S.E. Sem 3 (Rev.) EXTC / Principles of Control systems 30/5/08

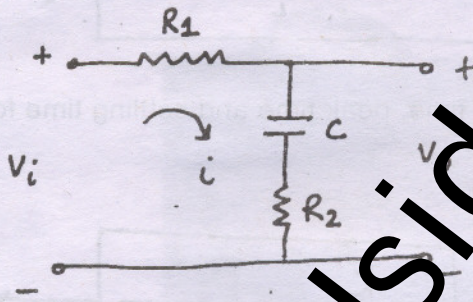
Con. 2623-08. CO-9607

(REVISED COURSE)

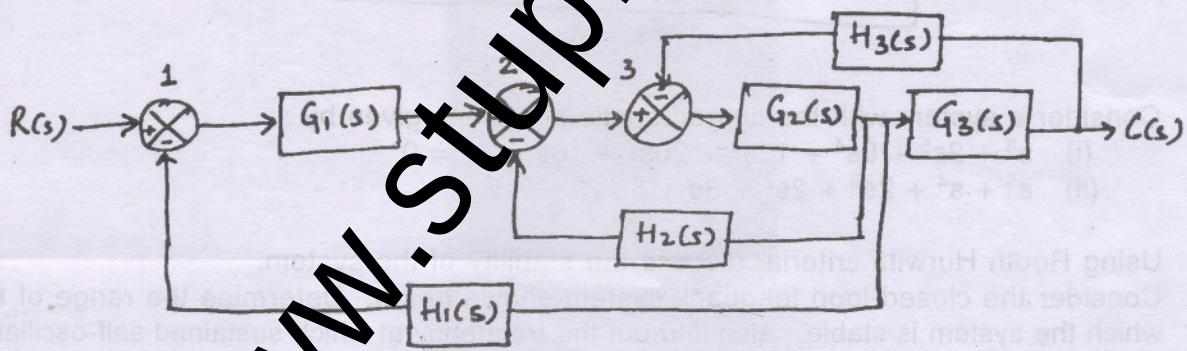
(3 Hours) [Total Marks : 100

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.

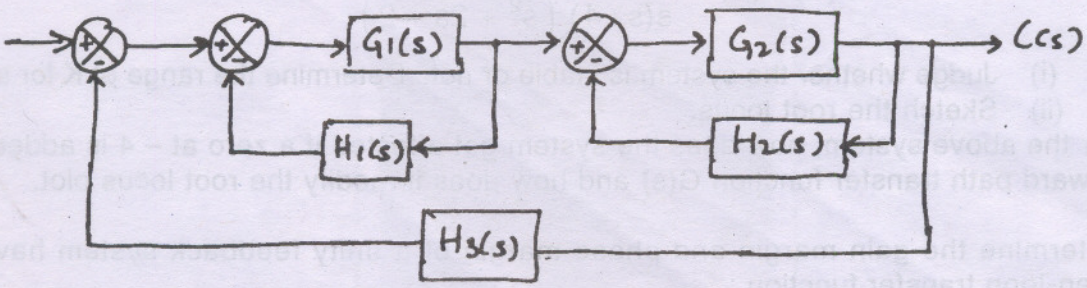
1. (a) Explain concept of stability. Differentiate between relative and absolute stability. 5
(b) Analyze and plot the unit step response and unit ramp response for a first order system. 5
(c) Explain concept of Gain margin and Phase margin from Nyquist plots. 5
(d) Determine the transfer function of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



2. (a) Obtain transfer function using Block diagram reduction for the **firgure** 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



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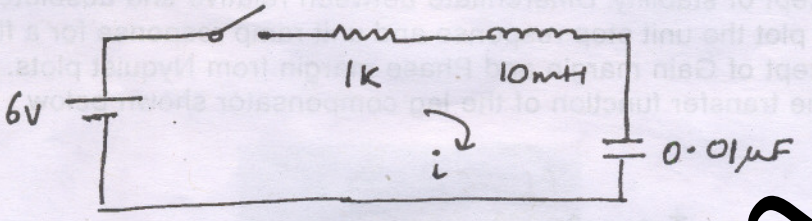
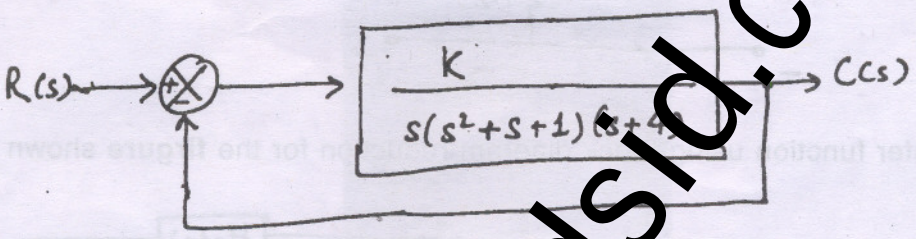
3. (a) A series RLC circuit is shown below. Determine gain, the undamped natural frequency and damping ratio of the circuit. Write an equation in terms of q $\left(i = \frac{dq}{dt}\right)$ as a function of time after the switch is closed. 10



(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 sysetm is given by— 12

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

(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

$$G(jw) = \frac{10}{jw\,(j0\cdot1w + 1)\,(j0\cdot05w+1)}$$

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