CBCS SCHEME

USN | | | | | | | | | | |

17MT34

Third Semester B.E. Degree Examination, Jan./Feb. 2021
Control Systems

Time: 3 hrs. Max. Marks: 100

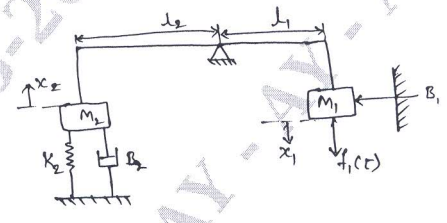
Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

1 a. Compare open loop control system and closed loop control system. **(10 Marks)**

b. Find $\frac{x_2(s)}{x_1(s)}$ for the Fig.Q.1(b) shown below. **(10 Marks)**

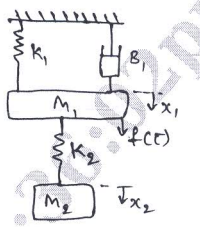
Fig.Q.1(b)



OR

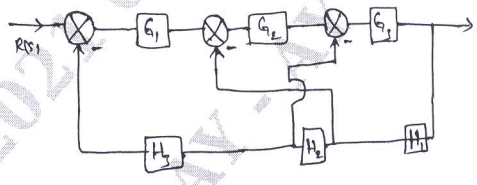
2 a. For the given system shown in Fig.Q.2(a) below, write the nodal diagram, and do the force current and force voltage analogy. **(12 Marks)**

Fig.Q.2(a)



b. Obtain $\frac{C(s)}{R(s)}$, using block diagram reduction techniques. (Refer Fig.Q.2(b)) **(08 Marks)**

Fig.Q.2(b)

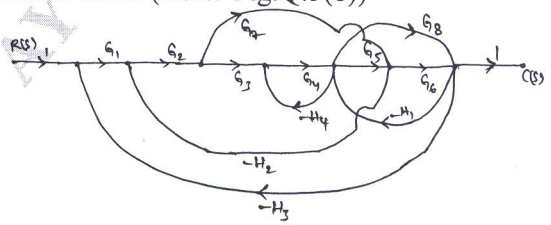


Module-2

3 a. Construct SFG for the set of system equations, $y_2 = G_1y_1 + G_3y_3$; $y_3 = G_4y_1 + G_2y_2 + G_5y_3$; $y_4 = G_6y_2 + G_7y_3$ where y_4 is the output and y_1 being input. Find transfer function y_4/y_1. **(10 Marks)**

b. Find C(S)/R(S) for the below SFG. (Refer Fig.Q.3(b)) **(10 Marks)**

Fig.Q.3(b)



OR

4 a. Define Delay time, Rise time, Peak time, Maximum overshoot, settling time with the help of an output (response) versus time graph. **(10 Marks)**

b. For a system having $G(s) = \frac{15}{(s+1)(s+3)}, H(s) = 1$. Determine: i) Characteristic equation ii) W_n & and iii) Time at which 1st undershoot will occur iv) Time period of oscillations v) Number of cycles output will perform before settling down. **(10 Marks)**

Module-3

5 a. Define absolute stability, relative stability, conditionally stable and critically stable. **(04 Marks)**

b. For unity feedback system, $G(s) = \frac{K}{s(1+0.4s)(1+0.25s)}$. Find the range of values of K, marginal value of K and frequency of oscillations, W. **(08 Marks)**

c. For a system with characteristic equation, $F(s) = s^6 + 3s^5 + 4s^4 + 6s^3 + 5s^2 + 3s + 2 = 0$, examine stability. **(08 Marks)**

OR

6 a. List the advantages and limitations of frequency domain analysis. **(08 Marks)**

b. Obtain an expression for maximum resonant frequency and angle for a second order system. **(12 Marks)**

Module-4

7 The open loop transfer function of a control system is given by $G(s).H(s) = \frac{K}{s(s+2)(s^2+6s+25)}$. Sketch the complete root locus as K is varied from 0 to ∞. **(20 Marks)**

OR

8 Sketch Bode plot for the transfer function $G(s) = \frac{Ks^2}{(1+0.2s)(1+0.02s)}$. Determine value of 'K' for gain cross over frequency to be $5 rads^{-1}$. **(20 Marks)**

Module-5

9 a. Define state variable, state vector, state space, state trajectory. **(08 Marks)**

b. State the applications of state systems. **(04 Marks)**

c. Derive transfer function from the state model. **(08 Marks)**

OR

10 a. State the properties of state transition matrix. **(06 Marks)**

b. A second order system is obtained by $\frac{d^2y}{dt^2} + 2\frac{dy}{dt} + 2y(t) = u(t)$. Obtain the state transition matrix. **(07 Marks)**

c. Consider a system having state model

$$\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \end{bmatrix} = \begin{bmatrix} -2 & -3 \\ 4 & 2 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} + \begin{bmatrix} 3 \\ 5 \end{bmatrix} u; \quad y = \begin{bmatrix} 1 & 1 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix}$$

With D = 0, obtain transfer function. **(07 Marks)**

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