**Reg. No. :** | | | | | | | | | | |

**Question Paper Code: 41502**

B.E. / B.Tech. DEGREE EXAMINATION, MAY 2017

Fourth Semester

Electronics and Communication Engineering

14UEI422 - LINEAR CONTROL ENGINEERING

(Regulation 2014)

Duration: Three hours | Maximum: 100 Marks

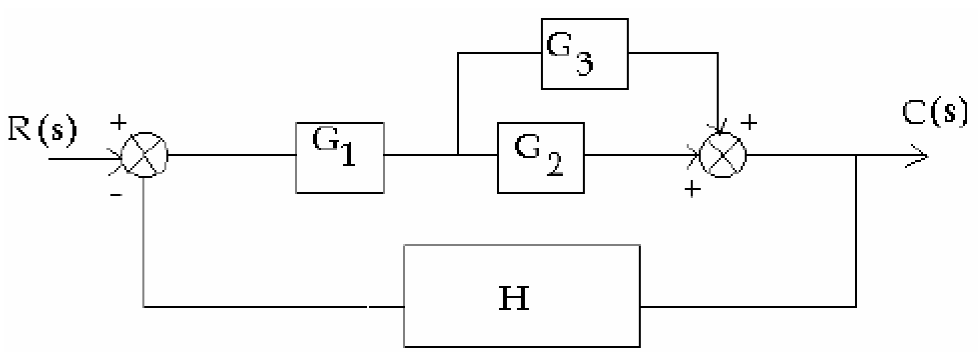
Answer ALL Questions

PART A - (10 x 1 = 10 Marks)

1. Which of the following is an open loop control system?

   (a) Field controlled D.C. motor | (b) Ward leonard control
   (c) Metadyne | (d) Stroboscope

2. The transfer function of the given block diagram is



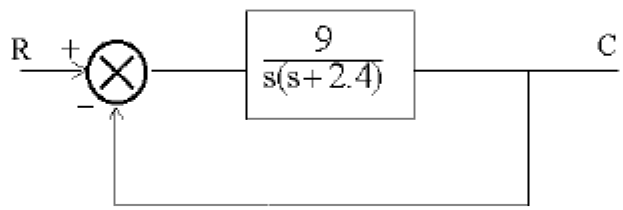

   (a) $\frac{G_2(G_1+G_3)}{1+G_1G_2H+G_1G_3H}$ | (b) $\frac{G_1(G_2+G_3)}{1+G_1G_2H+G_1G_3H}$

   (c) $\frac{G_2(G_1-G_3)}{1+G_1G_2H+G_1G_3H}$ | (d) $\frac{G_2G_1G_3}{1+G_1H+G_2H}$

3. The steady-state error of a feedback control system with an acceleration input becomes finite in a

   (a) Type 0 system (b) Type 1 system
   (c) Type 2 system (d) Type 3 system

4. Considering the unity feedback system of Fig.2, the settling time of the resulting second order system for 2% tolerance band will be




   (a) 3.33 (b) 4.5 (c) 2.25 (d) 2.84

5. If the Nyquist plot of the loop transfer function G(s)H(s) of a closed-loop system encloses the (−1, j0) point in the G(s)H(s) plane, the gain margin of the system is

   (a) zero (b) greater than zero
   (c) less than zero (d) infinity

6. Addition of zeros in transfer function causes which of the following

   (a) Lead compensation (b) Lag compensation
   (c) Lead-lag compensation (d) No compensation added

7. The equation $2S^4 + S^3 + 3S^2 + 5S + 10$ has _________ number of roots in the left half of s–plane.

   (a) One (b) Two (c) Three (d) Four

8. Consider the following statements regarding root loci:
   1. All root loci start from the respective poles of G(s) H(s).
   2. All root loci end at the respective zeros of G(s) H(s) or go to infinity.
   3. The root loci are symmetrical about the imaginary axis of the s-plane.

