53 (IE 506) CNTH

2014

CONTROL THEORY

Paper : IE 506

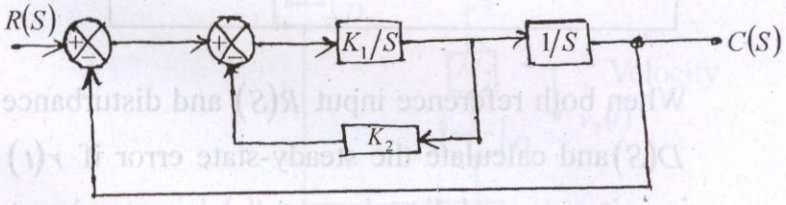
Full Marks : 100

Time : Three hours

The figures in the margin indicate full marks for the questions.

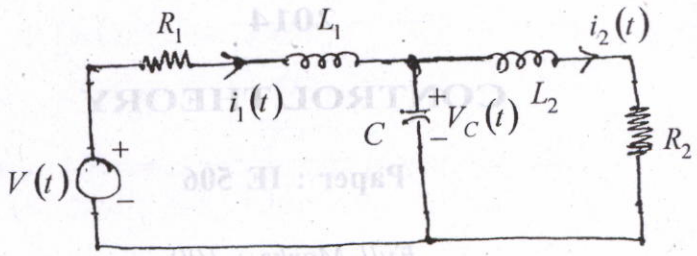
*Answer **any five** questions out of **seven**.*

1. *(a)* Determine the value of K_1 & K_2 of the closed loop system shown, so that



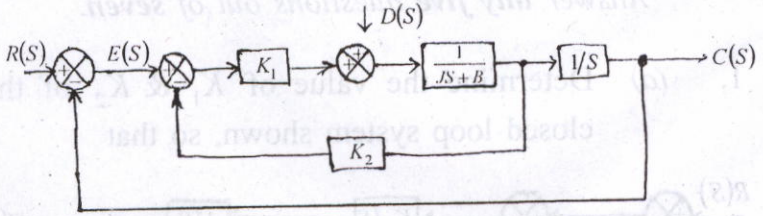
the maximum overshoot in the unit step response is 25% and peak time is 2 seconds. 10

(b) Write down the state equations for circuit below 5+5



and draw the signal flow for the circuit.

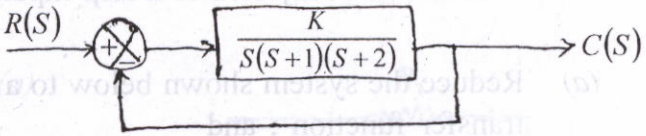
2. (a) Consider the system shown below ; obtain the expression for error signal $E(s)$,



When both reference input $R(S)$ and disturbance $D(S)$ and calculate the steady-state error if $r(t)$ is unit ramp and disturbance $d(t)$ is a step input. 5+5

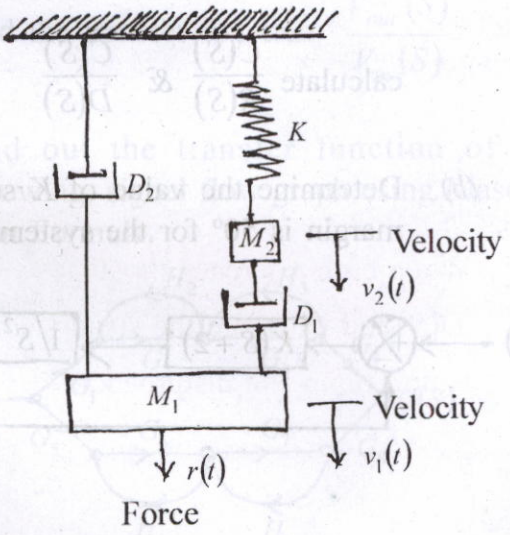
(b) A closed loop system is shown below having

$$G(S)=\frac{K}{S(S+1)(S+2)} \quad \& \quad H(S)=1 \ ;$$



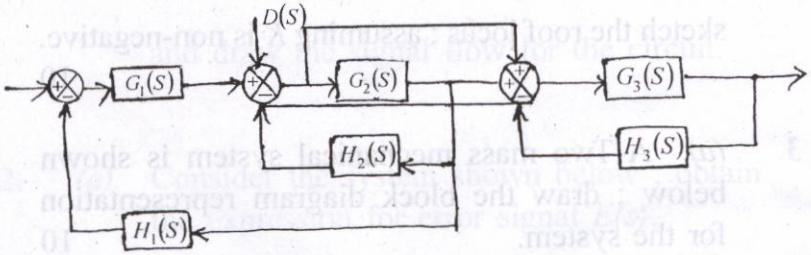
sketch the roof locus ; assuming K is non-negative. 10

