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III/IV B.Tech. DEGREE EXAMINATIONS, NOVEMBER- 2019

First Semester

EC/EE

LINEAR CONTROL SYSTEMS

Time: Three Hours **Maximum marks:60**

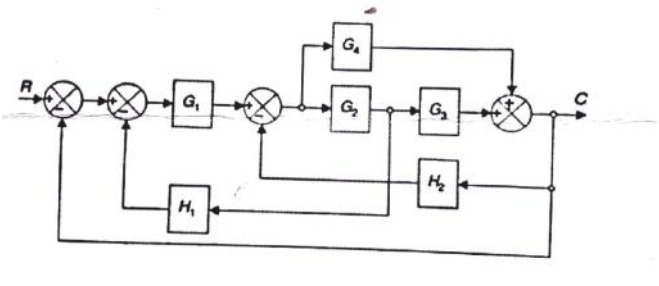
Answer Question No.1 Compulsory **12X1=12 M**

Answer ONE Question from each Unit **4X12=48 M**

1. a) What are the advantages of negative feedback?
   b) What are different types of controller?
   c) Define gain and phase margin
   d) Define dominant poles
   e) What are the advantages of bode plots?
   f) Define state transition matrix
   g) Define controllability
   h) What are the test signals?
   i) Define BIBO stability
   j) What is conditionally stable system
   k) Define routhhurwitzpolynomial
   l) What is peak overshoot

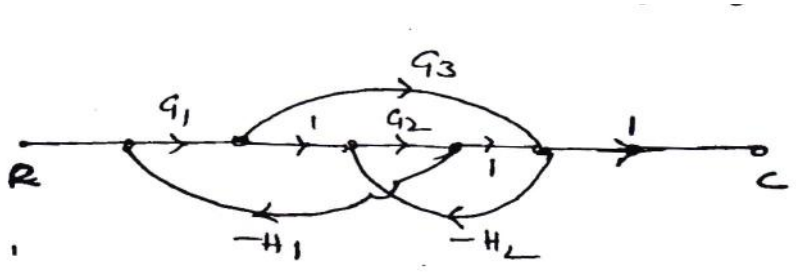
UNIT-I

2. a) Derive the transfer function and block diagram for speed control of DC servo motor?
   b) Obtain the transfer function of the closed loop control system shown in fig. using the block body reduction technique.



(OR)

3. a) Find the transfer function of the signal flow graph shown in fig. using the mason's gain formula.



b) Derive the expression for peak, rise time in iterms of ¶ and ω_n for a second order control system.

UNIT-II

4. a) A unity feedbacl system is characterized by a 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 settling time, peak overshoot, and time to peak overshoot for unit step input.

b) Find all steady state errors for open loop transfer function with unity feed back given by $G(s) = \frac{10}{s(0.1s+1)}$

(OR)

5. a) A unity feedback system is characterized by the open loop transfer function $G(s) = \frac{1000}{s^2(s+1)(s+20)}$. Determine the steady state error for unit-step, unit-ramp and unit acceleration inputs. Also determine the damping ratio and natural frequency of dominant roots?

b) Consider a sixth order system with character equation

$$s^6 + 2s^5 + 8s^4 + 12s^3 + 20s^2 + 16s + 16 = 0$$

Find the stability of the system using Routh's test and comment on nature of roots?

UNIT-III

6. Sketch the bode plot of the transfer function and determine the system gain K for which the gain cross over frequency w_c to be 5 rad/sec

$$G(s) = \frac{Ks^2}{(1+0.2s)(1+0.05s)}$$

(OR)

7. a) What are the advantages of frequency domain analysis.

   b) Explain the Nyquist Criterion for closed loop control system.

UNIT-IV

8. Sketch the root locus for the unity feedback system whose open loop transfer function is $G(s) = \frac{K}{s(s^2+6s+10)}$. Also determine range of 'K'?

(OR)

9. a) Write a short note on advantages and limitations of state variable approach.

   b) Find the transfer function of the systems with following state model

$$X = \begin{bmatrix} 0 & 1 \\ 1 & -4 \end{bmatrix} X + \begin{bmatrix} 1 \\ 0 \end{bmatrix} U, Y = \begin{bmatrix} 1 & 0 \end{bmatrix} X$$

   Also determine the system is controllable.

