S.E IV, Etrx   Control System Engg   27/5/06

Con. 1801-06.   TV-8109

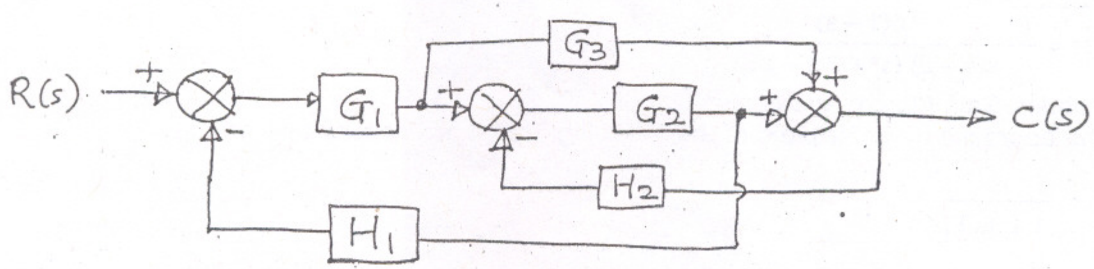
(REVISED COURSE)

(3 Hours)   [Total Marks : 100

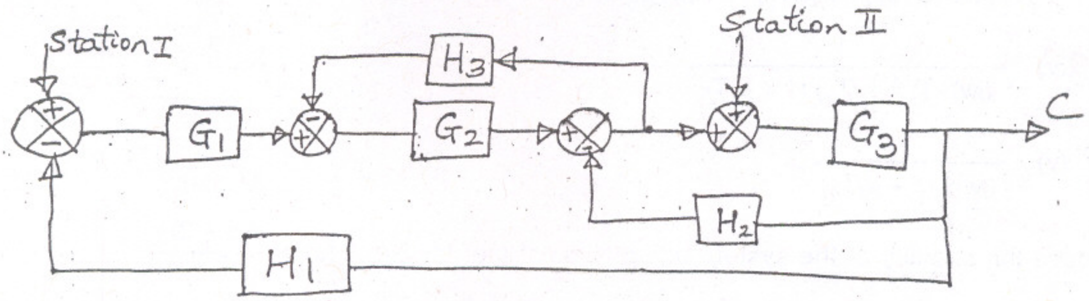
N.B. (1) Question No. 1 is **compulsory**.
(2) Answer any **four** questions out of remaining **six** questions.
(3) Assume **suitable data** wherever **necessary**.
(4) **Figures** to the **right** indicate **full** marks.

1. Attempt any **five** :— 20
   (a) The transfer function and impulse-response function of a linear, time-invariant system contain the same information about the system dynamics. Verify this statement.
   (b) How are the test signals useful in analysing an actual control system where the Inputs differ ?
   (c) Differentiate between type and order of a system.
   (d) What is Root Locus ? How are the conditions on which Root Locus are based formulated ?
   (e) Define Absolute and Relative stability of a system.
   (f) How is Gain Margin and Phase Margin found from Magnitude-phase plot ?

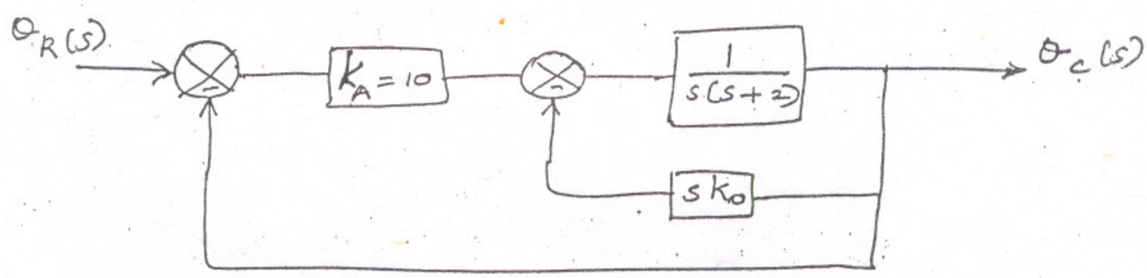
2. (a) Draw the signal flow graph of the given Block **Diagram** and derive the Transfer Function using Mason's Gain Formula. 10



(b) For the system represented by the Block **Diagram** shown, evaluate the closed loop transfer functions, when the Input R is (i) at station I (ii) at station II. 10

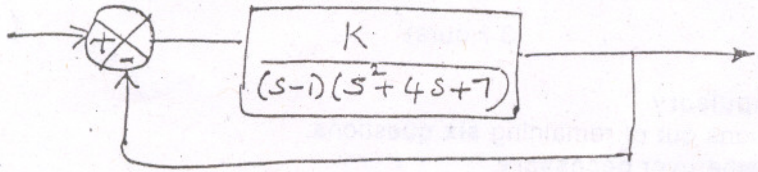


3. (a) (i) A feedback system is shown in the **figure**. In the absence of derivative feedback ($K_0 = 0$), determine the damping factor and natural frequency of the system. What is the steady state error resulting from unit ramp input ? 10
   (ii) Determine the derivative feedback constant K_0, which will increase the damping factor of the system to 0·6. What is the steady state error to unit ramp input with this setting of the derivative feedback constant ?



(b) A system is described by $\frac{d^2y}{dx^2} + 8\frac{dy}{dx} + 25\,y(t) = 50\,x(t)$. Evaluate the response and maximum output for a step of 2·5 units. 10

4. (a) Sketch the Root Loci of the control system shown. Determine the range of k for stability. 10



(b) Unit-step response data of a second order system is given below. Obtain the corresponding frequency response indices (M_r, w_r, w_b) for the system. 10

t(sec)	0	0·05	0·10	0·15	0·20	0·25	0·30	0·35	0·40	0·45	0·5
y(t)	0	0·25	0·8	1·08	1·12	1·02	0·98	0·98	1·0	1·0	1·0

5. (a) Consider a third order system with the characteristic equation $s^3 + 10{\cdot}1\, s^2 + 21\, s + 2 = 0$. Is the system stable ? If we shift the jw axis to the left by 0·2 units, analyse the relative stability of the system. 10

(b) Explain the principle of operation and characteristics of a two phase servomotor. What is the advantage of drag cup rotor ? 10

6. (a) Obtain Bode Plot. 10

$$G(s)H(s) = \frac{10(1-s)}{s(s+2)\,(s^2+2s+25)}$$

Hence obtain Gain Margin and Phase Margin.

(b) Draw the approximate polar plots of the following Transfer functions :— 10

(i) $\dfrac{1}{1 + jwT_1}$

(ii) $\dfrac{1}{jw\,(1 + jwT_1)}$

(iii) $\dfrac{1}{(1 + jwT_1)\,(1 + jwT_2)\,(1 + jwT_3)}$

(iv) $\dfrac{1}{(jw)^2\,(1 + jwT_1)\,(1 + jwT_2)}$

(v) $\dfrac{1}{(jw)^3\,(1 + jwT_1)}$.

7. (a) Discuss the stability of the system using Nyquist plot for $G(s)H(s) = \dfrac{k(s-2)}{(s+1)^2}$. 10

(b) Write short notes on Continuous and Discontinuous controller modes. 10