

# 國立臺北科技大學

## 106 學年第一學期電機系博士班資格考試

### 模糊控制 試題

第一頁 共二頁

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#### 注意事項：

1. 本試題共【5】題，配分共 100 分。
2. 請按順序標明題號作答，不必抄題。
3. 全部答案均須答在試卷答案欄內，否則不予計分。
4. 考試時間：二小時。
5. 不准使用任何形式之計算器。

1. Let  $U$  be the universe of discourse, and a fuzzy set  $F, F \subset U$ . Show that the law of the excluded middle,  $F \cup \bar{F} = U$  is not true. (15 分)
2. Consider fuzzy set  $B = \frac{0.6}{-2} + \frac{0.8}{-1} + \frac{0.5}{0} + \frac{0.4}{1} + \frac{0.3}{2} + \frac{0.9}{3}$  and function  $f(x) = x^2$ . Determine the fuzzy set  $f(B)$  using the extension principle. (15 分)
3. Consider the three binary fuzzy relations defined by the relational matrices:

$$Q_1 = \begin{pmatrix} 0.6 & 0 & 0.1 \\ 0.6 & 0.2 & 0 \\ 0 & 0.4 & 1 \end{pmatrix}, \quad Q_2 = \begin{pmatrix} 0.6 & 0.6 & 0.1 \\ 0.4 & 0.2 & 0.1 \\ 0 & 0.1 & 0.1 \end{pmatrix}, \quad Q_3 = \begin{pmatrix} 0 & 0.3 & 0.5 \\ 0.4 & 0.2 & 0.1 \\ 0.4 & 0.4 & 1 \end{pmatrix}.$$

Compute the max-min compositions: (a)  $Q_1 \circ Q_2$  (b)  $Q_1 \circ Q_3$  and (c)  $Q_1 \circ Q_2 \circ Q_3$ . (25 分)

4. Let  $U = \{2, 3, 4, 5\}$  and  $V = \{1, 2, 3\}$ . Suppose that  $x \in U, y \in V$  and use the following fuzzy IF-THEN rule:

IF  $x$  is  $A$ , THEN  $y$  is  $B$

Where the fuzzy sets  $A$  and  $B$  are defined as

$$A = \frac{0.6}{2} + \frac{0.8}{3} + \frac{0.5}{4} + \frac{0.4}{5} \quad \text{and} \quad B = \frac{0.3}{1} + \frac{0.7}{2} + \frac{0.2}{3}$$

Compute the implications using (a) Mamdani minimum implication (b) Mamdani product

implication. (20 分)

5. Consider a two-input-one-output fuzzy system and two fuzzy rules:

*IF*  $x_1$  is  $A$  and  $x_2$  is  $B$ , *THEN*  $y$  is  $A$

*IF*  $x_1$  is  $B$  and  $x_2$  is  $A$ , *THEN*  $y$  is  $B$

Where  $A$  and  $B$  are fuzzy sets in  $\mathbf{R}$  with membership functions

$$\mu_A(u) = \begin{cases} 1 - |u + 1| & \text{if } -2 \leq u \leq 0 \\ 0 & \text{otherwise} \end{cases}$$

$$\mu_B(u) = \begin{cases} 1 - |u| & \text{if } -1 \leq u \leq 1 \\ 0 & \text{otherwise} \end{cases}$$

If the input to the fuzzy system is  $(x_1^*, x_2^*) = (-0.7, -0.4)$  and use the singleton fuzzifier.

Determine the output of the fuzzy system  $y^*$  using product inference engine and center average defuzzifier. (25 分)