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**A**

Total No. of Questions : 9]

[Total No. of Printed Pages : 7

**IC-204**

**LINEAR CONTROL SYSTEM  
(NEW)**

(B.Tech., 4th Semester, 2055)

Time : 3 Hours

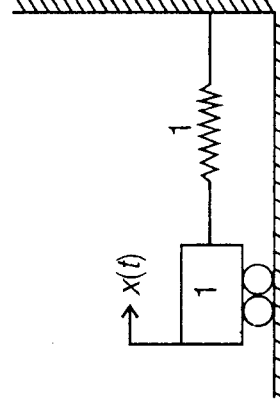
Maximum Marks : 60

**Note :-** Section A is compulsory. Attempt any *Four* questions from Section B and any *Two* questions from Section C.

**Section-A**

Marks : 2 Each

1. (a) Consider the mechanical system shown in the given below figure. If the system is set into motion by unit impulse force, find out the equation of oscillation.



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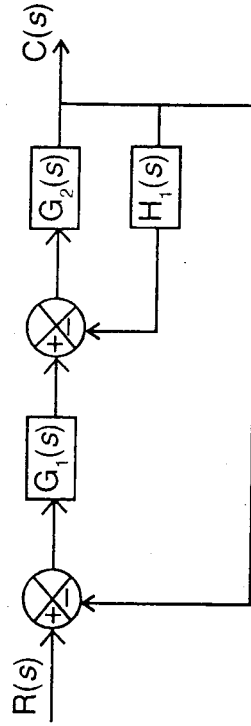
**J-85**

( 2 )

- (b) Calculate the sensitivity  $S_G^M$  of the system having the transfer function

$$M = \frac{G}{1 + GH}$$

- (c) Find out the  $\frac{C(s)}{R(s)}$  for the system shown in the following block diagram.



- (d) Calculate the value of  $k$  for which the unity feedback system

$$G(s) = \frac{k}{s(s+2)(s+4)}$$

crosses the imaginary axis.

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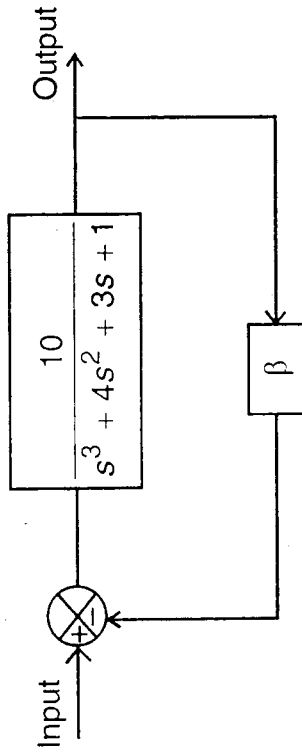
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- (e) Consider the system having transfer function

$$\frac{C(s)}{R(s)} = \frac{4}{s^2 + 1.65s + 4}$$

Calculate the settling time for 2% tolerance band, for the unit step response.

- (f) A closed loop system is shown in the following figure. Find out the largest possible value of  $\beta$  for which this system would be stable.



- (g) Calculate the natural frequency of a second order system described by the differential equation

$$J \frac{d^2\theta_0}{dt^2} + F \frac{d\theta_0}{dt} + K\theta_0 = K\theta_i$$

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- (h) Find out the phase angle for a transfer function

$$G(s) = \frac{1}{(1 + sT)^3}$$

at corner frequency.

- (i) The loop transfer function of a feedback control system is given by

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

Calculate the number of asymptotes of its root loci.

- (j) In a two-phase a.c. servomotor, the rotor has a resistance R and a reactance X. Give the condition for which torque-speed characteristic of the servomotor will be linear.

**Section-B** Marks : 5 Each

2. Discuss in brief three different canonical state models to study the controllability and observability properties of a system.

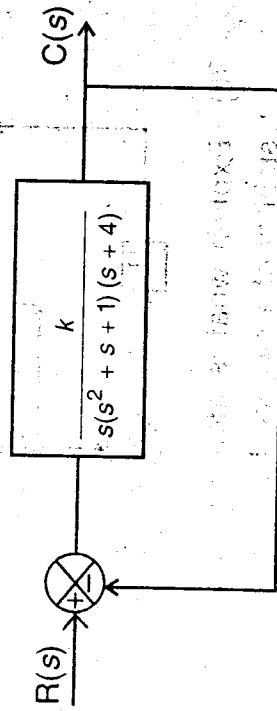
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( 5 )

3. List the advantages and disadvantages of hydraulic controllers.
4. Sketch the desirable range of the location of the poles of the transfer function of a system if the system's damping ratio is to lie between 0.3 and 0.7 and its natural frequency is to lie between 2 and 4 rad/s.

5. Consider the closed loop feedback system shown in the figure below. Determine the range of K for which the system is stable.



6. Explain the construction and working principle of Synchro error detector.

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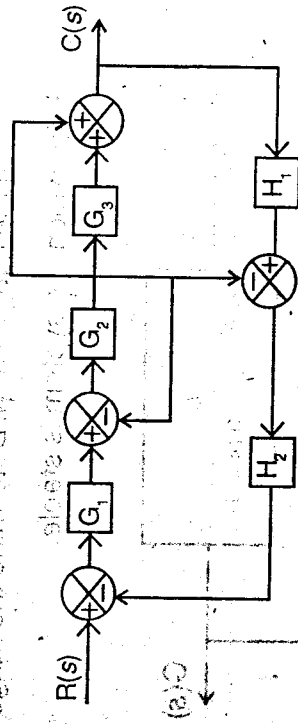
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to a positive value. **Section-C** Marks : 10 Each

7. Show that the lead network and lag network are inserted in cascade in an open loop acts as a proportional plus derivative control (in the region of small  $w$ ) and proportional plus integral control (in the region of large  $w$ ), respectively.

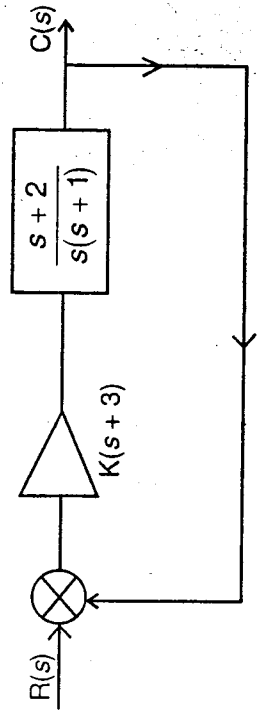
8. (a) Obtain the transfer function  $\frac{C(s)}{R(s)}$  for the multi-loop control system shown.



(b) Explain what is meant by the relative stability of a system. How do we specify relative stability in terms of :

- (i) closed-loop pole locations
- (ii) gain margin and phase margin ?

9. (a) Draw the root locus diagram for the following control system and calculate the breakin and breakaway points.



(b) Discuss the various salient features of Root Locus Plot.