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

Question Paper Code: 59404

B.E. / B.Tech. DEGREE EXAMINATION, NOV 2022

Elective

Electronics and Communication Engineering

15UEC904–LINEAR CONTROL ENGINEERING

(Regulation 2015)

Duration: Three hours Maximum: 100 Marks

Answer ALL Questions

PART A - (10 x 1 = 10 Marks)

1. In closed loop control system, with positive value of feedback gain the overall gain of the system will CO1- R

   (a)increase (b)decrease (c) be unaffected (d)any of the above

2. The branch of a signal flow graph represents CO1- R

   (a)The system variable (b) The functional relations of the variables

   (c) The system parameters (d) None of the above

3. The impulse response of a first order system is CO2-U

   (a) Constant with respect to time

   (b) Varies linearly with respect to time

   (c) Exponentially increasing with respect to time

   (d)Exponentially decreasing with respect to time

4. A Second order system said to be critically damped if the damping factor is ξ CO2- R

   (a) $\xi > 1$ (b) $\xi < 1$

   (c) $\xi = 1$ (d) $\xi = 0.707$

5. By substituting $s=j\omega$, the frequency response plot gives CO3-R

   (a) Transient response of the system

   (b) Steady state response of the system

   (c) Initially transient and then steady state response

   (d) None of the above

6. The transfer function of a system is G(S) =K / [S(S+1)(S^2+6S+8)].The order of system is CO3-U

(a) 4 (b) 2

(c) 5 (d) 3

7. By using Routh's stability criterion it is possible to find the roots of the characteristic polynomial in CO4 R

(a) RHP only (b) LHP only

(c) Imaginary axis only (d) All the above three

8. The root loci are CO4-U

(a) Straight lines (b) Continuous curves

(c) Curves with discontinuity (d) None of the above

9. State model representation is possible using CO5-R

(a) Physical variables (b)Phase variables

(c) Canonical state variables (d) All of the above

10. The state-variable description of a linear autonomous system is X=Ax Where x is a two-dimensional state vector and A is a matrix given by $A = \begin{bmatrix} 0 & 2 \\ 2 & 0 \end{bmatrix}$ The poles of the system are located at CO5-R

(a) -2 and +2 (b) -2j and +2j (c) -2 and -2 (d) +2 and +2

PART – B (5 x 2= 10Marks)

11. Define transfer function of the system. CO1-R

12. Write the effect of PI controller in a system? CO2-U

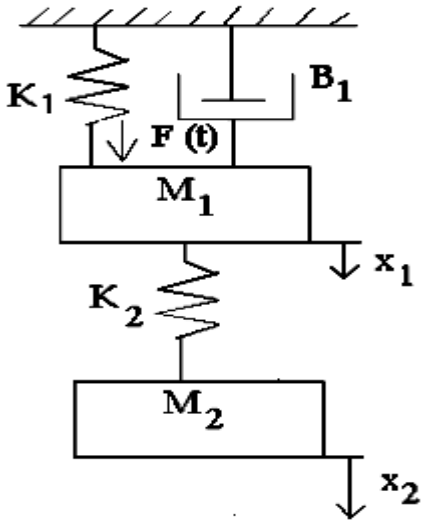
13. What is compensator and writes its types? CO3-U

14. What is Nyquist Stability Criterion? CO4-R

15. What are advantages of state space analysis? CO5- R

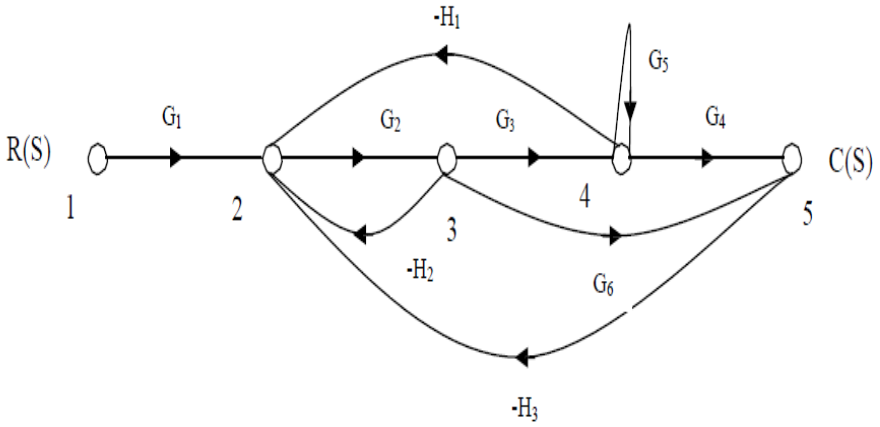
PART – C (5 x 16= 80 Marks)

16. (a) Find the transfer function $X_2(s)$ / F(s) of the mechanical system shown in figure. CO1- App (16)



Or

(b) Find the overall gain C(s) / R(s) for the signal flow graph shown below. CO1- App (16)



17. (a) Derive the unit step response of the second order system for the under damped case. CO2-U (16)

Or

(b) A closed loop servo is represented by the differential equation $d^2c/dt^2 + 8dc/dt = 64\ e$ Where c is the displacement of the output shaft r is the displacement of the input shaft and e= r-c. Determine undamped natural frequency, damping ratio and percentage maximum overshoot for unit step input. CO2-App (16)

18. (a) The open loop transfer function of a unity feedback system is $G(S) = 1/ S(1+S) (1+2S)$.Sketch the Polar plot and determine the Gain margin and Phase margin CO3-App (16)

Or

(b) What is meant by lag compensator and write design steps of lag compensator using bode plot approach. CO3-U (16)

19. (a) (i) Construct Routh array and determine the stability of the system whose characteristic equation is CO4-App (10)

$S^6+2S^5+8S^4+12S^3+20S^2+16S+16=0$. comment on location of the roots.

(ii) Construct Routh array and determine the stability of the system whose characteristic equation is CO4-App (6)

$S^5+S^4+2S^3+2S^2+3S+5=0$.comment on location of the roots.

Or

(b) Construct Routh array and determine the stability of the system represented by the characteristics equation $S^7+9S^6+24S^4+24S^3+24S^2+23S+15=0$ comment on the location of the roots of characteristic equation. CO4-Ana (16)

20. (a) Construct a state model for a system characterized by the differential equation CO5-App (16)

$$\frac{d^3y}{dt^3}+6\frac{d^2y}{dt^2}+11\frac{dy}{dt}+6y+4=0$$

Or

(b) (i)The state model of a system is given by CO5-App (10)

$$\begin{bmatrix}\dot{X}_1\\ \dot{X}_2\\ \dot{X}_3\end{bmatrix}=\begin{bmatrix}0 & 0 & 1\\ -2 & -3 & 0\\ 0 & 2 & -3\end{bmatrix}\begin{bmatrix}X_1\\ X_2\\ X_3\end{bmatrix}+\begin{bmatrix}0\\ 2\\ 0\end{bmatrix}[u];\quad Y=[1\quad 0\quad 0]\begin{bmatrix}X_1\\ X_2\\ X_3\end{bmatrix}$$

Determine whether the system is completely controllable and observable.

(ii) A linear time –invariant system is characterized by homogeneous state equation. CO5-App (6)

$$\begin{bmatrix}\dot{X}_1\\ \dot{X}_2\end{bmatrix}=\begin{bmatrix}1 & 0\\ 1 & 1\end{bmatrix}\begin{bmatrix}X_1\\ X_2\end{bmatrix}$$

Compute the solution of the homogeneous equation, assuming the initial state vector. $X0=\begin{bmatrix}1\\ 0\end{bmatrix}$