## Seventh Semester B.E. Degree Examination, Dec.2016/Jan.2017 **Control Engineering**

Max. Marks: 100 Time: 3 hrs.

Note: Answer any FIVE full questions, selecting atleast TWO questions from each part.

## PART - A

Explain the following controllers with their transfer functions:

i) proportional

ii) integral

iii) integral proportional

iv) proportional integral differential controllers.

(12 Marks)

Explain open loop control system with its advantages and disadvantages.

(08 Marks)

Considering small deviations from steady state operation, draw a block diagram of the air heating system shown in Fig. Q2(a). Assume that the heat loss to surroundings and the heat (08 Marks) capacitance of the metal parts of the heater are negligible.

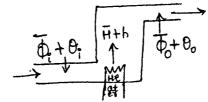


Fig. Q2(a)

Determine system equations of the system shown in Fig. Q2(b). Draw f - v and f - i (12 Marks) analogies.

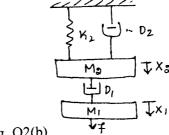


Fig. Q2(b)

Reduce the block diagram and obtain its loop T.F. C(s)/R(s).

(10 Marks)

(10 Marks)

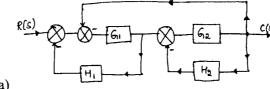


Fig. Q3(a)

b. Find  $\frac{C(s)}{R(s)}$ .

Fig. Q3(b)

1 of 2

4 a. A second order system has unity feedback and open loop transfer function:

$$G(s) = \frac{500}{s(s+15)}$$

- i) Draw the block diagram for closed loop system
- ii) What is characteristic equation?
- iii) What is damping ratio and natural frequency values?
- iv) Calculate  $T_p$ (peak time),  $M_p$ (peak overshoot) and  $T_s$  (setting time) for the system output response when excited by unit step input. (10 Marks)
- b. For a system with characteristic equation:

$$F(s) = s^6 + 3s^5 + 4s^4 + 6s^3 + 5s^2 + 3s + 2 = 0, examine stability.$$
 (10 Marks)

## PART - B

- 5 a. Define:
  - i) polar plot
  - ii) phase margin
  - iii) gain margin
  - iv) gain cross over frequency.

(08 Marks)

b. The open loop transfer function is  $\frac{(s+2)(s+8)}{s^3}$ . Is the closed loop system stable? if not, deduce the number of unstable poles. Use the Nyquist criterion to arrive at your answers.

(12 Marks)

6 Draw the Bode magnitude and phase angle plots for the transfer function:

$$G(s) = \frac{2000(s+1)}{s(s+10)(s+40)}.$$
 (20 Marks)

7 Sketch the complete root locus for the system having:

G(s)H(s) = 
$$\frac{k(s+5)}{(s^2+4s+20)}$$
. (20 Marks)

8 a. What is series and feedback compensation? Explain.

(06 Marks)

b. Consider the system with state equation:

$$\begin{bmatrix} \mathbf{x}_1 \\ \mathbf{x}_2 \\ \mathbf{x}_3 \\ \end{bmatrix} = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ -6 & -11 & -6 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} + \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix} \mathbf{u}(t)$$

Estimate the state controllability by: i) Kalman's test and ii) Gilbert's test. (14 Marks)