Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2013/2014

COURSE NAME	:	MECHATRONIC MECHANISM
COURSE CODE	:	BEH 41103
PROGRAMME	:	BEJ
EXAMINATION DATE	:	DECEMBER 2013
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER **ALL** QUESTIONS

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

Q1 A gear system consists of five (5) gears as in Figure Q1. Where gear A has T_A teeth, gear B has 150 teeth, gear C has 50 teeth, gear D has 500 teeth and gear F has 80% of the number of teeth of gear A.

(a) Calculate the gear ratio (GR).

(10 marks)

(b) Calculate the number of teeth of gear A and gear F.

(5 marks)

(c) Determine the directions of gear A and gear F rotation if gear C rotates anti-clockwise.

(5 marks)

Q2 A belt system has slack tension which is 10% of tight tension. Maximum power transmitted by belt is 60.5 kW. Speed of belt is 1500 rpm and belt embraces the shorter pulley by angle 45°. The width of the belt is 0.3m and the thickness is 0.005m. Its density is 500 kg/m^3.

(a) Evaluate the maximum permissible stress of the belt.

(15 marks)

(b) Determine the friction coefficient of the belt.

(5 marks)

Q3 (a) List four (4) types of gear.

(8 marks)

(b) Describe the following terms:

(i) static balancing

(2 marks)

(ii) dynamic balancing

(2 marks)

(iii) gear system

(2 marks)

(iv) belt.

(2 marks)

(c) Explain the pitch surface and backlash of a gear.

(4 marks)

Q4 (a) Moving a rigid body resting on a rough horizontal plane can be done in two ways. The first way is by pulling the body with 180 N of force inclined at 30° to the plane. The second way is by pushing the body with 200 N of force inclined at 30° to the plane. Determine the weight of the body and the coefficient of friction.

(10 marks)

(b) A double acting hydraulic cylinder has a bore of 100 mm. The rod is 40 mm diameter and the stroke is 0.120m. It must produce a pushing force of 12 kN. The flow rate available in both directions is 0.0002 m^3/sec. Assume ideal conditions. Calculate:

(i) The required pressure of the system.

(2 marks)

(ii) The pulling force at the same pressure.

(2 marks)

(iii) The speed on the outward stroke.

(2 marks)

(iv) The speed of retraction.

(2 marks)

(v) The power used on the outstroke

(2 marks)

Q5 Figure Q5 shows a rocking lever mechanism in which steady rotation of the wheel produces an oscillating motion of the lever OA. Both the wheel and the lever are mounted in fixed centres. The wheel rotates clockwise at a uniform angular velocity (ω) of 100 rad/s. The lengths of the links are as follow: BC = 25 mm AB = 100 mm OA = 50 mm and OC = 90 mm.

(a) Determine the angular velocity of the link AB and the absolute velocity of point A.

(8 marks)

(b) Determine the centrifugal accelerations of BC, AB and OA.

(3 marks)

(c) Evaluate the magnitude and direction of the acceleration of point A.

(9 marks)

- END OF QUESTION -

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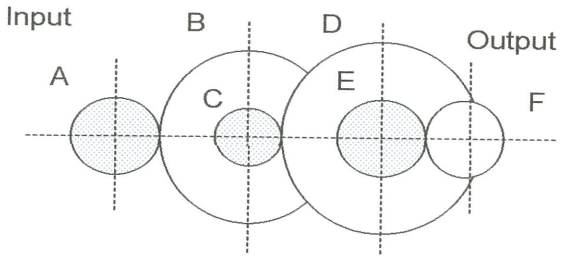

