



UTHM
Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

**FINAL EXAMINATION
SEMESTER I
SESSION 2019/2020**

COURSE NAME : FUZZY SYSTEM DEVELOPMENT
COURSE CODE : BIT 33703
PROGRAMME CODE : 3 BIT
EXAMINATION DATE : DECEMBER 2019/ JANUARY 2020
DURATION : 3 HOURS
INSTRUCTION : ANSWER ALL QUESTIONS

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THIS QUESTION PAPER CONSISTS OF **FOUR (4)** PAGES

Q1 (a) Describe briefly a membership function of a fuzzy set. (4 marks)

(b) What is the difference between classical rules and fuzzy rules? (4 marks)

Q2 By using a diagram, explain the architecture of fuzzy system. (10 marks)

Q3 In a survey, students are compared based on their score marks and activity participation. A universe of discourse of score marks is, $X = \{0, 20, 40, 60, 80, 100\}$. The standard discrete form of fuzzy set for marks \tilde{S}_1 and activity participation \tilde{S}_2 are as follows:

$$\tilde{S}_1 = \left\{ \frac{0}{0} + \frac{0.5}{20} + \frac{0.65}{40} + \frac{0.85}{60} + \frac{1.0}{80} + \frac{1.0}{100} \right\}$$

$$\tilde{S}_2 = \left\{ \frac{0}{0} + \frac{0.45}{20} + \frac{0.6}{40} + \frac{0.8}{60} + \frac{0.95}{80} + \frac{1.0}{100} \right\}$$

Find the following membership functions using standard fuzzy operations.

(a) $\mu_{\tilde{S}_1 \cup \tilde{S}_2}(x)$ (2 marks)

(b) $\mu_{\tilde{S}_1 \cap \tilde{S}_2}(x)$ (2 marks)

(c) $\mu_{\tilde{S}_1 \cup \tilde{S}_1}(x)$ (2 marks)

(d) $\mu_{\tilde{S}_1 \cap \tilde{S}_1}(x)$ (2 marks)

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Q4 TechnyCorp is planning a new product and has created the Fuzzy Associative Matrix as illustrated in **Table 1** to relate demand and manufactured cost to price. The following trapezoidal/triangular normalized membership functions have been estimated.

Demand (in millions of units annually)
 Small {100, 1 300, 0}
 Large {150, 0 350, 1}
 Manufactured Cost (in yen per unit)
 Cheap {10, 1 20, 0}
 Expensive {12, 0 24, 1}
 Price (in cost per unit)
 Low {20, 1 35, 0}
 Medium {25, 0 35, 1}
 High {35, 0 50, 1}

Table 1: Fuzzy Associative Matrix

Price		
	Manufactured Cost	
Demand	Cheap	Expensive
Small	Low	Medium
Large	Medium	High

Answer the following questions:

- (a) Design a fuzzy system which accommodates the given situation. (4 marks)
- (b) Construct the rule base statements for the given situation. (8 marks)
- (c) Draw the membership functions graphs for all the fuzzy input(s) and output. (12 marks)
- (d) If the Demand Forecast = 250 and the Manufactured Cost Forecast = 15, decide upon Price using the max-min technique and centroid defuzzification (Estimate your own centroid location). (10 marks)

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Q5 Answer the following based on **Table 2**.

Table 2: BMI categories

Variable	Categories	Range
Height	Short	Less than 5 feet
	Medium	5' 3½ " to 5' 88.5½ "
	Tall	Greater than > 6 feet
Weight	Underweight	< 110lbs.
	Normal	110 lbs to 150 lbs
	Overweight	Greater than 150
BMI	Underweight	Less than 18.5
	Healthy weight	18.5 – 24.9
	Overweight	More than 25

- (a) Draw a fuzzy system design using suitable diagram. (4 marks)

- (b) Identify and write the linguistic variable and the linguistic value. (12 marks)

- (c) Draw a membership function graph for each system inputs and output based on **Table 2**. (15 marks)

- (d) Construct fuzzy rule based on the Fuzzy Associative Memory (FAM) in **Figure Q5(d)**.

Height	Short	Medium	Tall
Weight			
Underweight	Underweight	Underweight	Healthy
Normal	Underweight	Healthy	Healthy
Overweight	Overweight	Overweight	Overweight

Figure Q5(d)

(9 marks)

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- END OF QUESTIONS -