EC/EE 311 (R-15)

Total No. of Questions :09] [Total No. of Pages : 03

III/IV B.Tech. DEGREE EXAMINATIONS, NOV/DEC-2018

First Semester

EC/EE

LINEAR CONTROL SYSTEMS

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

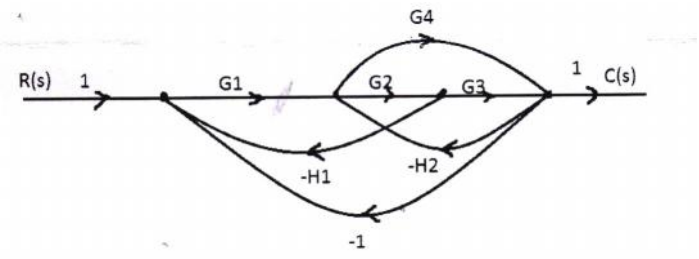
Answer Question No.1 Compulsory **12X1=12 M**

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

1. a) What are the limitations of transfer function approach?
   b) State the applications of AC servo motor.
   c) State disadvantages of the block diagram reduction technique.
   d) Define critical damped system.
   e) Define steady state response and steady error.
   f) Discuss the advantage of feedback in a control system
   g) Define relative stability
   h) State the advantages of Routh's method.
   i) Define terms asymptotes and centroid.
   j) What are the standard test signals?
   k) What is compensating network?
   l) What are the limitations of time domain analysis?

UNIT-I

2. a) Obtain the C(s)/R(s) for the flow graph show in Figure using the Mason's gain formula.

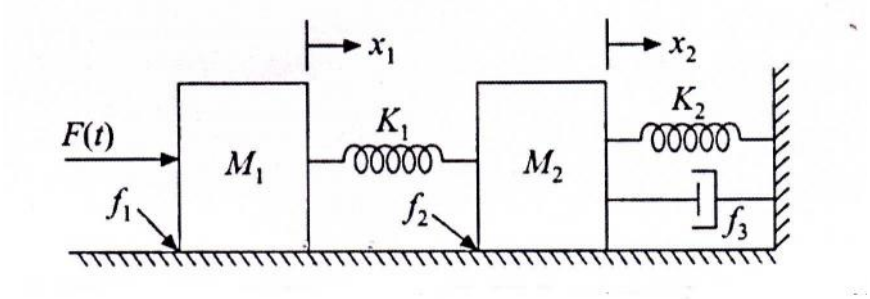


   b) Explain the working of an AC servo motor and discuss its applications.

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) Determine the transfer function of Field controlled DC motor and draw the block diagram.

UNIT-II

4. a) Draw the step response of second order system and indicate all time domain specifications?

b) A unity feedback system is characterized by the open loop transfer function $G(s)=\frac{1000(s+1)}{(s+10)(s+50)}$. 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?

(OR)

5. a) What are the necessary condition to have all roots of the characteristic equation in the left hand of s-plane?

b) Determine the stability of the system represented by the characteristic equations $s^5+s^4+s^3+9s^2+16s+10=0$, also determine the number of roots on the right half s-plane?

UNIT-III

6. Sketch the bode plots showing the magnitude in dB and phase angle in degrees of $G(s)=\frac{10}{s(1+0.5s)(1+0.02s)}$. Determine the gain cross over frequency, phase cross over frequency and margins?

P.T.O

(OR)

7. a) State and Explain Nyquist stability criterion to determine the stability of a system.

   b) What are compensating network? Explain about lead, lag networks?

UNIT-IV

8. a) State and Explain Nyquist stability criterion to determine the stability of a system?

   b) Sketch the polar plot and determine gain margin and phase margin for open loop transfer function of unity feedback system $G(s)=\frac{1}{s(s+2)(s+4)}$

(OR)

9. a) Obtain state variable representation of a field control DC motor?

   b) Determine whether the following system is completely state controllable and observable using Kalman's test?

$$A=\begin{vmatrix} 0 & 1 & 1 \\ 0 & 0 & 1 \\ -1 & -3 & -3 \end{vmatrix} \quad B=\begin{vmatrix} 0 \\ 0 \\ 1 \end{vmatrix} \quad C=\begin{bmatrix} 0 & 1 & -1 \end{bmatrix}$$

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III/IV B.Tech. DEGREE EXAMINATIONS, NOV/DEC-2018

