



**PILLAI COLLEGE OF ENGINEERING, NEW PANVEL**  
**(Autonomous) (Accredited 'A+' by NAAC)**  
**END SEMESTER EXAMINATION**  
**May 2023**

SEM-VI

BRANCH: Information Technology

Subject:- Evolutionary Computing and Fuzzy systems.

Time: 02.00 Hours

Max. Marks: 60

Date: 08/05/2023

N.B 1. Q.1 is compulsory

Subject Code IT 319

2. Attempt any two from the remaining three questions

3. Each Question carry 20 marks.

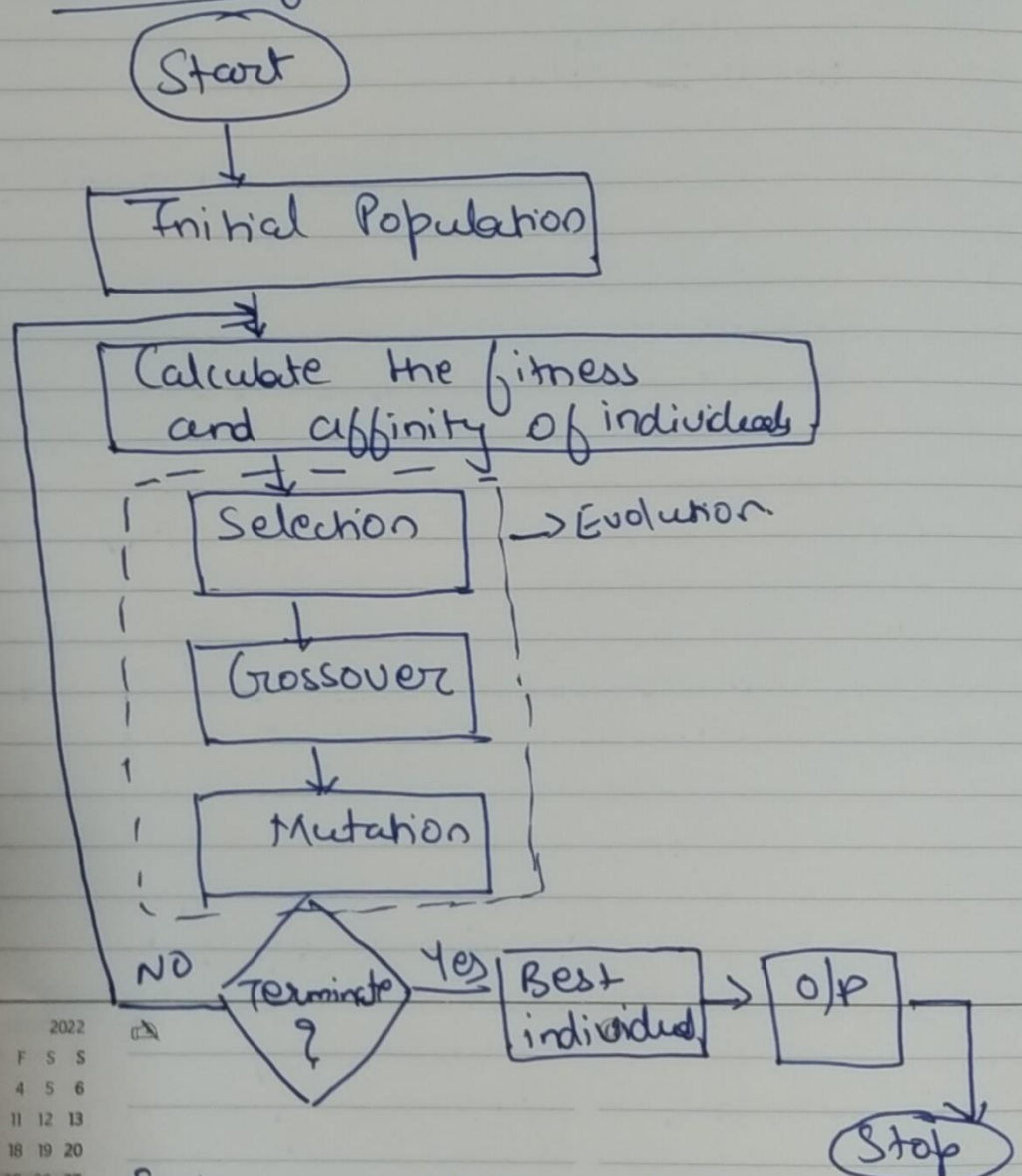
Q.1.	Attempt All	Marks
a)	What are genetic algorithms? Explain the flow chart of the genetic algorithm.	5
b)	Explain the evolutionary programming in detail.	5
c)	<p>What are fuzzy sets? How fuzzy sets are different from crisp sets.            Consider the following two fuzzy sets:</p> $\text{Fuzzy } A = \left\{ \frac{0.2}{1} + \frac{0.3}{2} + \frac{0.4}{3} + \frac{0.5}{4} \right\}$ $\text{Fuzzy } B = \left\{ \frac{0.1}{1} + \frac{0.2}{2} + \frac{0.2}{3} + \frac{1}{4} \right\}$ <p>Find the Algebraic sum and bounded difference.</p>	5
d)	What is fuzzification? Explain fuzzification with an example.	5
Q.2.	Attempt All	
a)	Why there is a need for a selection operator in genetic algorithm. What will happen if we maintain TOO HIGH and TOO LOW selection pressure?	4
b)	<p>Perform Max-min and Max-product composition between the following fuzzy relations:</p> $R = \begin{bmatrix} 0.6 & 0.3 \\ 0.2 & 0.9 \end{bmatrix}$ $S = \begin{bmatrix} 1 & 0.5 & 0.3 \\ 0.8 & 0.4 & 0.7 \end{bmatrix}$	4
c)	Explain the tournament selection technique with an example. Compare the crossover and mutation operators.	6
d)	Explain the Mamdani inference mechanism with an example.	6
Q.3.	Attempt All	
a)	Give various stopping criteria for genetic algorithms.	4
b)	What are fuzzy quantifiers? Explain fuzzy quantifiers with an example.	4

