

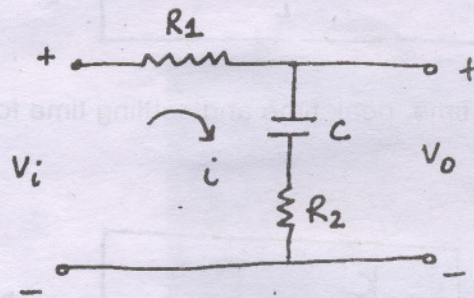
(REVISED COURSE)

(3 Hours)

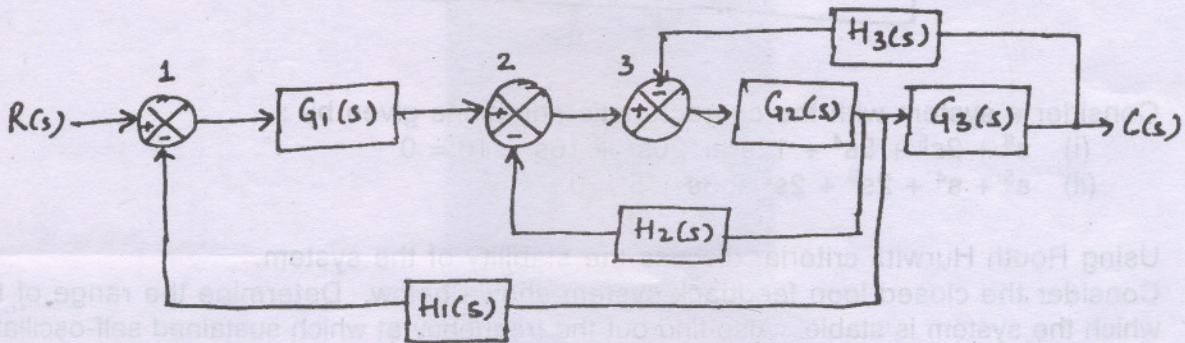
[Total Marks : 100

- N.B. (1) Question No. 1 is compulsory.
 (2) Attempt any four out of remaining six questions.
 (3) Figures to the right indicate full marks.

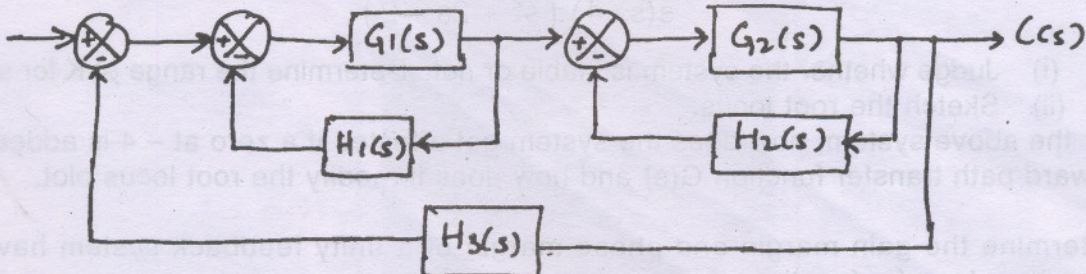
1. (a) Explain concept of stability. Differentiate between relative and absolute stability. 5
- (b) Analyze and plot the unit step response and unit ramp response for a first order system. 5
- (c) Explain concept of Gain margin and Phase margin from Nyquist plots. 5
- (d) Determine the transfer function of the lag compensator shown below : 5



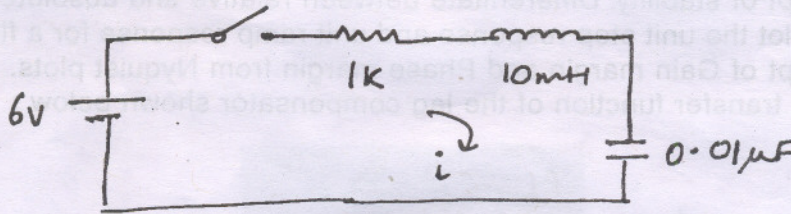
2. (a) Obtain transfer function using Block diagram reduction for the figure shown below : 10



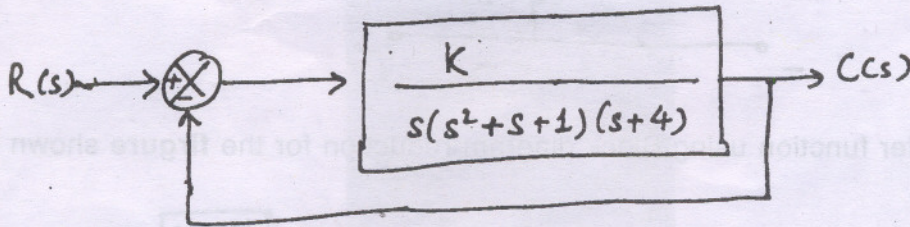
- (b) For the system shown below, obtain the signal flow graph and find overall gain using Mason's gain formula. Verify result using block diagram reduction. 10



3. (a) A series RLC circuit is shown below. Determine gain, the undamped natural frequency and damping ratio of the circuit. Write an equation in terms of q ($i = \frac{dq}{dt}$) as a function of time after the switch is closed. 10



- (b) Derive the expression for rise time, peak time and settling time for a second order system. 10



4. (a) Consider a system with the characteristic equations given by : 10
 (i) $s^6 + 2s^5 + 8s^4 + 12s^3 + 20s^2 + 16s + 16 = 0$
 (ii) $s^5 + s^4 + 2s^3 + 2s^2 + 3s + 5 = 0$

Using Routh Hurwitz criteria, discuss the stability of the system.

- (b) Consider the closed loop feedback system shown below. Determine the range of K for which the system is stable. Also find out the frequency at which sustained self-oscillations will take place. 10
5. (a) The open loop transfer of a feedback control system is given by— 12

$$G(s)H(s) = \frac{12}{s(s+4)(s^2 + 2s + 2)}$$

- (i) Judge whether the system is stable or not. Determine the range of K for stability.
 (ii) Sketch the root locus.
- (b) For the above system, how does the system get affected if a zero at -4 is added in the forward path transfer function $G(s)$ and how does it modify the root locus plot. 8
6. (a) Determine the gain margin and phase margin of a unity feedback system having an open-loop transfer function : 15

$$G(j\omega) = \frac{10}{j\omega(j0.1\omega + 1)(j0.05\omega + 1)}$$

- by use of Bode plot.
- (b) State and explain Nyquist stability criteria. 5
7. (a) With the help of a schematic diagram explain a positional servomechanism. 10
 (b) Derive the transfer function of a armature controlled d.c. motor. 10