UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2011/2012

COURSE NAME	:	FUZZY SYSTEM DEVELOPMENT
COURSE CODE	:	BIT 3373
PROGRAMME	:	BACHELOR OF INFORMATION TECHNOLOGY
DATE	:	JANUARY 2012
DURATION	:	2 HOURS AND 30 MINUTES
INSTRUCTION	:	ANSWER **ALL** QUESTIONS.

THIS QUESTION PAPER CONSISTS OF FIVE (5) PAGES

Instruction: Answer **ALL** questions.

Q1 (a) State **TWO (2)** basic Fuzzy Logic operators

(2 marks)

(b) For each operator in **Q1(a)** write its corresponding mathematical expression

(4 marks)

Q2 Describe **TWO (2)** conditions in which Fuzzy Logic is beneficial for?

(4 marks)

Q3 Explain **TWO (2)** rules of thumb which are helpful in defining fuzzy set.

(4 marks)

Q4 Describe the role in each phase of a fuzzy system development:

(a) fuzzification
(b) fuzzy rule inference
(c) aggregation
(d) defuzzification

(8 marks)

Q5 Choose **ONE (1)** application from the following:

(i) Medical application.
(ii) Hydrological or meteorological forecasting
(iii) Automotive application.

Based on the chosen application,

(a) Determine **ONE (1)** possible problem to be solved.

(2 marks)

(b) State **TWO (2)** linguistic variables.

(4 marks)

(c) State **THREE (3)** linguistic terms for each linguistic variable.

(6 marks)

Q6 Given the rule below for fruit grading,

```
if COLOR_AND_SHAPE is perfect and SURFACE is slight_defect
then GRADE is superior
```

Use your assumption to:

(a) Provide other **FOUR (4)** possible rules for the problem.

(4 marks)

(b) Draw a detailed input and output membership functions for the rules provided in **Q6(a)** (each membership function should have at least **THREE (3)** fuzzy sets).

(8 marks)

Q7 Given a degree of membership for object x to be in the following fuzzy sets; A, B and C:

```
m(x,A):= 0.4,
m(x,B):= 0.3,
m(x,C):=0.7.
```

Compute:

(a) `m(x , (A and B))`

(2 marks)

(b) `m(x , (A or B))`

(2 marks)

(c) `m(x , (A and B) - complement(C) )`

(2 marks)

Q8 **Figure Q8** shows fuzzy graphs for membership functions A and B. Sketch a new graph yielded from the result of the operation A OR B.

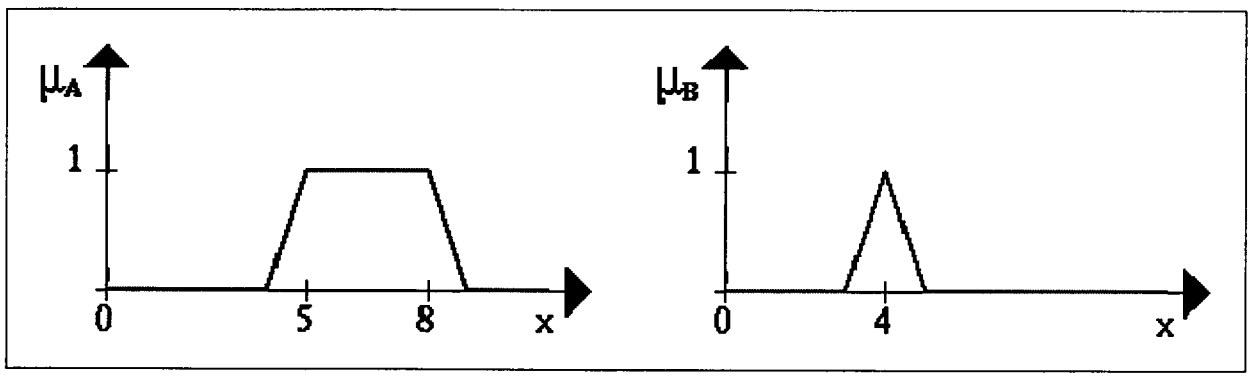

Figure Q8

(4 marks)

Q9 Convert the **crisp** membership function in **Figure Q9** below into **fuzzy** membership function.

