(b) Obtain the state model for a system whose transfer function is given as,

$$\frac{C(s)}{R(s)} = \frac{1}{s^3 + 9s^2 + 26s + 24}$$

Determine the time response for unit step input. Assume initial conditions as nil. (7)

(c) Explain Controllability and Observability with respect to state model? (4)

[This question paper contains 8 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 5766 **K**

Unique Paper Code : 2512014701

Name of the Paper : Control Systems

Name of the Course : **B.Sc. (H) Electronics (DSC)**

Semester : VII

Duration : 3 Hours Maximum Marks : 90

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. There are **seven** questions in all, out of which you have to attempt any **five** Questions.
3. Question no. **1** is compulsory.
4. **All** questions carry equal marks.
5. Use of Scientific Calculator is allowed.

1. (a) What is transfer function? Derive an expression for closed loop transfer function.

   (b) What is feedback? What type of feedback is employed in control systems?

   (c) How does the position of poles and zeros of a control system affect the stability of the system?

   (d) Draw the labelled diagram of time response of second order control system and define its terms.

   (e) What is resonant frequency? How is it related to natural frequency?

   (f) Compare PI and PD controllers. (3×6)

2. (a) For the transfer function G(s), of a control system

$$G(s) = \frac{1}{2}\frac{(s^2+4)(1+2.5s)}{(s^2+2)(1+0.5s)}$$

6. (a) Consider the system with the following open loop transfer function

$$G(s) = \frac{K(s+3)}{(s+1)(s+5)(s+6)}$$

   Draw a root locus for it. (9)

   (b) The open loop transfer function of a control system is given below : (9)

$$G(s)\,H(s) = \frac{2(s^3+3s+20)}{s(s+2)(s^2+4s+10)}$$

   Determine the static error coefficients and steady state error for the input given (i) 5 (ii) 4t.

7. (a) Derive the expression for the transfer function of a lag-lead compensator and plot its zeros and pole in the s-plane. (7)

(c) Three blocks with gain 4, 8 and 4 are connected in cascade. Determine the overall gain of this cascaded system. What would be the overall gain if the three systems were connected in parallel. (4)

5. (a) Determine the resonant peak, resonant frequency, natural frequency and bandwidth for the unity feedback system with the given open loop transfer function G(s),

$$G(s) = \frac{100}{s\,(s+5)}. \quad (7)$$

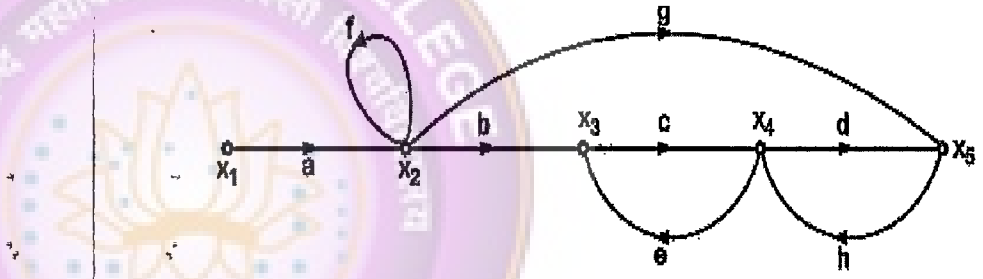
(b) Sketch the polar plot for the transfer function

$$G(s) = \frac{1}{s(s+1)} \quad (7)$$

(c) What are the advantages and disadvantages of Nyquist plot. (4)

Plot the poles and zeros in s-plane and determine the value of the transfer function at s = 2. Also find order of the system. (7)

(b) Using Mason's gain formula determine the overall gain relating x_5 and x_1. (7)



(c) A system is represented by the differential equation

$$M\frac{d^2x}{dt^2} + F\frac{dx}{dt} + Kx = u(t)$$

Determine the transfer function relating X(s) and U(s). (4)

P.T.O.

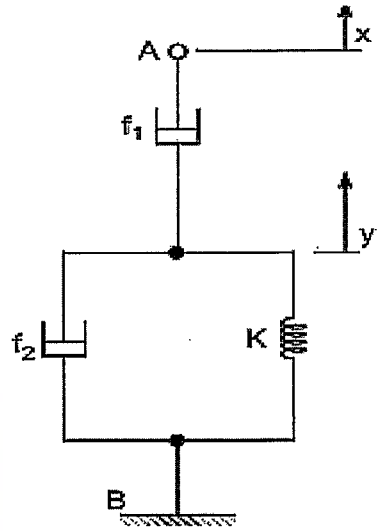
3. (a) The forward path transfer function of a unity feedback control system is given $G(s) = \frac{\bar{2}}{s\,(s+3)}$.

Obtain the expression for unit step response of the system in the time domain. (7)

(b) Examine the stability of $s^6 + 2s^5 + 8s^4 + 15s^3 + 20s^2 + 16s + 16 = 0$. Using Routh's method, find the number of roots lying in the right half of the s-plane. (7)

(c) What do you mean by a derivative control? What is the effect of derivative control on damping ratio, peak overshoot, steady-state error and rise time? (4)

4. (a) Find the transfer function relating displacements y and x for the mechanical system shown below. (7)



(b) Sketch the Bode plot for the transfer function G(s) (7)

$$G(s) = \frac{10}{s\,(s+10)}$$