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

Question Paper Code: 31451

B.E. / B.Tech. DEGREE EXAMINATION, MAY 2016

Fourth Semester

Electronics and Instrumentation Engineering

01UEI401 – CONTROL ENGINEERING

(Regulation 2013)

Duration: Three hours Maximum: 100 Marks

Answer ALL Questions

PART A - (10 x 2 = 20 Marks)

1. Differentiate open loop and closed loop system.

2. Give the reduced form of the block diagram shown in Figure 1.

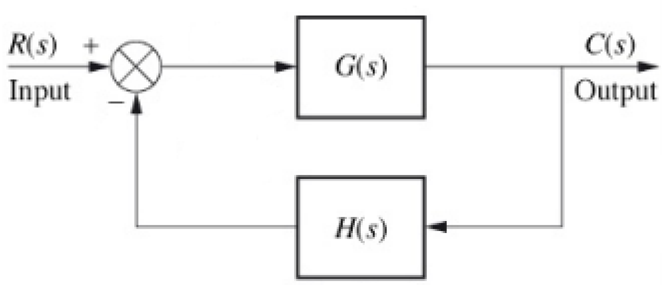

Figure 1

3. List the time domain specifications.

4. Define steady state error.

5. Define phase margin and gain margin.

6. List any two advantages of frequency response analysis over the time domain.

7. State Nyquist stability criterion.

8. Give the expression for finding the ‘centroid’ in the construction of root locus.

9. List the properties of state transition matrix.

10. Write the various canonical models for state space representation.

PART - B (5 x 16 = 80 Marks)

11. (a) (i) For the mechanical system shown in Figure 2, compute the transfer function of $Y_2(S) / F(S)$. (8)

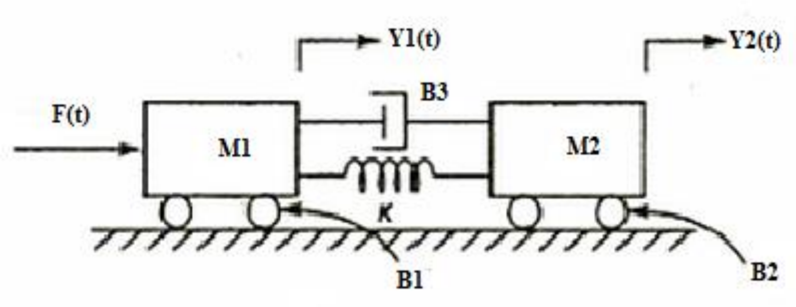

Figure 2

(ii) For the mechanical system shown in Figure 3, compute the transfer function of $Y_1(S) / F(S)$. (8)

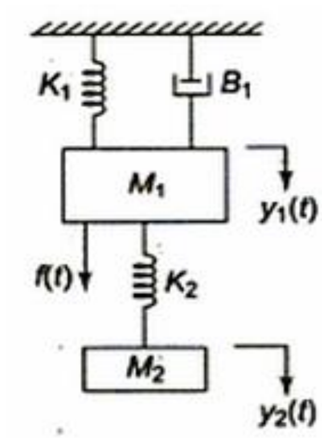

Figure 3

Or

(b) (i) Simplify the block diagram shown in Figure 4, using block diagram reduction technique compute the closed loop transfer function of the system. (10)