   On these statements:

   (a) 1, 2 and 3 are correct (b) 1 and 2 are correct
   (c) 1 and 3 are correct (d) 2 and 3 are correct

9. The state space approach is applicable to the control systems which are

(a) Time variant (b) Time invariant

(c) Both (a) and (b) (d) None of these

10. For a control system to be completely controllable, it should be

(a) Input controllable (b) Gain controllable

(c) State controllable (d) State and output controllable

PART - B (5 x 2 = 10 Marks)

11. Write Masons Gain formula.

12. Define steady state error.

13. List out the frequency domain specifications.

14. How the roots of characteristic equation are related to stability?

15. Draw the block diagram representation of state model.

PART - C (5 x 16 = 80 Marks)

16. (a) Determine the transfer function $\frac{C(s)}{R(s)}$ for the block diagram shown in Figure.3 by first drawing its signal flow graph and then using the Mason's gain formula.(16)

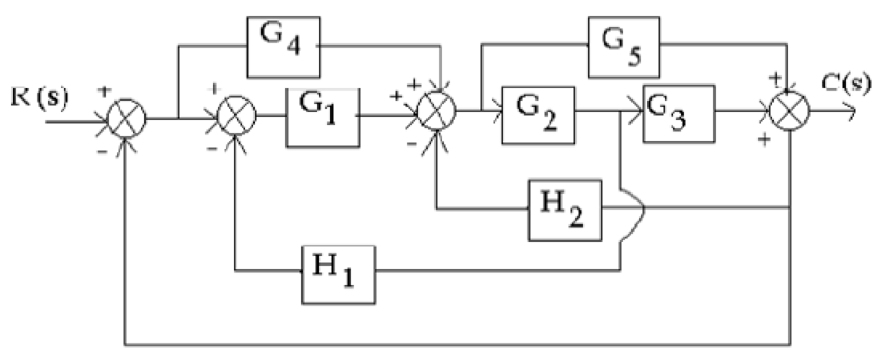



Figure 3

Or

(b) For the mechanical system shown in Figure.4 , find the differential equations. Also draw the force-voltage and force-current electrical analogous circuits. (16)

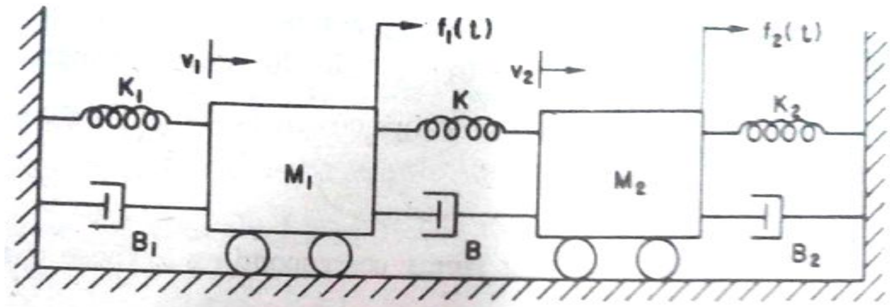



Figure 4

17. (a) A unity feedback systems has G(s)= $\frac{1}{s(1+s)}$ . The input to the system is described by r(t)=4+6t+2t$^3$. Find the generalized error coefficients and steady state error. (16)

Or

(b) (i) Briefly explain the effects of adding poles and zeros to second order systems.(8)

(ii) Describe about PI and PD compensation. (8)

18. (a) Sketch the bode plot for the following transfer function and find the system gain K for the gain cross over frequency to be 5 rad/sec. G(s)= $\frac{Ks^2}{(1+0.2s)(1+0.02s)}$. (16)

Or

(b) Consider the unity feedback system having an open loop transfer function G(s)= $\frac{K}{s(1+0.5s)(1+4s)}$ . Sketch the polar plot and find the value of K so that (i) gain margin is 20db and (ii) phase margin is 30$^0$. (16)

19. (a) (i) For the characteristic equationF(s)= $s^6+s^5-2s^4-3s^3-7s^2-4s-4$ . Find the number roots falling in the right half and left half of the s-plane.(8)

(ii) The open loop transfer function of an unity feedback system is given by G(s)= $\frac{K(s+2)}{s(s+1)(s+3)(s+5)}$. Find the value of K for which the system is just stable. (8)

Or

(b) The open loop transfer function of a unity feedback system is given by G(s)= $\frac{K}{s(s+1)(s^2+2s+2)}$. Sketch the root locus of the system. (16)

20. (a) A discrete system is described by the difference equation.

$$y(k+2)+5y(k+1)+6y(k)=u(k)$$

$$y(0)=y(1)=0;$$

$$T=1\,\text{sec}$$

(a) Find a state model in canonical form

(b) Find the state transition matrix. (16)

Or

(b) Find the state controllability for the systems represented by the state equation

$$\begin{bmatrix} \dot{X}_1 \\ \dot{X}_2 \end{bmatrix} = \begin{bmatrix} 0 & 1 \\ -1 & -2 \end{bmatrix}\begin{bmatrix} X_1 \\ X_2 \end{bmatrix} + \begin{bmatrix} 1 \\ -1 \end{bmatrix} u \, .$$ (16)