CBCS SCHEME

USN | | | | | | | | | | 15ME73

Seventh Semester B.E. Degree Examination, July/August 2022
Control Engineering

Time: 3 hrs. Max. Marks: 80

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

1 a. Explain open loop and closed loop control systems, with block diagram. What are the advantages and disadvantages of a closed loop system over an open loop system. **(10 Marks)**

b. What are the requirements of a Ideal Control system? Briefly explain. **(06 Marks)**

OR

2 a. Explain Feed forward and Feed backward control system with block diagram. **(06 Marks)**

b. What are control actions? Briefly explain proportional, proportional plus derivative and proportional plus derivative plus integral controllers, with block diagram. **(10 Marks)**

Module-2

3 a. Write the equilibrium equations for the mechanical system shown in Fig. Q3 (a), hence obtain transfer function $\frac{x_2(S)}{F(S)}$. **(08 Marks)**

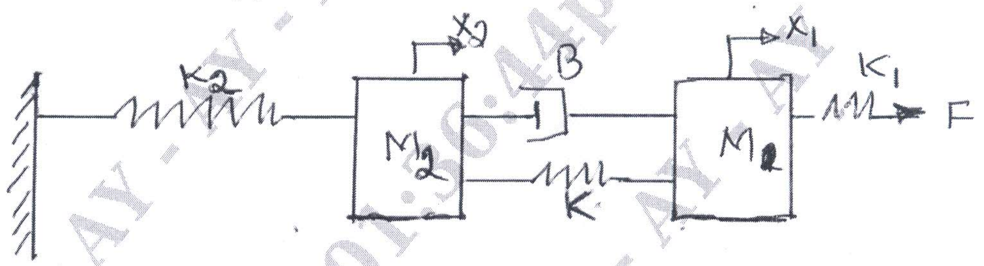

Fig. Q3 (a)

b. A thermometer is dipped in a vessel containing liquid at a constant temperature of $\theta_i(t)$. The Thermometer has a thermal capacitance for storing heat as C and the thermal resistance to limit heat flow as R. If the temperature indicated by the thermometer is $\theta_0(t)$, obtain the transfer function of the system. **(08 Marks)**

OR

4 a. Reduce the block diagram shown in Fig. Q4 (a) to its simplest possible form and find its closed loop transfer function. **(08 Marks)**

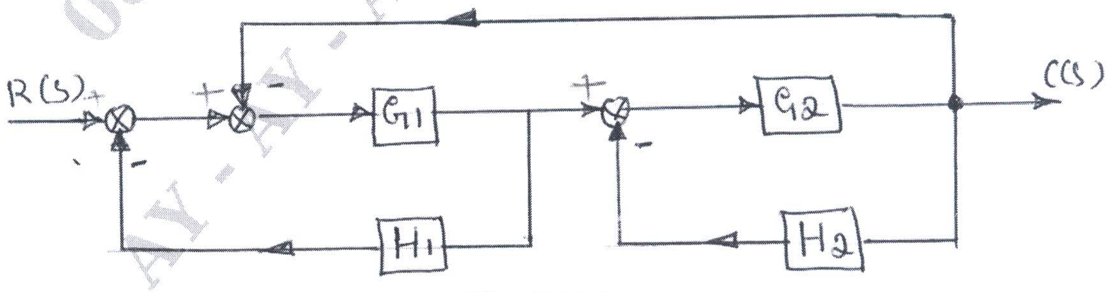

Fig. Q4 (a)

b. Use MANSON's gain formula to obtain transfer function of the system shown in Fig.Q4 (b). (08 Marks)

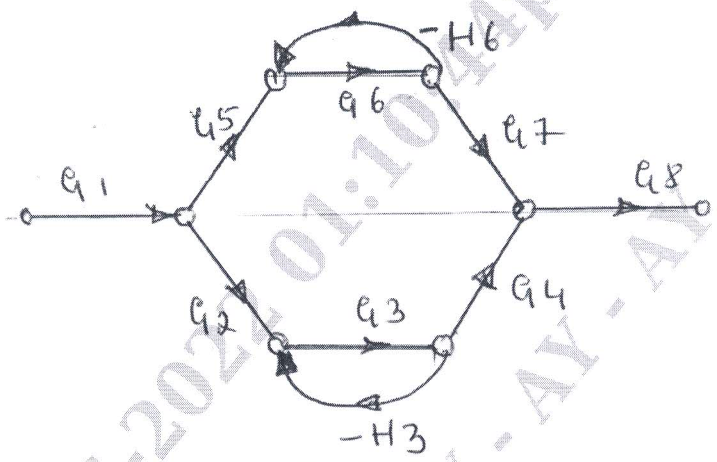

Fig. Q4 (b)

Module-3

5 a. Derive an expression for the unit step response of first order system. (08 Marks)

b. Ascertain the stability of the system given by the characteristic equation, $s^5+2s^4+3s^3+6s^2+2s+1=0$ using R-H criteria. (08 Marks)

OR

6 Sketch the root locus plot for, $G(s)H(s)=\dfrac{K}{s(s+1)(s+2)(s+3)}$. For what values of K the system becomes unstable. (16 Marks)

Module-4

7 a. Explain Gain cross over frequency, phase cross over frequency and Nyquist stability criterion. (04 Marks)

b. Apply Nyquist stability criterion to the system with transfer function, $G(s)H(s)=\dfrac{K}{s(s+2)(s+10)}$ and calculate the range of values of K for stability. (12 Marks)

OR

8 The open loop transfer function of a unity feedback system is,

$$G(s)=\frac{Ke^{-0.1s}}{s(1+0.1s)(1+s)}$$

Sketch the Bode plot, determine the value of K so that the gain margin of the system is 20 dB. (16 Marks)

Module-5

9 a. Explain state, state vector, state space. (03 Marks)

b. Explain series compensator. (03 Marks)

c. Derive the state model for the transfer function given below:

$$\frac{Y(s)}{u(s)}=\frac{12}{6s^3+12s^2+3s+24}.$$ (10 Marks)

OR

10 a. Explain state controllability and observability. **(04 Marks)**

b. Find the observability of the state model.

$$\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \\ \dot{x}_3 \end{bmatrix} = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ 0 & -2 & -3 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} + \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix} u$$

$$Y = \begin{bmatrix} 3 & 4 & 1 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix}$$

using Kalman's test. **(12 Marks)**

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