First Semester

EC/EE

LINEAR CONTROL SYSTEMS

Time: Three Hours **Maximum marks:70**

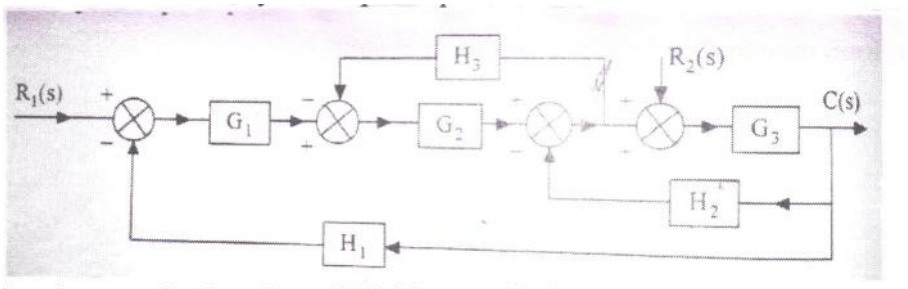
Answer Question No.1 Compulsory **14X1=14 M**

Answer ONE Question from each Unit **4X14=56 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) Explain 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?
   l) What is PID controller?
   m) What is digitalization?
   n) Define zero input stability.

UNIT-I

2. a) Find the transform function $C(s)/R_1(s)$, $C(s)/R_2(s)$ in figure using signal flow graph technique and assume that only one input is present in each case.

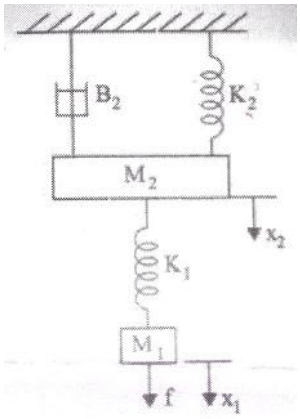


P.T.O

b) Determine the transfer function of Field controlled DC motor and draw the block diagram.

(OR)

3. a) Write the differential equations governing the behavior of the mechanical system shown in figure. Also obtain the analogous electrical circuit in force-current analogy.



b) Explain the principle and operation of synchro transmitter and receiver pair and its applications.

UNIT-II

4. a) Draw the second order system step response and indicate all time domain specifications.

b) A unity feedback system is characterized by the open loop transfer function

$$G(s)=\frac{1000(s+1)}{(s+10)(s+50)}$$

Determine the steady state error for unit-step, unit-ramp and unit acceleration inputs. Also determine the damping ratio and natural frequecny of dominant roots?

(OR)

5. a) Determine the stability of the system represented by the characteristic equations $s^6+3s^5+5s^4+9s^3+8s^2+6s+4=0$, also determine the number of roots on the right half s-plane.

P.T.O

b) Discuss the effect of adding poles and zeros to open loop transfer function.

UNIT-III

6. Sketch the bode plots showing the magnitude in dB and phase angle in degrees of $G(s)=\frac{10}{s(1+0.5s)(1+0.02s)}$. Determine the gain cross over frequency, phase cross over frequency and margins?

(OR)

7. a) State and explain Nyquist stability criterion to determine the stability of a system.

b) What are compensating network? Explain about lead, lag network?

UNIT-IV

8. The open loop transfer function of a feedback system is

$$G(s)H(s)=\frac{K}{s(s+4)(s^2+4s+20)}$$

Obtain root locus plot and determine the range of K for which the system is stable.

(OR)

9. a) Obrain state variable representation of a field control DC motor?

b) Determine whether the following system is completely state controllable and observable using Kalman's test?

$$A=\begin{bmatrix}0 & 1 & 1\\ 0 & 0 & 1\\ -1 & -3 & -3\end{bmatrix}\quad B=\begin{bmatrix}0\\0\\1\end{bmatrix}\quad C=\begin{bmatrix}0 & 1 & -1\end{bmatrix}$$

EC/EE/EI 312 (CR)

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III/IV B.Tech. DEGREE (Supple) EXAMINATIONS, JUNE/JULY-2018

First Semester

EC/EE/EI

LINEAR CONTROL SYSTEMS

Time: Three Hours **Maximum marks:70**

Answer Question No.1 Compulsory **14X1=14 M**

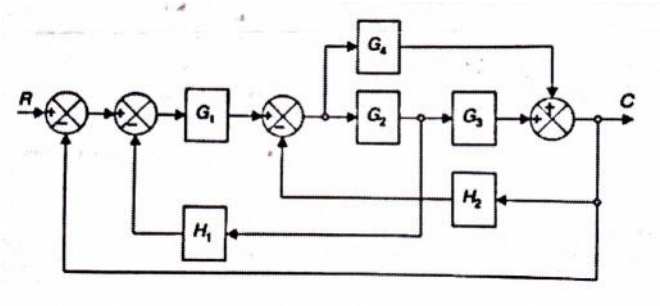
Answer ONE Question from each Unit **4X14=56 M**