c)	<p>Perform defuzzification using the center of gravity (COG) method:</p>	6
d)	<p>Define the terms crossover probability and mutation probability.          Consider the parent chromosomes given below. Apply uniform crossover with mask technique and generate the offspring solutions.          Parent1: 0110100101          Parent2: 0100110000          Mask: 1101001010          Apply any mutation on the offspring solution.</p>	6
Q.4.	<b>Attempt All</b>	
a)	<p>What are fuzzy controllers? Consider a fuzzy controller for a train approaching the station. Assume the inputs are a distance from the station and the speed of the train. The output is the broken power applied. Perform the following:</p> <ol style="list-style-type: none"> <li>1. List descriptors used for input and output variables.</li> <li>2. For every input and output descriptor draw the appropriate membership function and provide its formula.</li> <li>3. Formulate a rule base.</li> </ol>	10
b)	<p>Explain various representation or encoding techniques used in genetic algorithm. Give one example where permutation representation can be used.</p>	10

Solution:

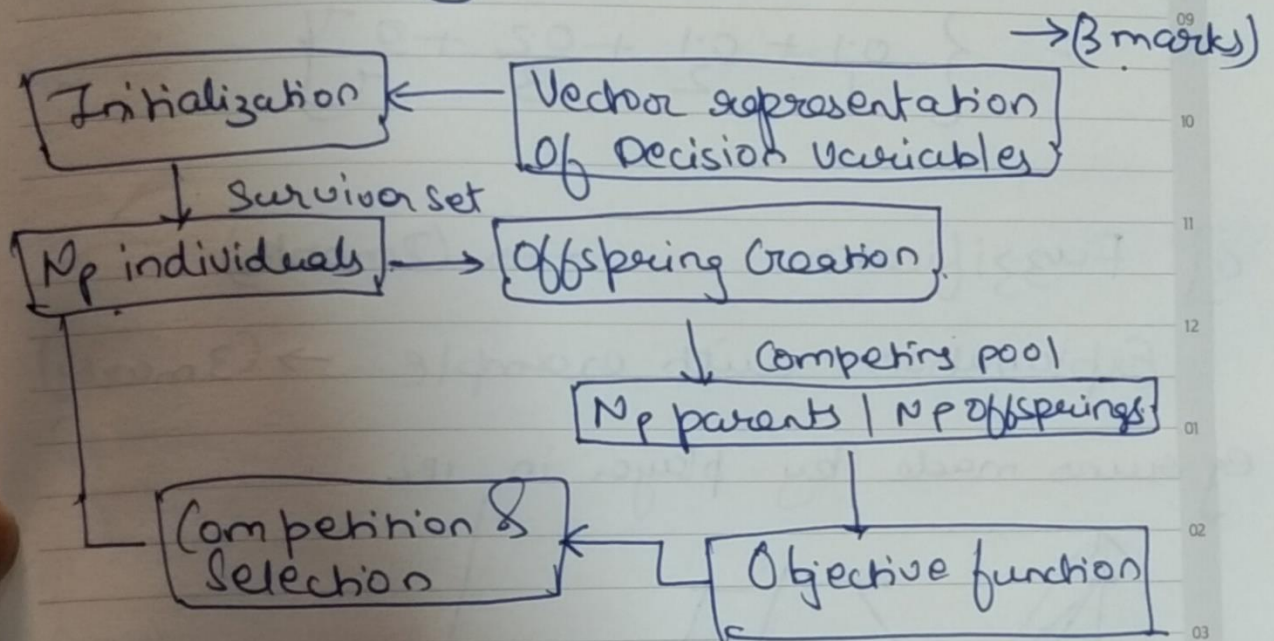
Answer key.

