the real numbers Z given by

(a) $Z = 3x-2$

(b) $Z = 4x^2+3$ [16]

5. $\sqrt{3}$ is not a rational number; i.e., show that it can not be the ratio of two even integers by contradiction? [16]
6. What is canonical rule forms? [16]
7. One of the decisions your project team faces with each new computer product is what type of printed circuit board (PCB) will be required for the unit. Depending on the density of tracks (metal interconnected traces on the PCB that act like wire to connect components together) which is related to the density of the components we may use single layer PCB, doubled layer PCB four layer PCB or Six layer PCB. A PCB layer is a two dimensional plane of interconnecting tracks. The number of

layers on a PCB is the number of parallel interconnection layers in the PCB. The greater the density of the interconnections in the design, the greater the number of layers required to fit the design on to a PCB of given size. One measure of board track density is the number of nodes required in the design. A node is created at a location in the circuit where two or more lines meet.

Define fuzzy alternatives? [16]

8. A fuzzy tolerance relation. R is reflexive and symmetric. Find the equivalence relation R and then classify it according to λ -cut levels $=\{0.9, 0.8, 0.5\}$.

$$R = \begin{Bmatrix} 1 & 0.8 & 0 & 0.2 & 0.1 \\ 0.8 & 1 & 0.9 & 0 & 0.4 \\ 0 & 0.9 & 1 & 0 & 0.3 \\ 0.2 & 0 & 0 & 1 & 0.5 \\ 0.1 & 0.4 & 0.3 & 0.5 & 1 \end{Bmatrix} \quad [16]$$

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1. Consider two fuzzy sets;
 long pencils= {pencil 1/0.1, pencil 2/0.2, pencil 3/0.4, pencil 4/0.6, pencil 5/0.8, pencil 6/1},
 Medium pencils= {pencil 1/1, pencil 2/0.6, pencil 3/0.4, pencil 4/0.3, pencil 5/0.1}.
 Determine the results of the union and intersection of these fuzzy sets. [16]

2. For the fuzzy relation

$$R = \begin{bmatrix} 1.0 & 0.4 & 0.8 & 0.3 & 0.0 \\ 0.5 & 1.0 & 0.6 & 0.7 & 1.0 \\ 0.9 & 1.0 & 0.0 & 0.6 & 0.8 \\ 1.0 & 0.5 & 0.2 & 0.0 & 0.9 \\ 0.3 & 0.5 & 0.3 & 0.1 & 1.0 \end{bmatrix}$$

Compute its projections and reconstruct the relation from these projections. [16]

3. Explain Bell shaped membership function and Triangular membership functions? [16]

4. Given the following fuzzy numbers and using Zadeh's extension principle
 Calculate $K = \tilde{I} \cdot \tilde{J}$ and explain why $\tilde{K}$ is nonconvex.

$$\begin{aligned} \tilde{I} = \tilde{3} &= \frac{0.2}{2} + \frac{1}{3} + \frac{0.1}{4} \\ \tilde{J} = \tilde{2} &= \frac{0.1}{1} + \frac{1}{2} + \frac{0.3}{3} \end{aligned} \quad [16]$$

5. Prove that $((P \rightarrow Q) \wedge P \rightarrow Q)$ BY contradiction? [16]

6. Amplifier capacity on a normalized universe, say $[0, 100]$, can be describe linguistically by fuzzy variables like these:

$$\text{"Power full"} = \left\{ \frac{0}{1} + \frac{0.4}{10} + \frac{0.8}{50} + \frac{1}{100} \right\}$$

$$\text{"Weak"} = \left\{ \frac{1}{1} + \frac{0.9}{10} + \frac{0.3}{50} + \frac{0}{100} \right\}$$

find the membership function for the following linguistic phrases used to describe the capacity of various amplifiers;

- (a) Powerful and not weak
- (b) Very powerful or very weak
- (c) Very, very powerful and not weak. [16]

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Set No. 2

7. What is fuzzy ordering? [16]
8. Explain Hard C - Means clustering (HCM)? [16]

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1. What are the limitations of conventional controllers and how fuzzy controllers overcome these limitations explain? [16]
2. In a computer engineering different logic families are often compared on the basis of their power-delay product.
 The fuzzy set F is the logic families $F = \{\text{NMOS, CMOS, TTL, ECL, JJ}\}$.
 The range of delay time $D = \{0.1, 1, 10, 100\}$ in Nano seconds.
 The power dissipation in micro watts $P = \{0.01, 0.1, 1, 10, 100\}$
 By using max-min composition to obtain a fuzzy relation between delay time and Power dissipation. [16]
3. What is Fuzzification? Explain clearly with suitable example? [16]
4. For the function $y = x_1^2 + x_2^2 - 3x_1 + 4$, where the membership functions for fuzzy variables X_1, X_2 shown in Figure 4: find and plot the membership function for the fuzzy out put variable, y , using the vertex method. [16]