FIGURE Q1

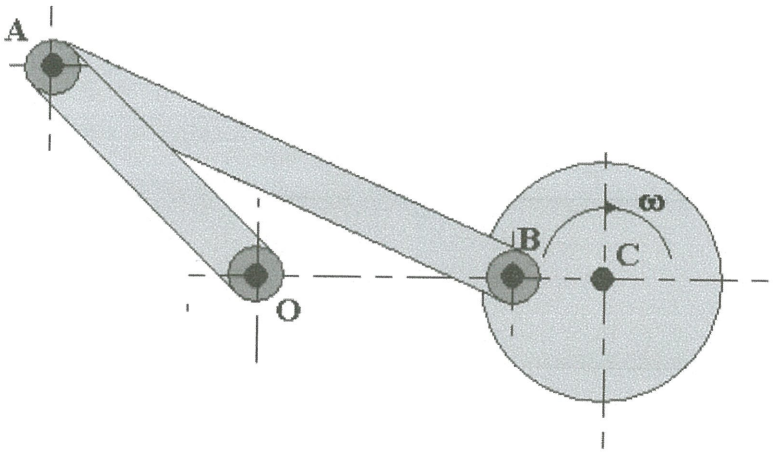

FIGURE Q5

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FINAL EXAMINATION
SEMESTER I
SESSION 2013/2014

COURSE NAME	: INTELLIGENT CONTROL SYSTEM
COURSE CODE	: BEH 41803
PROGRAMME	: BEJ
EXAMINATION DATE	: JANUARY2014
DURATION	: 3 HOURS
INSTRUCTION	: ANSWER **ALL** QUESTIONS

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

Q1 Fuzzy control system is applied to control arm robot gripper position by controlling input voltage of the motor. Motor has function as an actuator of the robot gripper. The type of fuzzy control system is Sugeno type. Fuzzy control system has two inputs: error (e) and change in error (Δe), and output is the input voltage of the motor. Error and change in error have same fuzzy sets as in Figure Q1. Fuzzy output sets consist of Negative Big (NB), Negative Medium (NM), Negative Small (NS), Zero (Z), Positive Small (PS), Positive Medium (PM), Positive Big (PB) and position at -6, -4, -2, 0, 2, 4 and 6 respectively. Rule tabulation of fuzzy control system is represented in Table Q1. If error (e) and change in error (Δe) values are -1.5 and 2.2 respectively:

(a) Create the possible rule fire based on max-max method related with error (e) and change in error (Δe) value

(3 marks)

(b) Determine each rule quantification

(20 marks)

(c) Draw the clipping of the rule quantification result

(1 mark)

(d) Evaluate the crisp value of throttle angle using weighted average defuzzyfication

(1 mark)

Q2 A Takagi-Sugeno (T-S) fuzzy model is derived from nonlinear equation below:

$$\begin{cases} \dot{x}_1 = x_2 \\ \dot{x}_2 = x_1^2 + 2x_2^2 + u \end{cases}$$

Assumed that $x_1 \in [0.5, 3.5]$ and $x_2 \in [-1, 4]$, x_1 and x_2 are nonlinear terms in the equations. As a premise, assumed that $x_1 = z_1$ and $x_2 = z_2$. T-S fuzzy model has rules with max method and have fuzzy set as Positive, Negative, Small and Big. The value of $x_1 = z_1 = 2.75$ and $x_2 = z_2 = 0.25$.

(a) Construct the membership function graph

(4 marks)

(b) Evaluate the quantification based on values of $x_1 = z_1$ and $x_2 = z_2$

(10 marks)

(c) Calculate inference based on rule result.

(10 marks)

(d) Calculate the defuzzification result.

(1 mark)

Q3 (a) A Steepest Descent Backpropagation (SDBP) neural network is represented in Figure Q3. The initial weights of the networks are: $w_1 = 0.01$, $w_2 = -0.01$ and $w_3 = 0.11$. Activation function for hidden layer and output layer is $f(net) = \frac{1}{1+e^{-net}}$ with a learning rate (η) at 0.6. Neural network is used to evaluate input $x_1 = 0.2$, $x_2 = 0.3$ and target $t = 0.15$.

i) Evaluate the value of each weight.

(18 marks)

ii) Draw MSE for first iteration.