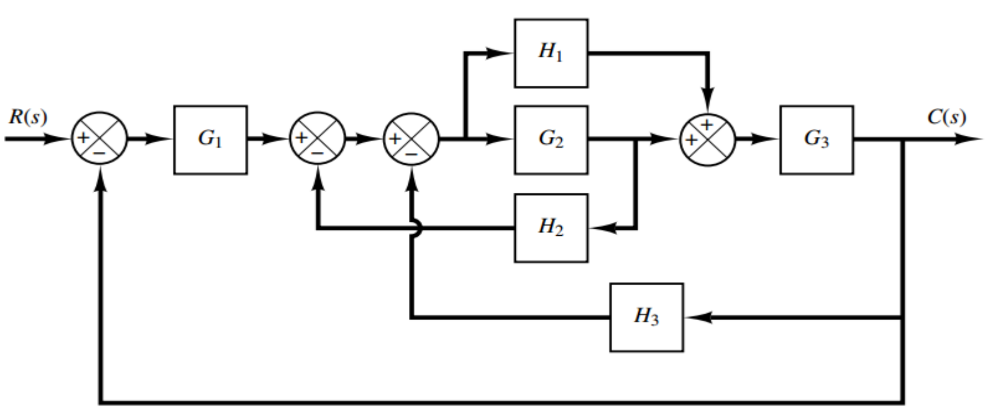

Figure 4

31451

(ii) Using the Mason's rule, determine the transfer function of the signal flow graphs shown in Figure 5. (6)

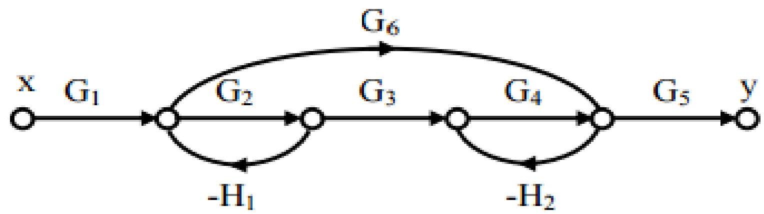

Figure 5

12. (a) (i) Derive an expression for time response of a second order under damped unity feedback system when excited with an unit step input. (10)

(ii) Derive an expression of peak time and rise time for time response of a second order under damped unity feedback system. (6)

Or

(b) A unity feedback system has a open loop transfer function as $G(S)=\frac{10(S+1)}{S^2(5S+6)}$.

Determine the steady state error, if $r(t)=1+4t+3t^2$. (16)

13. (a) Sketch the Bode plot for $G(S)H(S)=\frac{2}{S(S+1)(1+0.2S)}$, and compute phase margin, gain margin and cross over frequencies. (16)

Or

(b) Design a suitable compensator for a system with open-loop transfer function is $G(S)=\frac{1}{S(S+1)(0.5S+1)}$, so that the static velocity error constant K_v is 5 sec^{-1}, the phase margin is at least 40°, and the gain margin is at least 10 *dB*. (16)

14. (a) (i) Ascertain the stability of the system given by characteristic equation $S^6+3S^5+5S^4+9S^3+8S^2+6S+4=0$, by Routh array criterion. (10)

(ii) Determine Routh array and hence comment on the stability of the system, whose characteristic equation is given by $S^4+S^3+2S^2+2S+1=0$. (6)

Or

(b) Sketch the root locus of a unity feedback system whose open loop transfer function is given by $G(S)H(S)=\frac{k}{S(S+1)(S+2)}$, and compute the value of k on the verge of stability.

(16)

15\. (a) (i) Compute the state-space representation of the following transfer function system is given by $\frac{Y(S)}{U(S)} = \frac{S+6}{S^2+5S+6}$. (8)

(ii) Compute the state transition matrix for the state model whose system matrix is given by $A = \begin{bmatrix} 0 & 1 \\ -2 & -3 \end{bmatrix}$. (8)

Or

(b) (i) Compute $x_1(t)$ and $x_2(t)$ of the system described by $\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \end{bmatrix} = \begin{bmatrix} 0 & 1 \\ -3 & -2 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix}$, where the initial conditions are $\begin{bmatrix} x_1(0) \\ x_2(0) \end{bmatrix} = \begin{bmatrix} 1 \\ -1 \end{bmatrix}$. (8)

(ii) Compute the transfer function of a linear time-invariant system is represented by the state equation $\dot{X} = \begin{bmatrix} 0 & 3 \\ 0 & -2 \end{bmatrix} X + \begin{bmatrix} 1 \\ 1 \end{bmatrix} U$ and $Y = \begin{bmatrix} 2 & 1 \end{bmatrix} X$. (8)