1. a) Write merits and demerits of block diagram algebra
   b) Define peak time and peak overshoot?
   c) What is a minimum phase system?
   d) Define phase and gain margin?
   e) What is polar plot?
   f) Drawbacks of block body reduction technique?
   g) What is relative stability?
   h) What are the effects of Integral control on transient and steady state performance?
   i) What is servo mechanism?
   j) Define sensitivity.
   k) Define the Order of the system
   l) Define settling time.
   m) What are M and N circles.
   n) Define Non-linear control system

UNIT-I

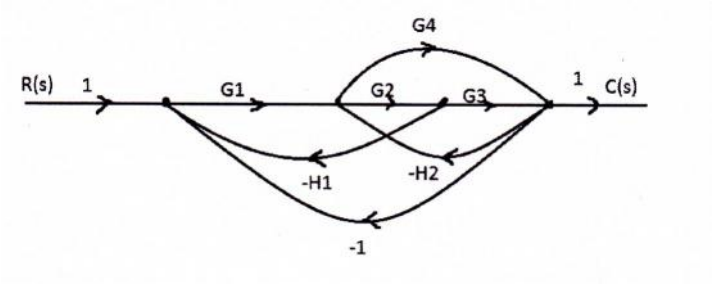
2. a) Derive the transfer function and block diagram for speed control of DC servo motor?
   b) Obtain the transfer function of the closed loop control system shown in fig. 1 using the block body reduction technique.

P.T.O



(OR)

3. a) Find the transfer function of the signal flow graph shown in fig.2 using the mason's gain formula.



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

UNIT-II

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

$$G(s) = \frac{10}{s(1+0.5s)}.$$

Determine (i) Damping ratio, (ii) Damped natural frequency, (iii) Undamped natural frequency and (iv) Maximum overshoot to a step input.

b) For a unity feedback system with open-loop transfer function is given as

$$G(s) = \frac{20(s+2)}{s(s+3)(s+4)}$$

Find (i) the static error constants Kp, Kv, Ka and (ii) the steady state error value for input r(t)=3u(t)+5tu(t).

P.T.O

(OR)

5. a) Using Routh-Hurwitz Criteria comment on the stability of given system represented by characteristic equation $2s^6+2s^5+3s^4+3s^3+2s^2+s+1=0$. Find the number of roots in the right half of S-plane.

   b) Discuss the effect of adding pole or zero to the system, on time-domain specification of control in detail?

UNIT-III

6. a) State the advantages and limitations of frequency domain approach?

   b) Draw the bode plot and find the gain margin and phae margin of the system represented by $G(s)H(s)=\frac{10(S+1)}{S(S+0.05)(S+3)(S+5)}$

(OR)

7. a) Explain the Nyquist stability criteria. What are the advantages of Nyquist plots?

   b) Determine the stability of the system $G(s)H(s)=\frac{5}{S(1+0.2S)(1+S)}$ using Nyquist stability criteria and draw the plot.

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 Eigenvalue and Eigenvectors of the system represented by state space matrix A. Also derive a diagonal matrix of the system.

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

EE 311 (R-15)

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III/IV B.Tech. DEGREE EXAMINATIONS, JUNE/JULY-2018

First Semester

ELECTRICAL & ELECTRONICS ENGINEERING

LINEAR CONTROL SYSTEMS

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

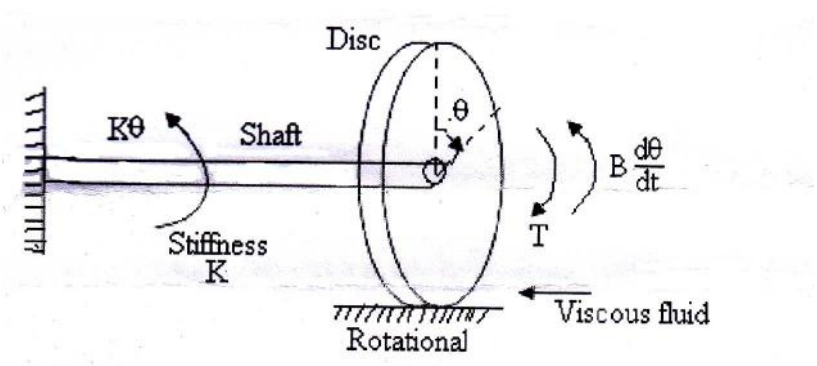
Answer Question No.1 Compulsory **12X1=12 M**

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

1. a) Define Transfer function
   b) Define Mathematical model
   c) Define feedback control system
   d) Define ramp signal
   e) Define synchro transmitter & Receiver
   f) Define first order systems
   g) Define zero input-output stability
   h) What is the difference between time and frequency responses
   i) What is PID controller.
   j) Define state variable
   k) Define Controllability
   l) Define State equation.

