[This question paper contains 5 printed pages.]

Your Roll No. .....

3216 **J**

MEE

Paper—EE.603

MODELLING, IDENTIFICATION AND CONTROL

Time : 3 *Hours* *Maximum Marks* : 100

(Write your Roll No. on the top immediately on receipt of this question paper.)

Attempt any ***five*** *questions.*

All *questions carry equal marks.*

Assume suitable data, if any.

Use of scientific calculator allowed.

1. (a) Point out the differences between estimation and identification. Derive the expression of state estimator using recursive least square algorithm. 10

(b) Compute the parameters and states of a second order system, if the measured output and input for it are given as below :

$y(0) = 2,\ y(1) = 1,\ y(2) = 5,\ y(3) = -2,\ y(4) = 0$

$u(0) = 1,\ u(1) = 2,\ u(2) = -1,\ u(3) = 0,\ u(4) = -2$

$y(5) = -6, \qquad y(6) = 7$

$u(5) = 3, \qquad u(6) = 4$ 10

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2. (a) State the Ackermann's formula for state feedback gain vector, k. Consider the system $x(k+1) = Gx(k) + Hu(k)$, where $G = \begin{bmatrix} 0 & 1 \\ -0.16 & -1 \end{bmatrix}$, $H = [0 \quad 1]^t$. Determine a suitable state feedback gain matrix such that the system will have the closed loop poles at $z = 0{\cdot}5 + j\ 0{\cdot}5$ and $z = 0{\cdot}5 - j\ 0{\cdot}5$. 10

(b) State and derive the necessary and sufficient condition for arbitrary pole placement, such that the closed loop poles meet the requirements. 10

3. (a) What do you understand by a mathematical model of a process plant ? Derive the model of a digital PID controller. 6

(b) Design the PID tuning parameters using direct synthesis approach. 7

(c) Design a controller for the following first order system :

$$g(s) = \frac{0.66}{6.75+1}$$

Using the direct synthesis approach and given that the desired closed loop behaviour is the first-order response with $C_r = 5$. 7

4. (a) State the criteria for selection of membership functions. For temperature measurement, HOT in fuzzy logic membership may be defined as :

$$\mu_{HOT} = \begin{cases} 0 & \text{if } 0°C \le T \le 50°C \\ \dfrac{T-50}{20} & 50°C \le T \le 70°C \\ 1 & 70°C \le T \le 100°C \end{cases}$$

WARM in fuzzy logic membership may be defined as :

$$\mu_{WARM} = \begin{cases} \dfrac{T-25}{25} & \text{if } 25°C \le T \le 50°C \\ \dfrac{70-T}{20} & 50°C \le T \le 70°C \end{cases}$$

COLD in fuzzy logic membership may be defined as :

$$\mu_{COLD} = \begin{cases} 0 & T \le 50°C \\ \dfrac{50-T}{20} & \text{if } 25°C \le T \le 50°C \\ 1 & T \le 25°C \end{cases}$$

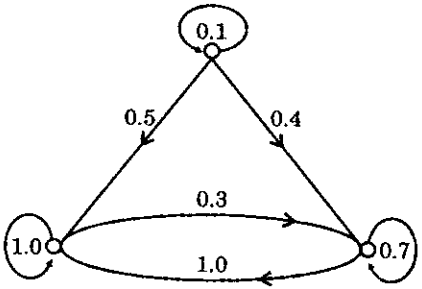
Draw the membership functions for temperature and find out membership for a temperature of 65°C. 10

(b) (i) The membership of fuzzy relation R is defined as

$$\mu_R(x, y) = \begin{cases} \dfrac{y-x}{x+y+2} & \text{if } y > x \\ 0 & \text{if } y \le 0 \end{cases}$$

if $x = \{1, 2, 3\}$ and $y = \{1, 2, 3, 4, 5, 6\}$, express the fuzzy relation R as matrix.

(ii) For the network shown below, write the expression for fuzzy relation R.



10

5. (a) Point out the differences between Model-reference adaptive control, schedule adaptive control and self tuning adaptive control. What are the different mechanism for the adaptation of the controller parameter ? Explain with block diagram. 10

(b) Draw the block diagram of neural adaptive control system. Explain its principle of operation. 10

6. (a) State and derive the relation for dead beat control algorithm. What do you understand by ringing in case of dead beat algorithm ? 10

(b) Explain how the problem of ringing is taken care in Dahlin's algorithm. Explain the Dahlin's control algorithm. 10

7. (a) Point out the criteria for selecting the feedback control, feedforward control, ratio control and adaptive

control. Draw the block diagram of a scheme for steam control using ratio controller. 10

(b) Design a controller for the inverse time response system and delay function system. 10

8. Write notes on any *two* of the following : 2 × 10

(i) Position and velocity algorithm.

(ii) Model reduction.

(iii) Physical concepts and logics of fuzzy logic.