BACHELOR OF POWER ENGINEERING EXAMINATION, 2017

(3rd Year, 1st Semester, Supplementary)

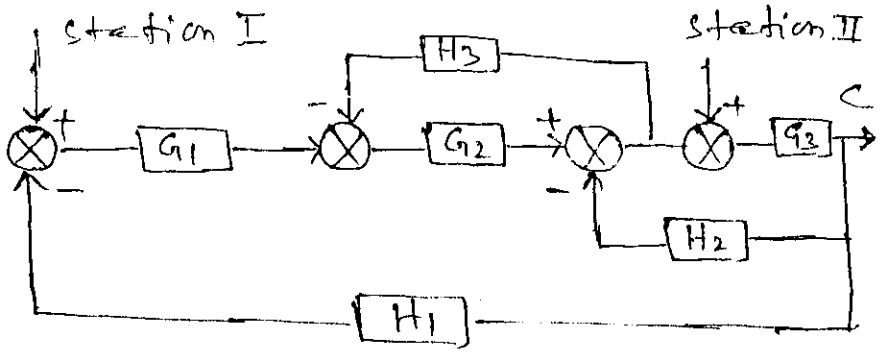
Introduction to Automatic Control (Old Syllabus)

Time : Three hours | Full Marks : 100

Answer any ***five***

Assume suitable values for missing data, if any.

All parts of a question to be answered at one place

No. of Question		Marks
1.	For the system as shown in fig.1 below, evaluate the closed loop transfer functions, when the input *R(s)* is (i) at station I and (ii) Station II using block diagram reduction technique.  fig. 1	10 +10
2.	Draw the signal flow graph for the system in Q.1 and verify your answer using Mason's gain formula.	10+10
3. (a)	Derive the expression for unit step response of a standard 2nd order system and hence find the steady state error for this case.	10
(b)	The open loop transfer function of a unity feedback system is given by $G(s)=\frac{4}{s(s+1)}$ Determine the nature (under damped, critically damped etc.) of the closed system for a unit step response. Also determine the rise time and peak overshoot.	10
4. (a)	By means of Routh criterion, determine the stability of the system represented by the following characteristic equation	8

$$s^5 + 4s^4 + 8s^3 + 8s^2 + 7s + 4 = 0$$

(b) The characteristic equation of a feedback control system is given by

$$s^3 + 3Ks^2 + (K+2)s + 4 = 0$$

(i) Determine the range of values of K for the system to be stable.

(ii) Can the system be marginally stable? If so, find the required value of K and the frequency of sustained oscillations. 12

5. Sketch the root locus plot with K as a variable parameter for the system given below.

$$G(s)H(s) = \frac{K}{s(s+1)(s+4)}$$

Is the system stable for all values of K ? If not determine the range of K for stable operation. Find also, the marginal value of K which causes sustained oscillations and the frequency of oscillations. 20

6. Sketch the bode plots showing the magnitude in dB and phase angle in degrees as a function of log frequency for the transfer function given below.

$$G(s) = \frac{8(s+4)}{(s+1)(s+2)}$$

Determine the gain cross over frequency, phase cross over frequency, gain margin (GM, and phase margin (PM). 20

7. Sketch the Nyquist plot and comment on the stability of closed loop system whose for the open loop transfer function *(K>0)* is given by

$$G(s)H(s) = \frac{K(s+3)}{s(s-1)}$$

Is the system stable for all values of K? If not determine the range of K for which the system is stable. 20