CBCS SCHEME

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18MT34

Third Semester B.E. Degree Examination, Dec.2019/Jan.2020
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. Explain open loop control system and closed loop control system with an example. State its advantages and limitations. **(12 Marks)**

b. Obtain the transfer function for the following mechanical system shown below in Fig.Q.1(b). **(08 Marks)**

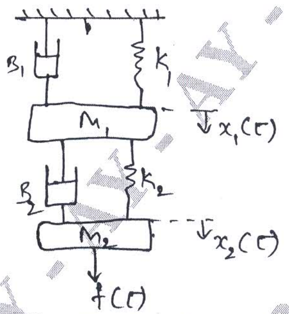


Fig.Q.1(b)

OR

2 a. For the given system shown in Fig.Q.2(a) below, write the differential equations in force voltage, and force current analogy. Make nodal representation of this model. **(10 Marks)**

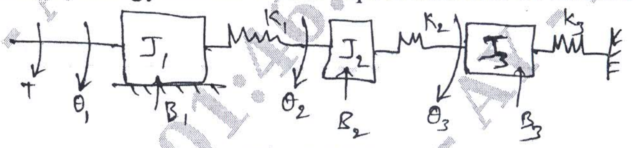


Fig.Q.2(a)

b. The performance equations of a controlled system are given by the following set of linear algebraic equations. Draw the block diagram and determine $\frac{C(s)}{R(s)}$ by reducing the block diagram in steps.

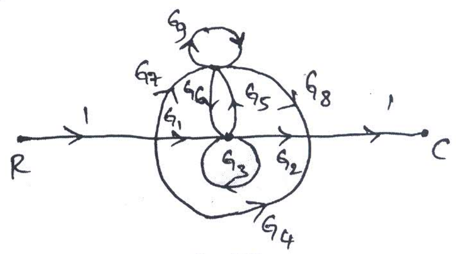
$E_1(s) = R(s) - H_3(s).C(s)$; $E_2(s) = E_1(s) - H_1(s)E_4(s)$; $E_3(s) = G_1(s).E_2(s) - H_2(s).C(s)$;
$E_4(s) = G_2(s).E_3(s)$; $C(s) = G_3(s).E_4(s)$ **(10 Marks)**

Module-2

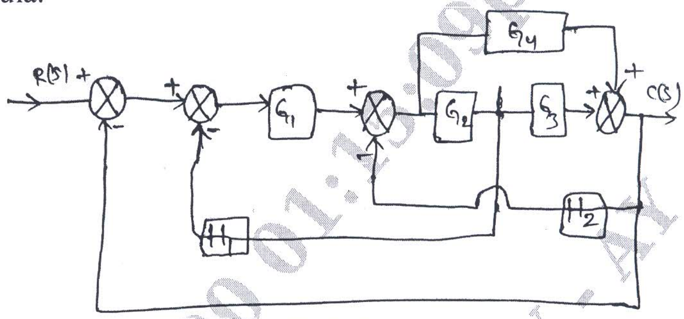
3 a. State and explain Mason's Gain formula. **(05 Marks)**

b. Find C/R using Mason's gain formula for the signal flow graph shown in the Fig.Q.3(b) below. **(08 Marks)**

Fig.Q.3(b)



c. For the block diagram, given in Fig.Q.3(c) below obtain overall transfer function using Maron's gain formula. **(07 Marks)**



FigQ.3(c)

OR

4 a. Derive an expression for response of a first order step input system. Obtain an expression for error response of it. **(10 Marks)**

b. For system shown in Fig.Q.4(b), find the error using dynamic error coefficient method for input of $6+5t+\frac{6t^2}{2}$. **(10 Marks)**

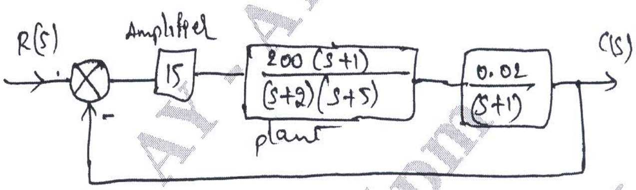


Fig.Q.4(b)

Module-3

5 a. What is stability analysis? State R-H criterion statement and explain. **(07 Marks)**

b. Examine the stability of the system, having C.E $S^5+2S^4+3S^3+6S^2+2S+1=0$. **(07 Marks)**

c. For an unity feedback system, the system is conditionally stable and oscillates with a frequency of 6rad s^{-1}. Find R and K_{mar}.

$$G(s)=\frac{9}{s^3+Rs^2+3ks}$$ **(06 Marks)**

OR

6 a. Define Bandwidth and derive an expression for bandwidth of a standard second order system. **(10 Marks)**

b. The OLTF of an unity FBCS, is $G(s)=\frac{k}{s(s+a)}$,

i) Find the value of 'k' and 'a' so that M_r = resonant, peak = 1.04 and W_r = resonant, frequency = 11.55 rad s^{-1}.

ii) For the values of 'k' and 'a' found in part (i), calculate the settling time and bandwidth of the system. **(10 Marks)**

Module-4

7 A feedback control system has an open loop transfer function $G(s).H(s)=\frac{K}{s(s+3)(s^2+2s+2)}$. Draw the root locus as 'K' varies from 0 to ∞. **(20 Marks)**

OR

8 a. Define the following:
   i) Gain crossover frequency
   ii) Phase crossover frequency
   iii) Resonant peak
   iv) Resonant frequency. **(06 Marks)**

b. Sketch the Bode plot for the transfer function:
$$\frac{300(s^2+2s+4)}{s(s+10)(s+20)}.$$ **(14 Marks)**

Module-5

9 a. List the advantages of state variable analysis. **(04 Marks)**

b. Define state, state variables, state space and state trajectory. **(08 Marks)**

c. Obtain the transfer function:

If $\begin{bmatrix} \dot{X}_1 \\ \dot{X}_2 \end{bmatrix} = \begin{bmatrix} -5 & -1 \\ 3 & -1 \end{bmatrix} \begin{bmatrix} X_1 \\ X_2 \end{bmatrix} + \begin{bmatrix} 2 \\ 5 \end{bmatrix}$

$y = \begin{bmatrix} 1 & 2 \end{bmatrix} \begin{bmatrix} X_1 \\ X_2 \end{bmatrix}$ **(08 Marks)**

OR

10 a. List the properties of state transition matrix and write the transfer function of a state space model in general. **(08 Marks)**

b. Obtain the state transition matrix for $A = \begin{bmatrix} 0 & 1 \\ -2 & -3 \end{bmatrix}$. **(12 Marks)**

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