EC/EE 311 (R-15)

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III/IV B.Tech. (Supple) DEGREE EXAMINATIONS, JUNE- 2019

First Semester

EC/EE

LINEAR CONTROL SYSTEMS

Time: Three Hours **Maximum marks:60**

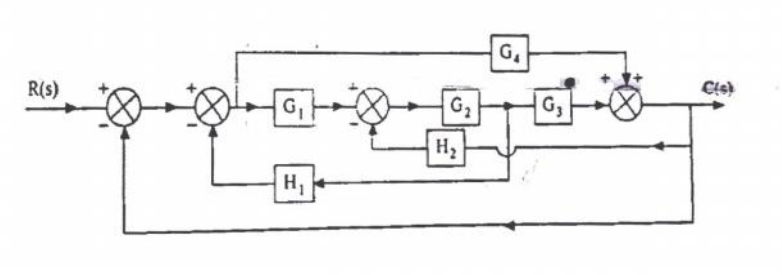
Answer Question No.1 Compulsory **12X1=12 M**

Answer ONE Question from each Unit **4X12=48 M**

1. a) Define system, control system
   b) Distinguish between linear and nonlinear control system
   c) State disadvantages and advantages of signal flow graph
   d) Define the term raise time, settling time.
   e) What are the conditions of Routh Hurwitz criteria of stability?
   f) What is the purpose of Nyquist plots.
   g) Define Phase margin, gain margin
   h) State the importance of state transmission matrix.
   i) Define conditionally stable system.
   j) Define angle of departure, angle of arrival
   k) Define bandwidth frequency
   l) What is PID controller?

UNIT-I

2. a) Draw the signal flow graph and derive the transfer function of the system using mason's gain formula.

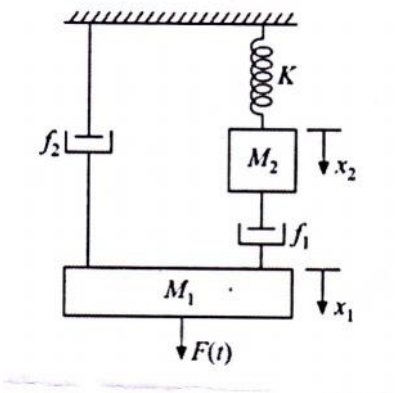


   b) Obtain the transfer function Armature controlled DC motor.

P.T.O

(OR)

3. a) Write the differential equations for mechanical system shown in figure and obtain an analogous electrical circuit in force-voltage analogy.



b) Explain the working principle of synchro transmitter.

UNIT-II

4. a) Write the expression for time domain specification of a second order control system and indicate with neat sketch? Also how damping ratio affect the time response of second order system.

b) Determine the range of K for stability

$S^3 + 2S^4 + 3S^3 + 4S^2 + K(S+1) + S + 5 = 0$ for K>0.

(OR)

5. a) Determine the stability of system represented by the characteristic equation $S^4 + 2S^3 + 8S^2 + 4S + 3 = 0$ by means of Routh criterion.

b) Determine the step, ramp and parabolic error constant for the following system with unity feedback.

i) $G(s) = \dfrac{K}{s(s^2 + 4s + 200)}$ ii) $G(s) = \dfrac{100}{s(1+0.1s)}$

UNIT-III

6. Sketch the bode plot for the transfer function and determine the system gain K for which the gain cross over frequency w_c to be 5 rad/sec.

$$G(s) = \frac{Ks^2}{(1+0.2s)(1+0.02s)}$$

P.T.O

(OR)

7. a) What are the advantages of frequency domain analysis?

   b) State and explain Nyquist stability criterion to determine the stability of a system?

UNIT-IV

8. Sketch the complete root locus for the system having

$$G(S)H(S)=\frac{K}{S(S+3)(S^2+3S+4.5)}$$

Determine the range of K for which the system is stable.

(OR)

9. a) Obtain the state space representation of the system whose differential equation is given by $Y_3+2Y_2+3Y_1+6Y_0=U_2-U_1+2U_0$

   b) Find the Eigen value and Eigen vectors of the system represented by state space matrix A. Also derive a diagonal matrix of the system.

$$A=\begin{vmatrix}1 & 1 & 2\\ 0 & 2 & 0\\ 0 & 0 & 2\end{vmatrix}$$