STIN3073 CONFIDENTIAL

UUM
Universiti Utara Malaysia

FINAL EXAM
FIRST SEMESTER SESSION 2011/2012

COURSE CODE / NAME : STIN3073 FUZZY LOGIC SYSTEM
DATE : 10 JANUARY 2012 (TUESDAY)
TIME : 9.00 – 11.30 AM (2 ½ HOURS)
VENUE : DSB K.TM

INSTRUCTION :

1. This exam paper contains SIX(6) structured questions and ONE(1) case study in NINE(9) printed pages, excluding the cover page.
2. Answer questions in SECTION A in the space provided and answer questions in SECTION B on the answer sheets provided.
3. You are NOT ALLOWED to remove the exam paper from the examination hall.

MATRIC NO : ____________________________ ( with word ) ____________________________ ( with number )
IDENTIFICATION CARD NO : ____________________________
LECTURER : ____________________________
GROUP : ______________________ TABLE NO : ____________________________

DO NOT OPEN THIS EXAMINATION PAPER UNTIL INSTRUCTED

CONFIDENTIAL
STIN3073 Fuzzy Logic System

SECTION A: STRUCTURED QUESTIONS (60 MARKS)

1. a) Give the definition of fuzzy logic based on your understanding. (2 marks)

b) What is the difference between classical set (crisp set) and fuzzy set? (2 marks)

c) Fuzzy logic is widely used in control problems. Give TWO (2) examples of fuzzy logic technologies used to solve such problems. (2 marks)
2. a) Given a classic example of tall men, define its linguistic variable and THREE (3) fuzzy sets associated to that particular variable.

(4 marks)

b) Based on your answer in (a), represent the fuzzy sets into fit vector with degree of membership values for each element in the sets given that the universe of discourse is as follows (in cm):

   Height - 200, 195, 190, 185, 180, 175, 170, 165, 160, 155, 150.

(6 marks)
3. a) List THREE (3) types of membership functions available for use in fuzzy logic. 

(b) Given a membership function as the following, draw the consequent functions if complement operation is performed.
c) Based on the given fuzzy logic structure of a terrain robot, Mars Rover, is the structure complete for a fuzzy logic based application? Explain why.

4. a) Name the **TWO (2)** processes involved in fuzzy inference. 

(2 marks)

b) Based on the following ‘how to buy fresh fish’ problem, construct a set of **fuzzy rules**:

“If you go to the fishmonger at a market to buy some fresh fish, you must know how to identify one. First, look at the eyes of the fish. If the eyes are reddish then the fish is no longer fresh, if the eyes are clear then the fish is fresh. Another tip is to look at the fish’s gills. The gills should be in rich red for the fish to be fresh. Otherwise, if the gills look pale red then it indicates that the fish is somewhat old and no longer fresh.”

(8 marks)
c) Based on the fuzzy rules in (b), construct a fuzzy associative memory (FAM) accordingly.

(5 marks)

5. a) List TWO (2) most widely used defuzzification functions and why are they normally used?

(3 marks)
b) Using Center of Area (CoA), defuzzify the aggregated fuzzy set.

(5 marks)
c) Explain briefly the issues concerning the defuzzification phase of a fuzzy logic system.

(4 marks)

d) List down THREE (3) criteria of choosing the defuzzification functions.

(3 marks)

6. What is the most laborious and tedious part in developing a fuzzy logic decision support system and why?

(3 marks)
SECTION B: CASE STUDY (40 MARKS)

1. Answer the following questions based on the sample application of fuzzy logic as described below:

**Fuzzy Logic Washing Machine**

Fuzzy-based washing machine is a common technology application everywhere. To design a fuzzy washing machine, many input variables need to be defined. However, to reduce complexity the problem of designing fuzzy washing machine is simplified by considering only two input variables – “Degree of dirt” and “Type of dirt”. Figure 1 shows the basic approach to the washing problem. The fuzzy controller takes two inputs, processes the information and outputs a wash time. The degree of dirt is determined by the transparency of the wash water. Dirtier clothes shall result in less transparent water that is being analyzed by the sensors. On the other hand, type of dirt is determined by the time of saturation, i.e. the time it takes to reach saturation. Saturation is a point, at which there is no more appreciable change in the colour of the water. The degree of dirt determines how dirty a cloth is where as the type of dirt determines the quality of dirt. Greasy clothes, for example, take longer for water transparency to reach transparency because grease is less soluble in water than other forms of dirt. Thus a fairly straightforward sensor system can provide us the necessary input for our fuzzy logic controller.

![Diagram](image)

**Figure 1:** The basic two input and one output fuzzy washing machine to determine the wash time.

Design a fuzzy logic system for an intelligent washing machine taking into considerations the input and output variables as defined in Figure 1. Your design must incorporate all phases involved in a fuzzy logic system:

- Fuzzification (16 marks)
- Fuzzy inference (15 marks)
- Defuzzification (9 marks)

Illustrate your answer where necessary.

END OF QUESTION