UNIT-I

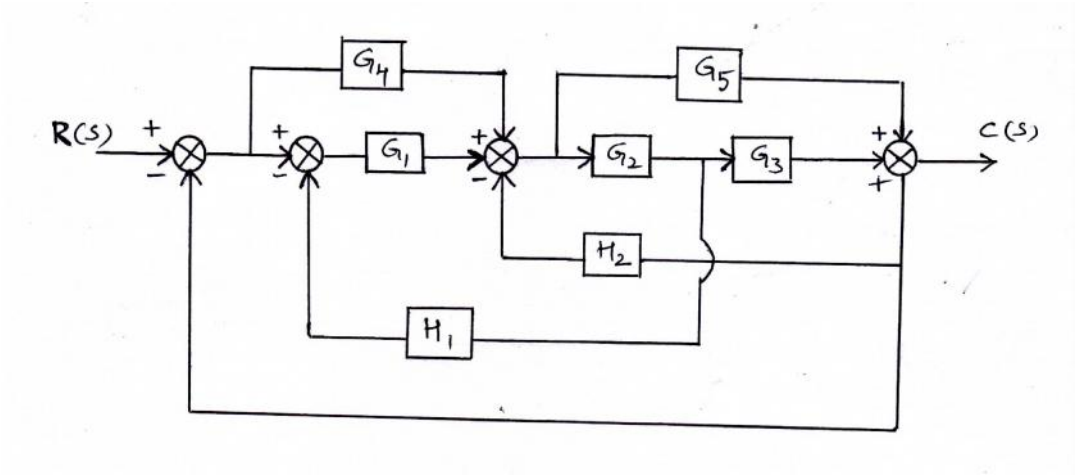
2. a) Explain the advantages and features of transfer function.
   b) Derive the transfer function for the following rotational mechanical systems shown in the figure.



(OR)

3. a) Explain the operation of Synchro transmitter and receiver pair and mention its applications.

   b) Determine the transfer function C(S)/R(S) for the block diagram shown in Fig below.



UNIT-II

4. a) Derive the expression for rise time, peak over shoot, settling time of 2nd order system of unit step input.

   b) A unit feedback system is characterized by an open-loop transfer function $G(s) = \frac{K}{s(s+5)}$. 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 times to peak overshoot for a unit-step input.

(OR)

5. a) A unity feedback system has a forward path transfer function $G(s) = \frac{K(S+13)}{S(S+3)(S+7)}$ using R-H criterion, find the range of 'K' for which the closed loop system is stable.

   b) Derive the expression for overshoot, risetime, band width.

P.T.O

UNIT-III

6. a) Explain the concept of phase margin and gain margin in frequency domain.

   b) Sketch the Bode Plot for $G(s)=\frac{(1+100s)(1+s)}{(1+10s)(1+0.1s)}$. Assume unity feedback. Obtain gain margin and phase margin.

(OR)

7. A unity feedback control system has an open loop transfer function given by $G(S)H(S)=\frac{100}{(S+5)(S+2)}$. Draw the Nyquist diagram and determine its stability

UNIT-IV

8. a) Sketch the root locus plot of a unity feeb-back system whose open loop transfer function is given as $G(S)=\frac{s}{(s+2)(s^2+4)}$

   b) What is compensation? What are the different types of compensators?

(OR)

9. a) For the given system X' = AX + BU, where $A=\begin{bmatrix}1 & 2 & 1\\ 0 & 1 & 3\\ 1 & 1 & 1\end{bmatrix}, B=\begin{bmatrix}1\\0\\1\end{bmatrix}$, test the controllability or not.

   b) Given $\dot{x}(t)=\begin{bmatrix}0 & 1\\ -2 & -3\end{bmatrix}\begin{bmatrix}x_1(t)\\ x_2(t)\end{bmatrix}+\begin{bmatrix}0\\1\end{bmatrix}u(t)$, find the unit step response when $x(0)=\begin{bmatrix}1\\1\end{bmatrix}$.