G 492 (Pages : 4) Reg. No..................

Name..................

B.TECH. DEGREE EXAMINATION, MAY 2014

Sixth Semester

Branch : Electronics and Communication Engineering

CONTROL SYSTEMS (L)

(Prior to 2010 Admissions)

[Old Scheme—Supplementary/Mercy Chance]

Time : Three Hours Maximum : 100 Marks

Graph Sheets and Semi-log sheets may be supplied.

Part A

Answer **all** *questions briefly.*
Each question carries 4 marks.

1. Write the force balance equations for an ideal mass, ideal spring and ideal dash pot.
2. Define transfer function. What are the advantages of transfer function approach ?
3. A unity feedback system, is represented as $G(s) = \frac{10}{s(s+1)}$. Determine the dynamic error coefficients and obtain the error signal.
4. Applying Routh's criteria, check for stability of the systems having the characteristic equation $2s^5 + s^4 + s^3 + 2s^2 + s + 2 = 0$.
5. What is gain margin ? Discuss its relevance in the analysis of a control system ?
6. Distinguish between absolute stability and conditional stability.
7. Check for the stability of the system described by the characteristic equation :

   $$s^5 + 7s^4 + 3s^3 + 4s^2 + 15s + 4 = 0.$$

   How many roots are on the right half s-plane ?
8. Explain the working of a tachogenerator.
9. Find the state transition matrix for a system which has $A = \begin{bmatrix} 0 & 1 \\ -15 & -8 \end{bmatrix}$.
10. What is a compensator ? Discuss the need of the same in control system ?

(10 × 4 = 40 marks)

Turn over

Part B

Answer **all** *questions.*
Each full question carries 12 *marks.*

11. Convert the block diagram to signal Flow Graph and obtain the transfer function using Mason's gain rule. (Fig. 1)

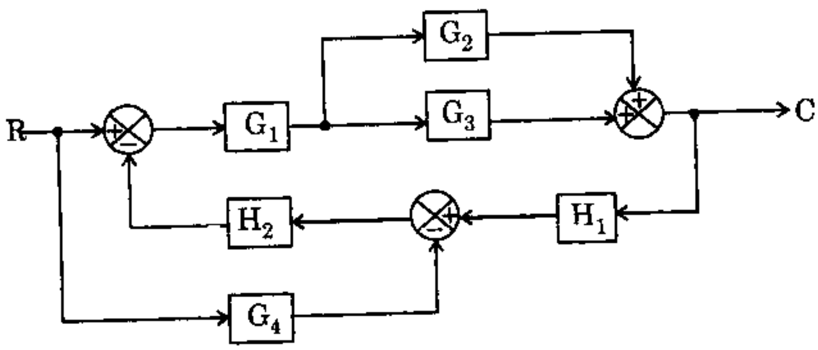
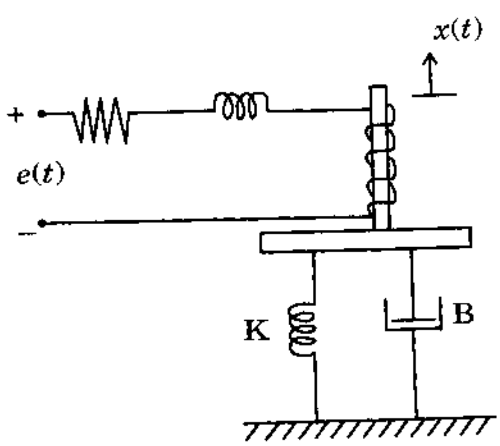


Fig. 1.

Or

12. Determine the transfer function for the system given in Fig. 2.



$e_b(t) = K_b \dfrac{dx}{dt}$ where

K_b is back e.m.f. constant in v/m/sec.

Fig. 2.

13. A unity feedback system is characterized by the feedback transfer function $G(s) = \dfrac{K}{s\,(s+10)}$.

Determine the gain K so that the system will have a damping ratio 0.5. For this value of K, determine the settling time, peak overshoot for a unit step input.

Or

14. (a) Find the range of K for the stability of the system whose characteristic equation is $s^4 + 7s^3 + 14s^2 + 8s + k = 0$. Find the frequency of oscillation when the system is marginally stable.

(8 marks)

(b) For an underdamped second order system subjected to unit step input, derive the expression for 'rise time' with usual notations.

(4 marks)

15. (a) Define and explain the significance of gain margin and phase margin and explain how they can be used to determine the stability of a system ?

(4 marks)

(b) Explain clearly the effect of addition of a pole or zero on stability, with suitable examples.

(8 marks)

Or

16. Obtain Bode plot for the following open loop transfer function and evaluate the gain margin and phase margin :

$$G(s) = \frac{10}{s(1+0.2s)(1+0.02s)}.$$

17. Using step by step procedure, draw the root locus plot for the system having open loop transfer function

$$G(s)H(s) = \frac{K}{s(s+0.5)\left(s^2+0.5s+10\right)} \quad 0 < k < \infty.$$

Or

18. A unity feedback control system has an open loop transfer function $G(s) = \frac{K(s+5)}{s(s+2)(s+3)}$. Sketch the approximate root loci for $K \geq 0$. Show that for $K = 8$, the closed loop poles are located at $-4, -0.5 \pm j\,3.12$.

19. A system is represented by the following equation

$$\frac{d^2y}{dt^2} + 5\frac{dy}{dt} + 4y = r(t).$$

Obtain :

(i) State equation.

(ii) Eigen values.

(iii) State transition matrix.

Or

20. (a) Explain any *one* method of computing state transition matrix. (4 marks)

(b) A discrete time system is represented by the state model :

$$X(k+1) = \begin{bmatrix} 0 & 1 \\ -0.16 & 1 \end{bmatrix} X(k) + \begin{bmatrix} +1 \\ +1 \end{bmatrix} r(k)$$

$$y(k) = \begin{bmatrix} 1 & 0 \end{bmatrix} X(k).$$

Determine the unit step response sequence, given $X(0) = \begin{bmatrix} 1 \\ -1 \end{bmatrix}$.

(8 marks)

[5 × 12 = 60 marks]