Q1a] Defination of generic algorithm - (1 marks)

Flow chart of G.A - (2 marks)

Explanation of flow chart - (2 marks)

b] Evolutionary programming.



Explanation — (2 marks)

c] Definition of fuzzy sets → (1 mark)  
 Difference with Crisp → (1 mark)

Algebraic Sum =

→ (1.5 marks)

$$\mu_{A+B}(x) = [\mu_A(x) + \mu_B(x)] - [\mu_A(x) \cdot \mu_B(x)]$$

$$= \left\{ \frac{0.28}{1} + \frac{0.44}{2} + \frac{0.52}{3} + \frac{1}{4} \right\}$$

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DECEMBER							2022
wk	M	T	W	T	F	S	S
48				1	2	3	4
49	5	6	7	8	9	10	11
50	12	13	14	15	16	17	18
51	19	20	21	22	23	24	25
52	26	27	28	29	30	31	



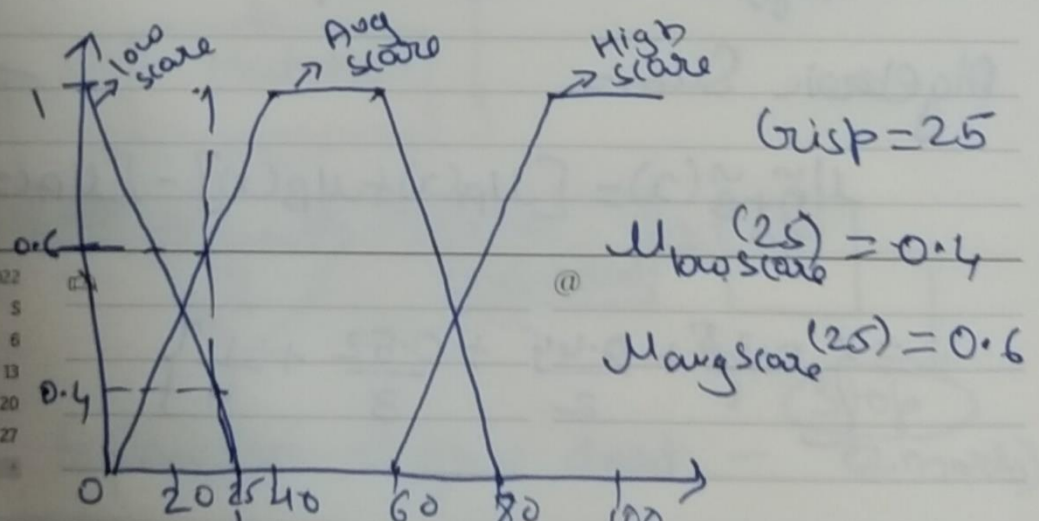
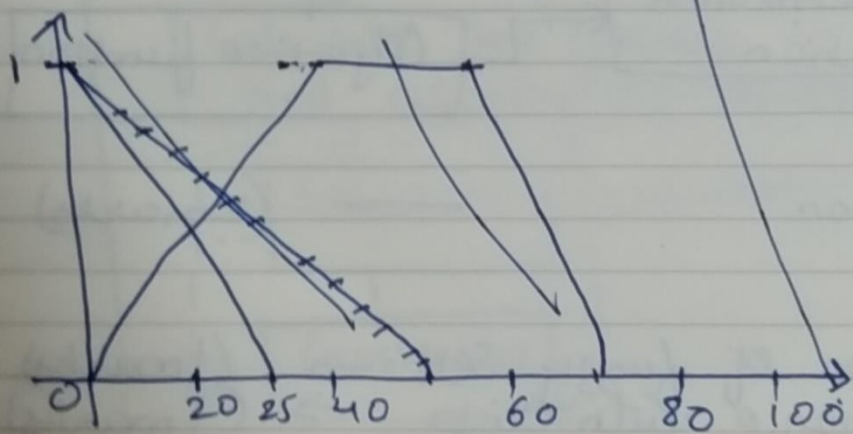
$$\mu_{\tilde{A} \odot \tilde{B}}(x) = \max\{0, \mu_{\tilde{A}}(x) - \mu_{\tilde{B}}(x)\}$$

$$= \left\{ \frac{0.1}{1} + \frac{0.1}{2} + \frac{0.2}{3} + \frac{0.4}{4} \right\}$$

d] Fuzzification  $\rightarrow$  (2 marks)

Explanation with example  $\rightarrow$  (3 marks)

eg. runs made by player in IPL



Q27

a) Need of Selection operation in G.A.

