



UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION  
SEMESTER I  
SESSION 2022/2023

COURSE NAME : FUZZY SYSTEM DEVELOPMENT

COURSE CODE : BIT 33703

PROGRAMME CODE : BIT

EXAMINATION DATE : FEBRUARY 2023

DURATION : 3 HOURS

INSTRUCTION : 1. ANSWERS **ALL** QUESTIONS.

2. THIS FINAL EXAMINATION  
CONDUCTED VIA **CLOSED BOOK**.

3. STUDENTS ARE **PROHIBITED** TO  
CONSULT THEIR OWN MATERIAL  
OR ANY EXTERNAL RESOURCES  
DURING THE EXAMINATION  
CONDUCTED VIA CLOSED BOOK.

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

- Q1** (a) Explain why the Fuzzy System require knowledge from the domain application. (2 marks)
- (b) Explain how knowledge acquisition processes can become complex and complicated. (4 marks)
- (b) Differentiate between classical rules and fuzzy rules. (4 marks)
- Q2** Consider a universe of discourse of  $A$  is  $X = \{1, 2, 3, 4, 5, 6, 7, 8, 9, 10\}$ . The membership function defined as  $\mu_A(x) = x / (x + 2)$ . Find the  $\alpha$ -cut that corresponds to  $\alpha = 0.5$ . (2 marks)

- Q3** Let  $X$  be the universe of commercial aircraft of interest,  
 $X = \{a10, b52, b117, c5, c130, f4, f14, f15, f16, f111, kc130\}$

Let  $A$  be the fuzzy set passenger class aircraft,

$$A = \left\{ \frac{0.3}{f16}, \frac{0.5}{f4}, \frac{0.4}{a10}, \frac{0.6}{f14}, \frac{0.7}{f111}, \frac{1.0}{b117}, \frac{1.0}{b52} \right\}$$

Let  $B$  be the fuzzy set of cargo,

$$B = \left\{ \frac{0.4}{b117}, \frac{0.4}{f111}, \frac{0.6}{f4}, \frac{0.8}{f15}, \frac{0.9}{f14}, \frac{1.0}{f16} \right\}$$

Find the following membership functions using standard fuzzy operations.

- (a)  $\mu_A \cup \mu_B(x)$  (4 marks)
- (b)  $\mu_A \cap \mu_B(x)$  (4 marks)
- (c)  $\mu_{\bar{A}}(x)$  (4 marks)
- (d)  $\mu_{\bar{B}}(x)$  (4 marks)

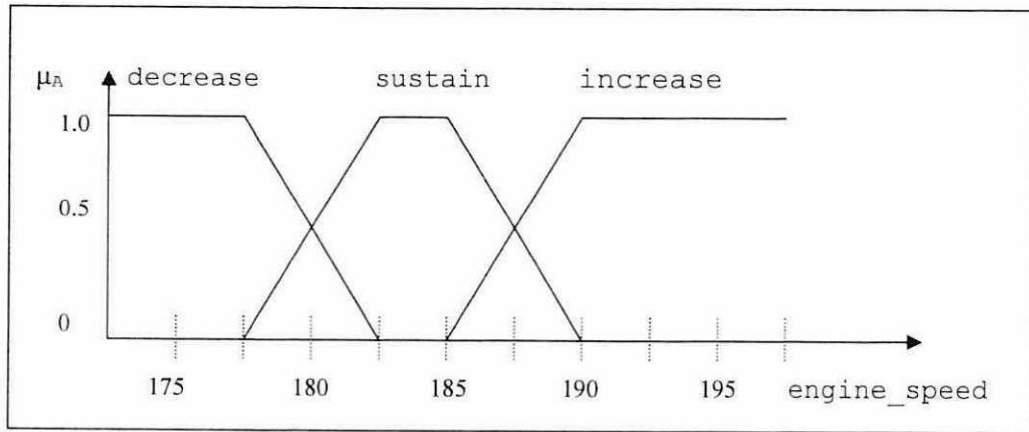
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**Q4** Consider the following fuzzy set.

$$tall\_men = \left\{ \frac{0}{175}, \frac{0.25}{177.5}, \frac{0.5}{180}, \frac{0.75}{182.5}, \frac{1}{185} \right\}$$

- (a) Draw the membership function for `tall_men`. (2 marks)
- (b) What is the complement of the following fuzzy set of `tall_men`? (2 marks)
- (c) If Ahmad has a 0.86 membership in the set of `tall_men`, what will be a membership in the set of `very_all men`? (4 marks)

**Q5** Answer questions **Q5(a) – Q5(c)** based on **Figure Q5**.



**Figure Q5**

- (a) Identify and write the linguistic variable and the linguistic value. (4 marks)
- (b) Write the fuzzy set expression for the fuzzy membership functions of `engine_speed`. (8 marks)
- (c) **Figure Q5** shows the membership functions of `engine_speed`. Explain using the membership graph and calculate the Center of Gravity defuzzification process. Given the `DECREASE=0.2`, `SUSTAIN=0.5` and `INCREASE=0.8`. (12 marks)

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- Q6** IntelliCorp manufactures a new washing machine and has created the data as illustrated in **Table Q6** to relate `dirt_type` and `dirt_level` to `wash_time`.

**Table Q6:** `cycle_time`

Variable	Categories	Range
<b>Dirty Type</b>	Less dirty	Less than 25
	Dirty	20 to 30
	Very Dirty	25 to 35
	Extremely Dirty	Greater than 30
<b>Dirtiness Level</b>	Non-greasy	Less than 20%
	Less greasy	15% to 40%
	Greasy	25% to 60%
	Very greasy	Greater than 55%
<b>Washing Time</b>	short	Less than 30 minutes
	medium	20 to 60 minutes
	long	More than 50 minutes

- (a) Based on **Table Q6**, write the fuzzy set expression for the following fuzzy variable
- (i) `dirt_type` (8 marks)
  - (ii) `dirt_level` (8 marks)
- (b) Based on **Table Q6**, draw the membership function graph for fuzzy variable for `wash_time`. (4 marks)

- END OF QUESTIONS -

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