3. (a) A Two mass mechanical system is shown below ; draw the block diagram representation for the system. 10



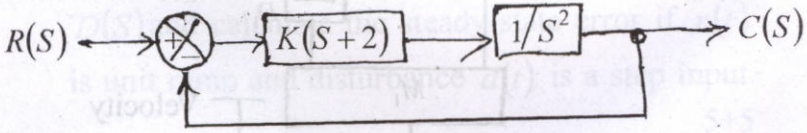
(b) For a typical second order system ; damping factor is given as 0·6 and natural oscillation frequency is $5 rad/sec$; calculate rise time peak time, maximum overshoot and setting time ts when subjected to a step input. 10

4. (a) Reduce the system shown below to a single transfer function ; and 10



calculate $\frac{C(S)}{R(S)}$ & $\frac{C(S)}{D(S)}$

(b) Determine the value of K such that phase margin is 50° for the system shown below



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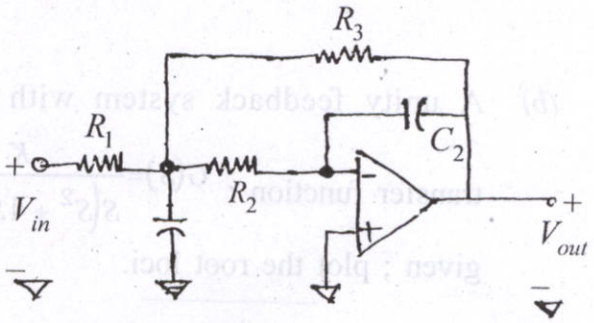
(c) Find the inverse Laplace transform of the transfer function shown below :

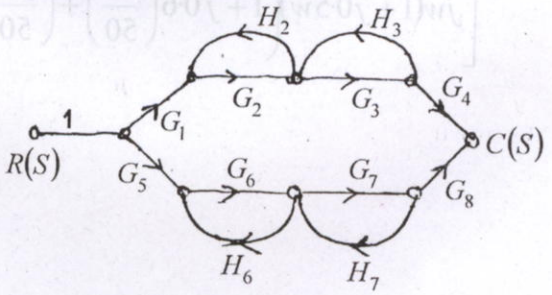
$$F(S)=\frac{S^4+2S^3+3S^2+4S+5}{S(S+1)}$$ 5

5. (a)

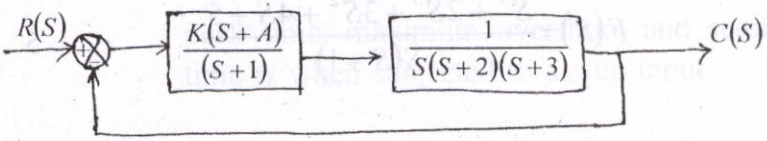


Find the transfer function $\frac{V_{out}(S)}{V_{in}(S)}$ 10

(b) Find out the transfer function of the following signal flow graph using Mason's Gain Formula. 10



6. *(a)* Determine the value of K & A such that system shown below is stable 10



(b) A unity feedback system with forward transfer function ; $G(S)=\dfrac{K}{S\left(S^2+4S+5\right)}$ is given ; plot the root loci. 10

7. *(a)* Construct the Bode Plot for the transfer function 10

$$G(jw)=\frac{5(1+j0{\cdot}1w)}{\left[jw(1+j0{\cdot}5w)\left(1+j0{\cdot}6\left(\frac{w}{50}\right)+\left(\frac{jw}{50}\right)^2\right)\right]}$$

(b) Mention different types of compensation techniques and discuss Lag-lead compensation, draw the circuit diagrams. 10