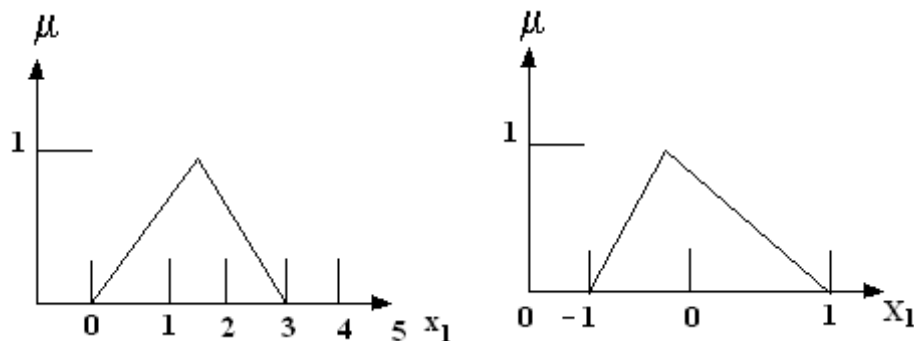


Figure 4

5. $\sqrt{3}$ is not a rational number; i.e., show that it can not be the ratio of two even integers by contradiction? [16]
6. In the design of robust control systems, uncertainty in system models must be estimated and used in the specifications of frequency - dependent weights to be used in the control design. Uncertainty at a particular frequency can be described by a number from 0 to 1 (e.g. 0= completely certain and 1= completely un certain) for these membership functions

$$\begin{aligned} \text{"Uncertain"} &= \left\{ \frac{0}{0} + \frac{0}{0.1} + \frac{0.2}{0.2} + \frac{0.6}{0.3} + \frac{1}{0.4} + \frac{1}{0.5} + \frac{1}{0.6} + \frac{1}{0.7} + \frac{1}{0.8} + \frac{1}{0.9} + \frac{1}{1} \right\} \\ \text{"Certain"} &= \left\{ \frac{1}{0} + \frac{0.8}{0.1} + \frac{0.5}{0.2} + \frac{0.2}{0.3} + \frac{0.1}{0.4} + \frac{0}{0.5} + \frac{0}{0.6} + \frac{0}{0.7} + \frac{0}{0.8} + \frac{0}{0.9} + \frac{0}{1} \right\} \end{aligned}$$

Find the following linguistic phrases

- (a) Not very certain
- (b) Not very certain and Uncertain
- (c) Not very certain and not very Uncertain. [16]

7. What is fuzzy ordering? [16]

8. A customer evaluates five banks by their mortgage policy, loan interest, and dividend benefits. She has developed a fuzzy tolerance relation R according to these three criteria for banks. If she uses a λ -cut level of 0.8, then how many classes can she make from these banks?

$$R = \begin{bmatrix} 1 & 0.2 & 0.5 & 0.9 & 0.7 \\ 0.2 & 1 & 0.6 & 0.4 & 0.8 \\ 0.5 & 0.6 & 1 & 0.4 & 0.3 \\ 0.9 & 0.4 & 0.4 & 1 & 0.5 \\ 0.7 & 0.8 & 0.3 & 0.5 & 1 \end{bmatrix} \quad [16]$$

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1. Explain the different shapes of fuzzy membership functions and which one is better to use? [16]
2. Write a short note on operations of crisp relations. [16]
3. How to generate membership function by using Genetic Algorithms? [16]
4. Given the following fuzzy numbers and using Zadeh's extension principle Calculate $\tilde{K} = \tilde{I} \cdot \tilde{J}$ and explain why $\tilde{K}$ is nonconvex.

$$\begin{aligned}\tilde{I} = \tilde{3} &= \frac{0.2}{2} + \frac{1}{3} + \frac{0.1}{4} \\ \tilde{J} = \tilde{2} &= \frac{0.1}{1} + \frac{1}{2} + \frac{0.3}{3}\end{aligned}\quad [16]$$

5. $\sqrt{3}$ is not a rational number; i.e., show that it can not be the ratio of two even integers by contradiction? [16]
6. Write a short notes on rule - based systems? [16]
7. Ordering: Consider a comparison of four chemicals with respect to human toxicity. Assume that C_1 is highly toxic, C_2 is very toxic, C_3 is moderately toxic, and C_4 is slightly toxic. Hence, on a pair wise comparison basis, C_2 resembles C_1 with a fuzzy membership value of 0.75, C_3 resemble C_1 with a fuzzy membership of 0.5, and C_4 resembles C_1 with a fuzzy membership of 0.25. the remainder of the pair wise comparison follow:

$$\begin{array}{cccc}f_{c_1}(C_1)=1 & f_{c_2}(C_2)=0.75 & f_{c_1}(C_3)=0.5 & f_{c_1}(C_4)=0.25 \\ f_{c_2}(C_1)=0.75 & f_{c_2}(C_2)=1 & f_{c_2}(C_3)=0.5 & f_{c_2}(C_4)=0.25 \\ f_{c_3}(C_1)=0.5 & f_{c_3}(C_2)=0.25 & f_{c_3}(C_3)=1 & f_{c_3}(C_4)=5 \\ f_{c_4}(C_1)=0.25 & f_{c_4}(C_2)=0.25 & f_{c_4}(C_3)=0.5 & f_{c_4}(C_4)=1\end{array}$$

Develop the comparison matrix and determine the overall ranking of toxicity. [16]

8. A customer evaluates five banks by their mortgage policy, loan interest, and dividend benefits. She has developed a fuzzy tolerance relation R according to these three criteria for banks. If she uses a λ -cut level of 0.8, then how many classes can she make from these banks?

$$R = \begin{bmatrix} 1 & 0.2 & 0.5 & 0.9 & 0.7 \\ 0.2 & 1 & 0.6 & 0.4 & 0.8 \\ 0.5 & 0.6 & 1 & 0.4 & 0.3 \\ 0.9 & 0.4 & 0.4 & 1 & 0.5 \\ 0.7 & 0.8 & 0.3 & 0.5 & 1 \end{bmatrix} \quad [16]$$

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Set No. 4