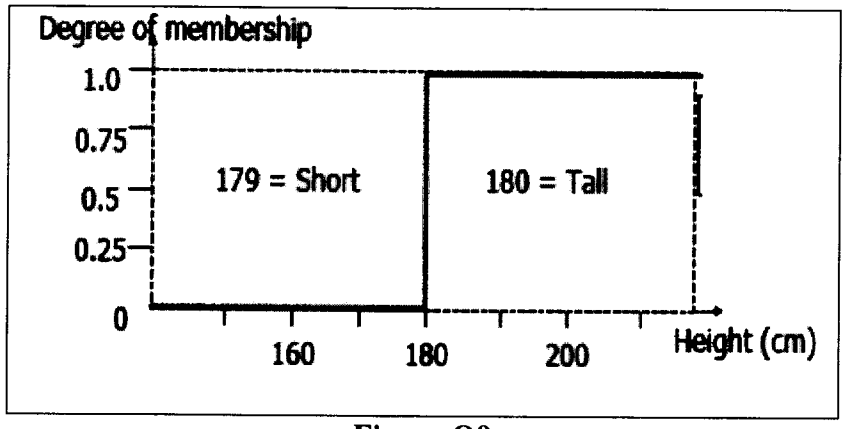

Figure Q9

(4 marks)

Q10 Given the case study, answer the following questions:

A factory process control operation involves two linguistic parameters consisting of pressure and temperature in a fluid delivery system. Nominal pressure limits range from 400 to 1000 psi maximum. Nominal temperature limits are 130F to 140F. Each parameter in fuzzy linguistic terms is characterized as follows:

"Low" temperature={1/0,.....,1/130,1/131,0.8/132,0.6/133,0.4/134,0.2/135,0/136}
"High" temperature={0/134,0.2/135,0.4/136,0.6/137,0.8/138,1/139,1/140}
"Low" pressure = {1/400, 0.8/500, 0.6/600, 0.4/700, 0.2/800, 0/900}
"High" pressure = {0/400, 0.2/500, 0.4/600, 0.6/700, 0.8/800, 1/900}

From the details above, draw the membership functions for:

(a) variable `temperature`

(4 marks)

(b) variable `pressure`

(4 marks)

(c) variable `temperature` with fuzzy set **NOT** "`Low`" and **NOT** "`High`".

(6 marks)

Q11 In a normal situation while driving, human drivers use the following three types of rules:

```
IF speed is slow, THEN apply more force to accelerator.
IF speed is medium, THEN apply normal force to the accelerator.
IF speed is fast, THEN apply less force to the accelerator.
```

The membership functions in **Figure Q11** translates a speed of 55 into fuzzy values of `SLOW = 0.25, MEDIUM = 0.75` and `FAST = 0`.

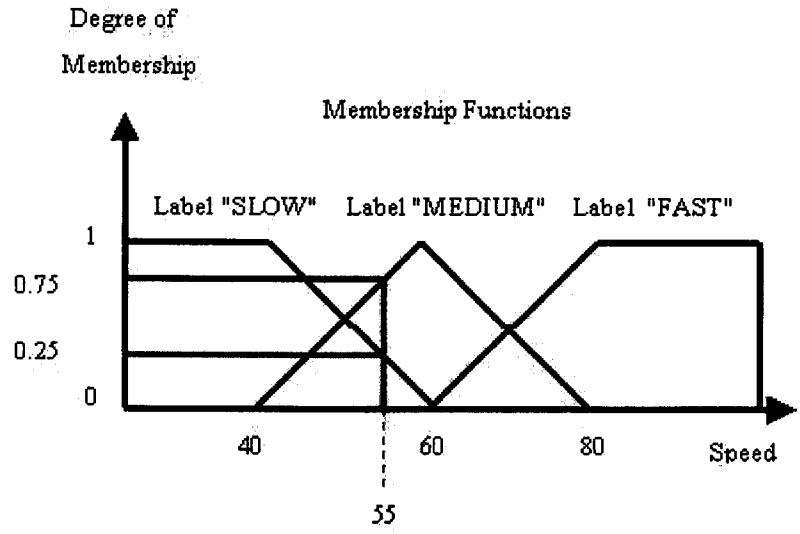

Figure Q11

Accordingly, the fit vectors for accelerator force is given as below:

```
LESS = {1/0, 1/20, 0.5/30, 0/40}
NORMAL = { 0/20, 0.5/30, 1/40, 1/50, 0.5/60, 0/70}
MORE = {0/50, 0.5/60, 1/70, ....., 1/100}
```

(a) Plot a graph resulted from aggregation (composition) process.

(10 marks)

(b) Evaluate the crisp output for the accelerator force by using **TWO (2)** defuzzification methods;

(i) Mean-Max.

(8 marks)

(ii) Center of Gravity

(8 marks)