Soft Computing
B.Tech. (IT) – 5th Semester
End-Semester Examination (November 2021)

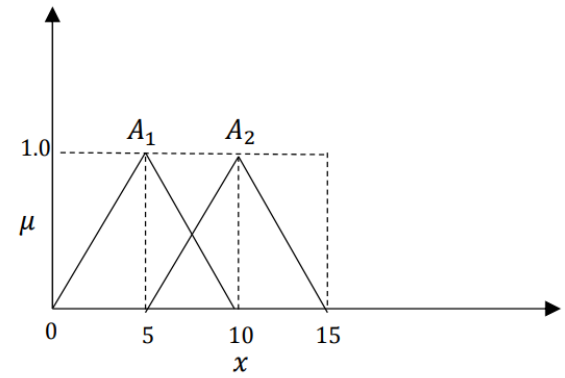
MAX: 70 Marks
Duration: 2 Hours

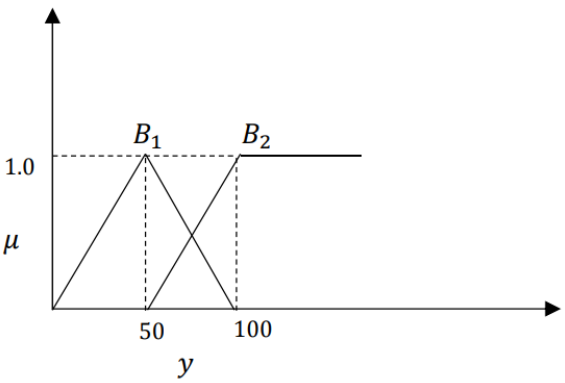
Instructions:

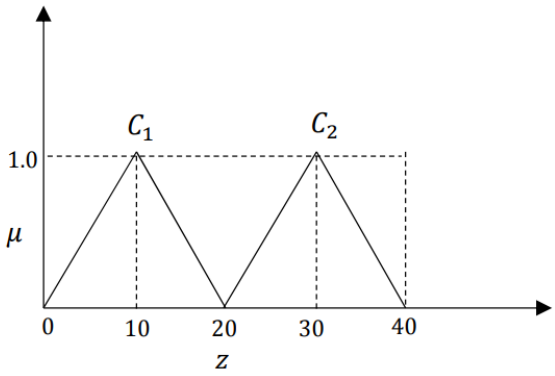
- *All Questions are compulsory.*
- *Solve the questions on your notebook and write your name and roll number on top of each page of the solution.*
- *Take pictures of those pages and prepare a pdf file (rename the pdf file by your roll number) to submit. Upload pdf file on the given google forms link.*

1. In a fuzzy controller for two inputs x = 6 and y = 25, two fuzzy rules are fired as follows:
   R_1 : IF x is A_1 and y is B_1 THEN z is C_1.
   R_2 : IF x is A_2 and y is B_2 THEN z is C_2.

   The fuzzy sets involved in R1 and R2 are known as given below: **[10 Marks]**







(a.) Graphically show the combined output due to R_1 and R_2 for x = 6 and y = 25.

(b.) Apply Center of Sum defuzzification method to obtain the crisp value of the output when x = 6 and y = 25

2. Suppose a genetic algorithm uses chromosomes of the form x = a b c d e f g h with a fixed length of eight genes. Each gene can be any digit between 0 and 9. Let the fitness of individual x be calculated as: **[15 Marks]**

$$f(x) = (a + b) - (c + d) + (e + f) - (g + h)$$

And let the initial population consist of four individuals with the following chromosomes:

x1 = 6 5 4 1 3 5 3 2
x2 = 8 7 1 2 6 6 0 1
x3 = 2 3 9 2 1 2 8 5
x4 = 4 1 8 5 2 0 9 4

(a.) Evaluate the fitness of each individual, and arrange them in order with the fittest first and the least fit last.

(b.) Perform the crossover operations between fittest two individuals using one–point crossover at the middle point.

(c.) By looking at the fitness function and considering that genes can only be digits between 0 and 9 find the chromosome representing the optimal solution (i.e. with the maximum fitness). Find the value of the maximum fitness

3. Perform two iterations of Particle Swarm Optimization (PSO) technique for the given objective function. **[20 Marks]**

Minimize $f(x) = 0.1*(x_1 - 1)^2 + 0.2*(x_2 - 2)^2 + 0.3*(x_3 - 3)^2$

Consider the following parameters:

Initial Population:
P1: (8, 9, 1)
P2: (9, 6, 1)
P3: (3, 5, 10)

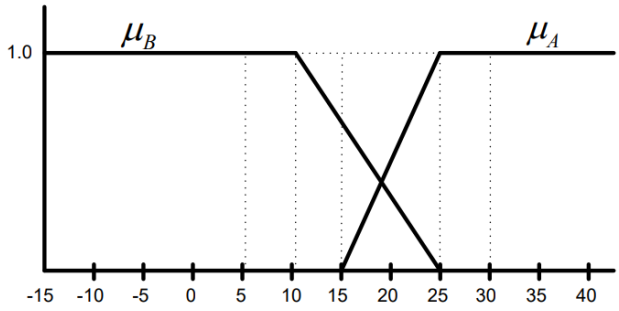
Initial Velocity for each particle:
V1: (0.8, 0.9, 0.1)
V2: (0.9, 0.6, 0.1)
V3: (0.3, 0.5, 1)

c1 = c2 = 2
r1 = r2 = 0.5

4. Name and describe the main features of Genetic Algorithms (GA) **[7 Marks]**

5. Discuss the Artificial Bee Colony optimization technique. **[7 Marks]**

6. The membership functions of two fuzzy sets A and B are shown in the following graph.
   A: climate is Hot.
   B: climate is cold.
   What would be the graph of the membership function μD of the fuzzy set D = $\overline{(A \cap B)}$?
   State D in terms of fuzzy linguistic. **[6 Marks]**



7. Two fuzzy relations 'likes' and 'earns' are defined as follows. Obtain the relation between games to money using max-min composition? **[5 Marks]**

$$\text{likes} = \begin{array}{c} \\ Dhoni \\ Virat \\ Rohit \\ Sekhar \end{array} \begin{array}{c} \begin{array}{ccc} Football & Hockey & Cricket \end{array} \\ \begin{bmatrix} 0.1 & 0.3 & 0.8 \\ 0.2 & 0.7 & 0.5 \\ 0.5 & 0.4 & 0.2 \\ 0.4 & 0.5 & 0.6 \end{bmatrix} \end{array}$$

$$\text{earns} = \begin{array}{c} \\ Dhoni \\ Virat \\ Rohit \\ Sekhar \end{array} \begin{array}{c} \begin{array}{ccc} 10L & 50L & 100L \end{array} \\ \begin{bmatrix} 0.6 & 0.3 & 0.2 \\ 0.4 & 0.7 & 0.8 \\ 0.1 & 0.3 & 0.2 \\ 0.5 & 0.2 & 0.6 \end{bmatrix} \end{array}$$