[This question paper contains 4 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 5573 **J**

Unique Paper Code : 2512043603

Name of the Paper : Control System

Name of the Course : **B.Sc. (H) Instrumentation CBCS**

Semester : VI

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. Attempt any **five** questions in all. Question No. **1** is compulsory.
3. **All** questions carry equal marks.
4. Non-programmable calculators are allowed.

Q.1. A Find the transfer function of the given network shown in figure 1. 3

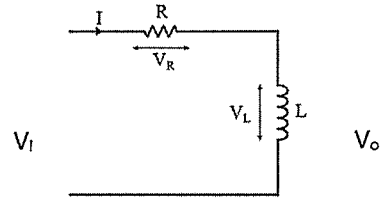

Fig. 1

B Define the following terms: (i) Delay Time (ii) Maximum Overshoot (iii) Steady State Error. 3

C What are the effects of phase lead network and phase lag network? 3

D A thermometer requires 1 min to indicate 98% of the response to a step input. Assuming the thermometer to be a first order system, find the time constant. 3

E What are the advantages and disadvantages of state space techniques? 3

F Sketch the polar plot of $G(s) = \frac{10}{S(1+S)}$. 3

Q.2. A Determine damping frequency, natural frequency, Maximum overshoot, setteling time, the time interval between maximum and minimum values of c(t). The block diagram is shown in figure 2 and the input being a unit step. 10

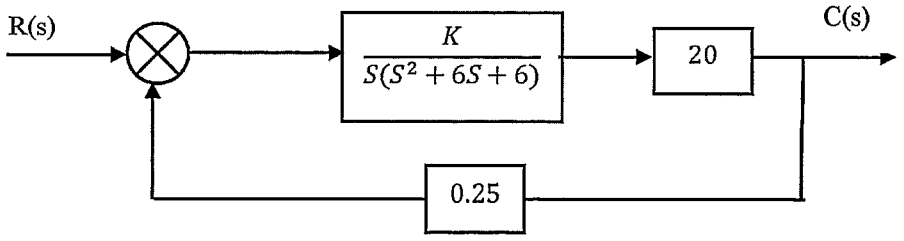

Fig. 2

P.T.O.

B The characteristic equation of a system is given by 8

$$S^6 + 3S^5 + 4S^4 + 6S^3 + 5S^2 + 3S + 2 = 0.$$

Comment on stability.

Q.3. A The open loop transfer function of a unity feedback control system is given by 10

$$G(s)H(s) = \frac{K}{S(S+2)(S^2+6S+25)}$$

(i) Sketch the root locus for $0 \leq K \leq \infty$.
(ii) At what value of K the system becomes unstable.
(iii) At this point of instability determine the frequency of oscillation of the system.

B Define natural frequency of oscillation and damping ratio of second order system. Find the nature of damping for the following systems: 8

(i) R(s) ← $\frac{12}{(S^2+8S+12)}$ → C(s)

(ii) R(s) ← $\frac{16}{(S^2+8S+16)}$ → C(s)

(iii) R(s) ← $\frac{20}{(S^2+8S+20)}$ → C(s)

Q.4. A A unity feedback system has open loop transfer function 10

$$G(s) = \frac{25}{S(1+S)(10+S)}$$

Draw Bode plot of transfer function and obtain the gain margin and the phase margin analytically.

B Use Nyquist criterion, determine whether the closed loop system having the following open loop transfer function is stable or not. If not, how many closed loop poles lie in the right half s-plane? 8

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

Q.5. A Find the time response of the system described by the equation 8

$$\dot{x}(t) = \begin{bmatrix} -1 & 1 \\ 0 & -2 \end{bmatrix} x(t) + \begin{bmatrix} 0 \\ 1 \end{bmatrix} u(t)$$

$$x(0) = \begin{bmatrix} -1 \\ 0 \end{bmatrix}, u(t) = 1, t > 0$$

B Obtain the state model for the given transfer function. 5

$$G(s) = \frac{y(s)}{u(s)} = \frac{K(C_2 s + C_1 s)}{s^3 + a_3 s^2 + a_2 s + a_1}$$

C Show that the steady state error increase by using the derivative feedback control. 5

Q.6. A Using block diagram reduction technique, find closed loop transfer function of the system whose block diagram is given in fig. 3 (a) when R_1=0 (b) when R_2=0. 10

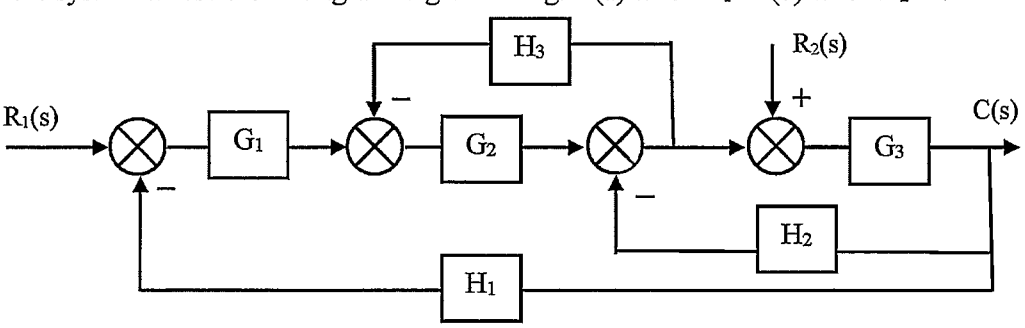

Fig. 3

B For the system represented by the given equations find the transfer function x_5/x_1 by the help of signal flow graph technique. 8

$$x_2 = a_{12}x_1 + a_{32}x_3 + a_{42}x_4 + a_{52}x_5$$

$$x_3 = a_{23}x_2$$

$$x_4 = a_{34}x_3 + a_{44}x_4$$

$$x_5 = a_{35}x_3 + a_{45}x_4$$

Where x_1 is input variable and x_5 is output variable.

Q.7. A The block diagram of electronic pacemaker is given in fig. 4. Determine the steady state error for unit ramp input when K=400. Also, determine the value of K for which the steady state error to a unit ramp will be 0.02. 10

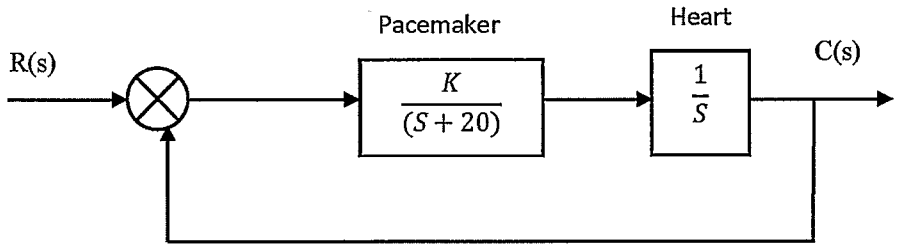

Fig. 4

B Realize the basic compensators using electrical network and obtain the transfer function. 8