(2 marks)

(b) Explain the steps to implement neural network control.

(5 marks)

Q4 (a) Describe fuzzification, rule base, inference mechanism, and defuzzification.

(4 marks)

(b) Draw a block diagram of Adaptive Neuro Fuzzy Inference System (ANFIS).

(2 mark)

(c) Explain six (6) fuzzy inference system considerations related to neuro fuzzy.

(9 marks)

(d) Analyze the program below, deduce its mistake and propose the correction.

```
1.  load mgdata.dat;
2.  t = mgdata(:,1);
3.  x = mgdata(:,2);
4.  plot(t,x)
5.     for t=118:1117,
6.        Data(t-117,:)=[x(t-18) x(t-12) x(t-6) x(t) x(t+6)];
7.     end
8.  trnData=Data(1:500, :);
9.  chkData=Data(501:end, :);
10. genfis1 = fismat (trnData);
11. plotmf(fismat, 'input')
```

(10 marks)

- END OF QUESTION –

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Table Q1

Voltage (V)		Error (e)						
		NB	NM	NS	ZE	PS	PM	PB
Change in Error (Δe)	NB	PB	PB	PM	PM	PS	PS	ZE
	NM	PB	PM	PM	PS	PS	ZE	NS
	NS	PM	PM	PS	PS	ZE	NS	NS
	ZE	PM	PS	PS	ZE	NS	NS	NM
	PS	PS	PS	ZE	NS	NS	NM	NM
	PM	PS	ZE	NS	NS	NM	NM	NB
	PB	ZE	NS	NS	NM	NM	NB	NB

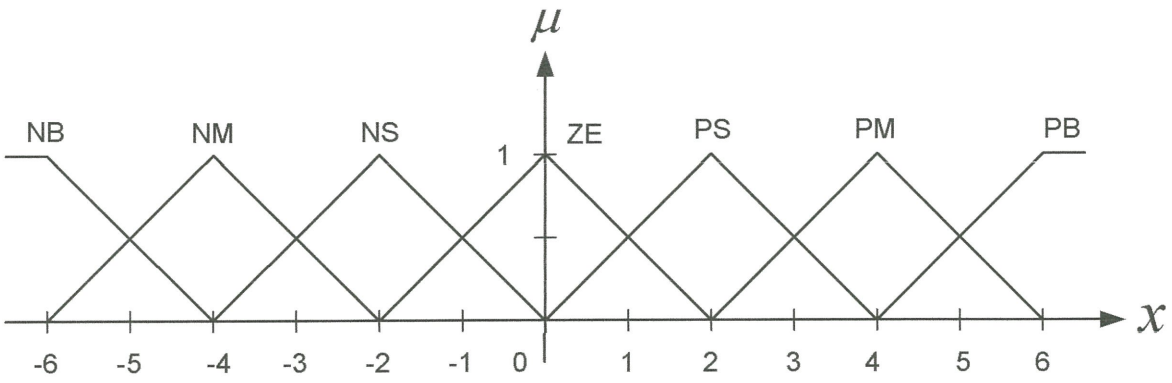

FIGURE Q1

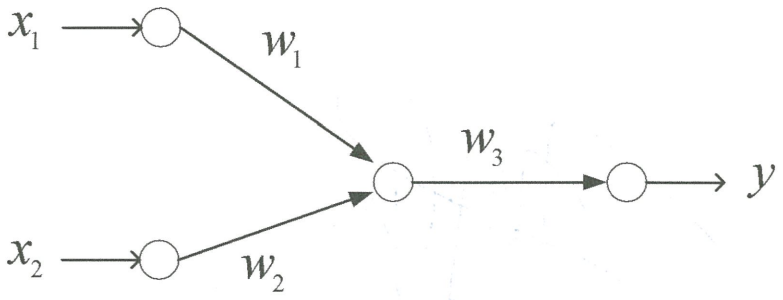

FIGURE Q3