→ (2 marks)

Selection pressure → degree to which better individuals are favoured. (2 marks)

Selection pressure too High → G.A will converge pre-maturely and will return Sub-optimal Solution.

Selection pressure too Low → G.A will take lot of time to converge.

b) max-min

→ (2 marks)

$$T = \begin{bmatrix} 0.6 & 0.5 & 0.3 \\ 0.8 & 0.4 & 0.7 \end{bmatrix}$$

max-product

(2 marks)

$$T = \begin{bmatrix} 0.6 & 0.3 & 0.21 \\ 0.72 & 0.36 & 0.63 \end{bmatrix}$$

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DECEMBER							2022
wk	M	T	W	T	F	S	S
48	.	.	.	1	2	3	4
49	5	6	7	8	9	10	11

Q] Tournament Selection with example.  
— (4 marks)

Crossover

Mutation — (2 marks)

1] Convergence operator

1] Divergence operator

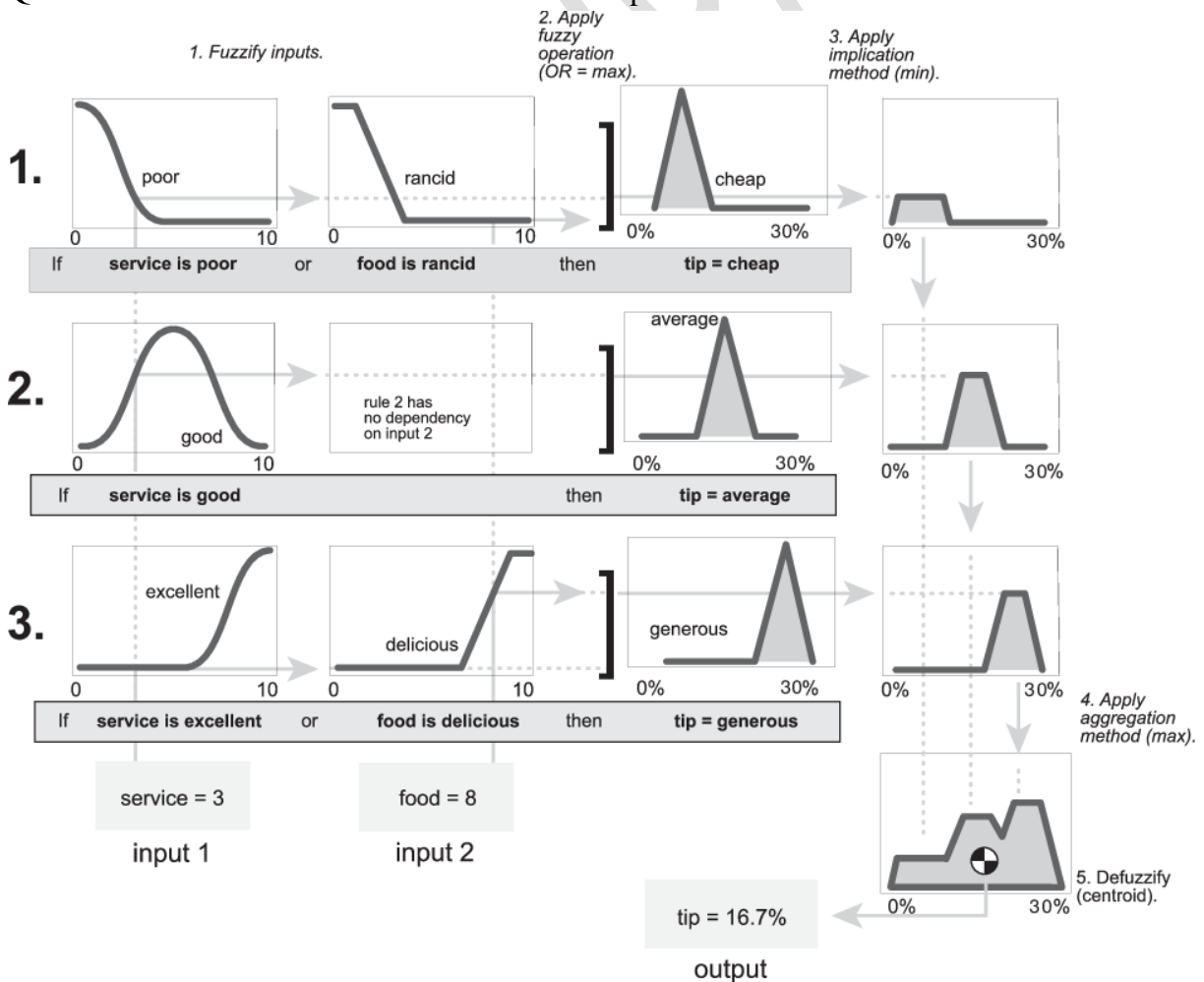
2] Used more often

2] Rarely happens.

3] performs exploitation

3] performs exploration

Q2 D: Mamdani inference mechanism with example:



Q3 a) ~~2~~ ~~maxi~~ Explain each points.  $\rightarrow$  (4 marks)  
 (each point 1 mark)

- 1] Maximum generations
- 2] Elapsed time
