CBCS SCHEME

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18AE732

Seventh Semester B.E. Degree Examination, Feb./Mar. 2022
Control Engineering

Time: 3 hrs. Max. Marks: 100

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

Module-1

1 a. Write the concept of control system. Compare open loop and closed loop system. **(10 Marks)**

b. Explain the various requirements of an ideal control system. **(10 Marks)**

OR

2 a. Define transfer function. Explain the concept of transfer function for a closed loop control system. **(10 Marks)**

b. Write the differential equations governing the mechanical system show in Fig.Q2(b) and determine the transfer function of the system.

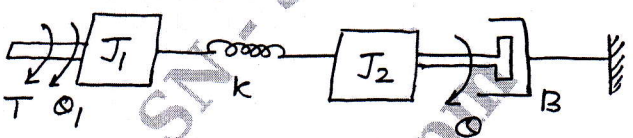

Fig.Q2(b) **(10 Marks)**

Module-2

3 a. Using the block diagram reduction technique find closed loop transfer function of the system whose block diagram is shown in Fig.Q3(a).

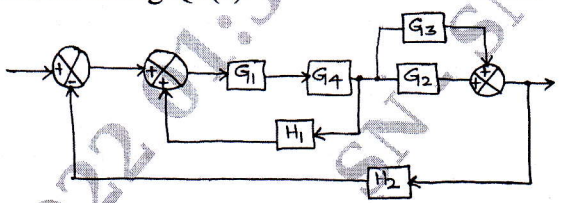

Fig.Q3(a) **(10 Marks)**

b. Find the overall transfer function of the system T(s), using Mason's gain formula whose signal flow graph is shown in Fig.Q3(b) below.

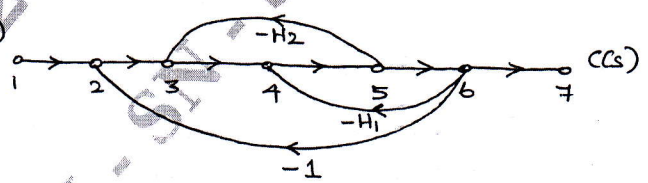

Fig.Q3(b) **(10 Marks)**

OR

4 a. Obtain an expression for time response of undamped second order system for unit step input. **(10 Marks)**

b. The unity feedback is characterized by an open loop transfer function $G(s) = \frac{k}{s(s+10)}$.

Determine the gain k, so that the system will have a damping ratio of 0.5 for this value of k. Determine peak overshoot and time at peak overshoot for unit step input. **(10 Marks)**

Module-3

5 a. Construct Routh array and determine the stability of the system whose characteristic equation is $s^6 + 2s^5 + 8s^4 + 12s^3 + 20s^2 + 16s + 16 = 0$. Also comment the location of roots on the s-plane. **(08 Marks)**

b. A unity feedback control system has an open loop transfer function $G(s) = \frac{k}{s(s^2+4s+13)}$.

Sketch the root locus. **(12 Marks)**

OR

6 Construct the bode plot for the open loop transfer function of a unity feedback system.

$$G(s) = \frac{k}{s(1+0.4s)(1+0.1s)}$$

Find :

i) Phase cross over frequency
ii) Gain cross over frequency
iii) Gain margin
iv) Phase margin. **(20 Marks)**

Module-4

7 a. The open loop transfer function of a unity feedback system is given by

$$G(s) = \frac{1}{s^2(1+s)(1+2s)}$$

Sketch the polar plot and determine the gain margin and phase margin. **(12 Marks)**

b. Explain the desired performed characteristics of a system with time response specifications. **(08 Marks)**

OR

8 a. Explain the concept of Nyquist stability criterion for the stability of control system in frequency domain. **(10 Marks)**

b. Discuss in detail about M and N circles. **(10 Marks)**

Module-5

9 a. Explain the following controllers with their transfer functions :

i) Proportional
ii) Integral
iii) Proportional integral
iv) Proportional integral differential controller. **(12 Marks)**

b. Enumerate series and feedback compensation with block diagram. **(08 Marks)**

OR

10 a. Write short note on the following terms :

i) State ii) state variables iii) state vector iv) state space v) state equation. **(10 Marks)**

b. Estimate the state controllability by :

i) Kalman test ii) Gilbert's test

for the given state equation.

$$\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \\ \dot{x}_3 \end{bmatrix} = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ -6 & 11 & -6 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} + \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix} u(t).$$ **(10 Marks)**

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