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

Question Paper Code: 59404

B.E. / B.Tech. DEGREE EXAMINATION, NOV 2018

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 a mechanical system consisting of mass, spring and dash-pot, the energy is dissipated in CO1- R

   (a) Mass (b) Spring (c) Dash-pot (d) None 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. The static error constants depend on CO2- R

   (a) The order of the system (b) The type of the system

   (c) Both type and order of the system (d) None of the above

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. If the phase margin is negative, it indicates that the system is CO3-U

(a) Highly stable (b) Unstable

(c) Oscillatory (d) It has nothing to do with stability

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. A transfer function of a control system does not have pole-zero cancellation. Which one of the following statements is true? CO5-R

(a) System is neither controllable or observable

(b)System is completely controllable and observable

(c) System is observable but uncontrollable

(d) System is Controllable but unobservable

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. State the mason's gain formula for signal flow graph. CO1-R

12. List out the drawback of static coefficients. CO2-U

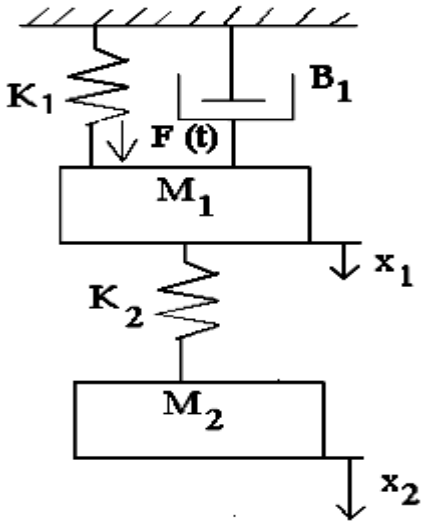
13. Interpret gain and phase cross over frequency. CO3-U

14. Write Routh Hurwitz stability criterion. CO4-R

15. Bring out the advantages and disadvantages of phase variables. CO5- R

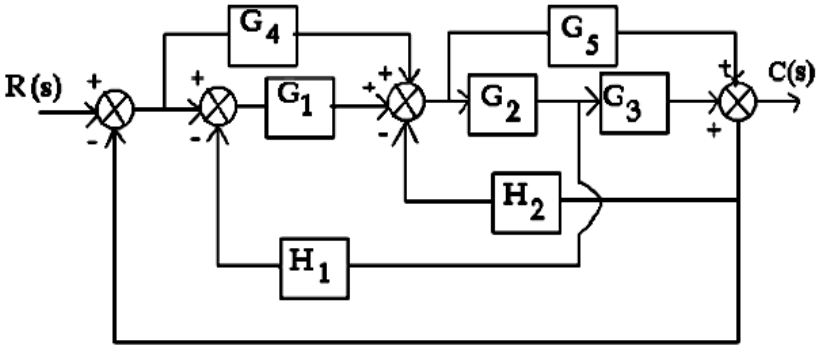
PART – C (5 x 16= 80 Marks)

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



Or

(b) Convert the block diagram to signal flow graph and determine the transfer Function using Mason's gain formula. 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 Unity feedback control system has an open loop transfer function G(s)=10/s(s+2) Find the rise time, percentage overshoot, peak time, time delay and settling time for a step input of 12 units. CO2-App (16)

18. (a) Plot the Bode diagram for the following transfer function. CO3-App (16)

G(s)=5(1+2s)/(1+4s)(1+0.25s)

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 $S^6+2S^5+8S^4+12S^3+20S^2+16S+16=0$. comment on location of the roots. CO4-App (10)

(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) The open loop transfer function of a unity feedback system is given by CO4-Ana (16)

$G(s) = K(S+9)/S(S^2+4S+11)$ Sketch the root locus.

20. (a) (i) Determine the canonical state model of the system whose transfer function is $T(s)=2(S+5)/(S+2)(s+3)(S+4)$ CO5-App (10)

(ii) Obtain the state model of the system CO5-App (6)

$Y(S)/U(S)=10/S^3+4S^2+2S+1$

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. $X0=\begin{bmatrix} 1 \\ 0 \end{bmatrix}$