- 3] No change in fitness
- 4] Stall generations.

b] Fuzzy quantifiers — (2 marks)  
 Types of fuzzy quantifiers.  
 Explanation with example (2 marks)

Q3 C:

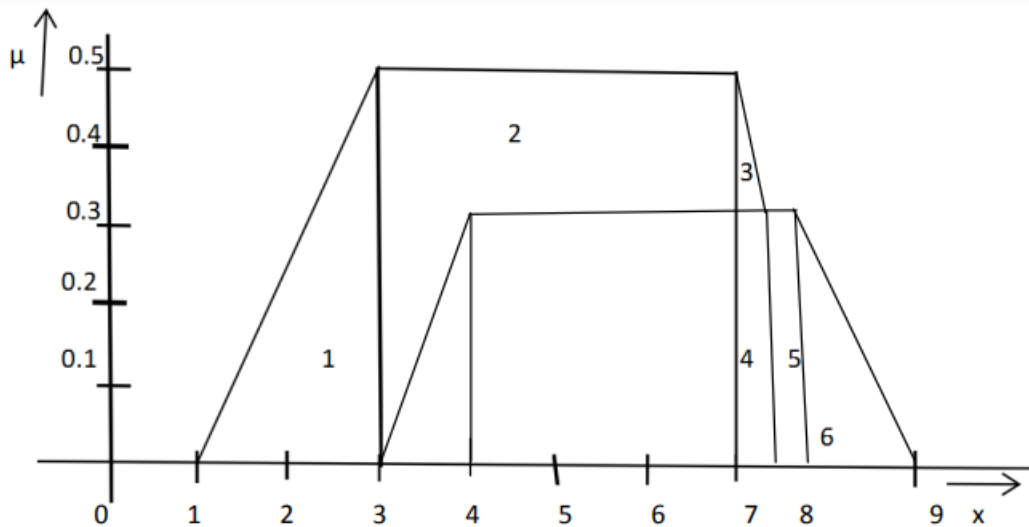




Table 1

Sub-area number	Area( $A_i$ )	Centroid of area( $\bar{x}_i$ )	$A_i \cdot \bar{x}_i$
1	0.5	2.333	1.1665
2	02	5	10
3	.05	7.166	0.3583
4	.15	7.25	1.0875
5	.15	7.75	1.1625
6	.15	8.333	1.2499

The defuzzified value  $x^*$  will be  $\frac{\sum_{i=1}^N A_i \times \bar{x}_i}{\sum_{i=1}^N A_i}$

$$= \frac{(1.1665+10+0.3583+1.0875+1.1625+1.2499)}{(0.5+2+.05+.15+.15+.15)}$$

$$= (15.0247)/3 = 5.008$$

$$x^* = 5.008$$

d] Parent 1 = 0 1 1 0 1 0 0 1 0 1 → (4 marks)  
 Parent 2 = 0 1 0 0 1 1 0 0 0 0  
 Mask = 1 1 0 1 0 0 1 0 1 0

offspring 1 = 0 1 0 0 1 1 0 0 0 0

offspring 2 = 0 1 1 0 1 0 0 1 0 1

Applying interchanging technique on offspring 1

parent = 0 1 0 0 1 1 0 0 0 0

offspring = 0 0 0 0 1 1 0 0 1 0

Crossover probability and mutation probability — (2 marks)

Disruptive :-

Example of permutation - (3 marks)