The LNM-IIT, Jaipur
Mid Term Examination
Control System Engineering

Time: 1:30 Hour **Max. Marks: 30**

Notes:- All questions are Compulsory.
Marks have been allotted against all questions.
Don't write anything on the question paper except Er. No.

Q.1. The signal flow graph is shown in Fig. 1. Determine the transfer function C(*s*)/R(*s*) of the system. [5]

Mason

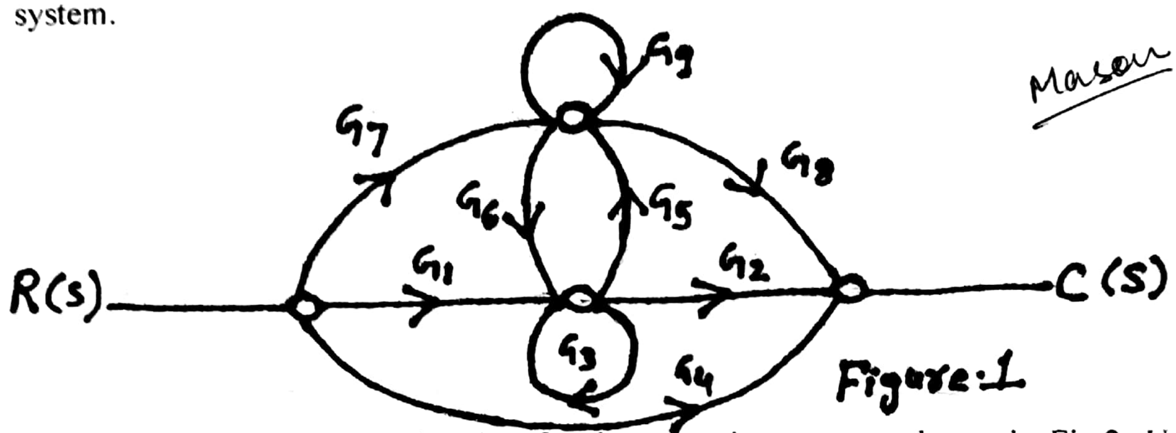

Figure:1

Q.2. Derive the overall transfer function for the control system as shown in Fig.2. Use block diagram reduction technique. [5]

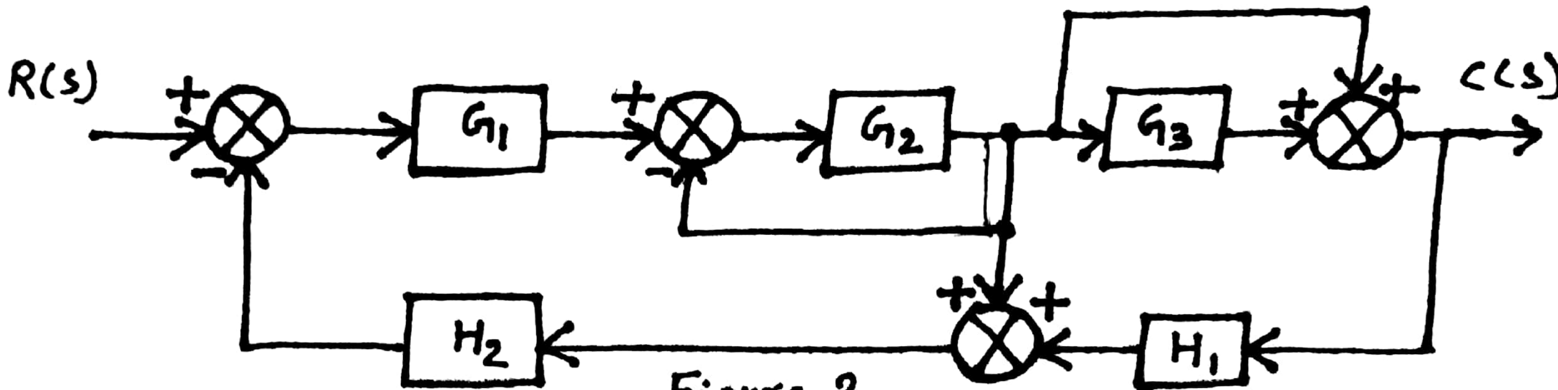

Figure.2

Q.3. Consider a unity feedback control system with the closed loop transfer function

$C(s)/R(s) = (Ks+b)/(s^2+as+b)$,

Determine the open loop transfer function. Show that the steady state error in the unit ramp input response is given by

$e_{ss} = (a-K)/b$ [5]

Scanned by CamScanner

Q.4. Measurement conducted on a servomechanism show the system response to be

$$c(t) = 1+0.2e^{-60t}-1.2e^{-10t}$$

when subjected to a unit step input.

(a) Obtain the expression for closed loop transfer function.

(b) Determine the undamped natural frequency and damping ratio of the system. [5]

Q.5. Derive the time response of an output for second order control system, when subjected to unit step input. Explain the effect of damping ratio, with proper expressions and specifications, on the system with valid location of roots of characteristic equation. [7]

Q.6. Determine the stability of a system having following characteristic equation.

$$s^6+s^5+5s^4+3s^3+2s^2-4s-8=0$$

[3]

The LNM-IIT, Jaipur
End Semester Examination
Control System Engineering

Time: 3 Hour **Max. Marks: 50**

Notes:- All questions are Compulsory.
Marks have been allotted against all questions.
Don't write anything on the question paper except Er. No.
All answers should be in an order.

Q.1.The open loop transfer function of a unity feedback is given by,

$$G(s) = (K(s+2))/(s^4+3s^3+4s^2+2s),\ K \geq 0$$

(a) Determine all the poles and zeros of $G(s)$.

(b)Draw the root locus of the system showing all the relevant points. [4]

Q.2.Consider the system as shown in Fig. 1. Draw the locus of the poles of the overall system as K is varied from 0 to infinity. [4]

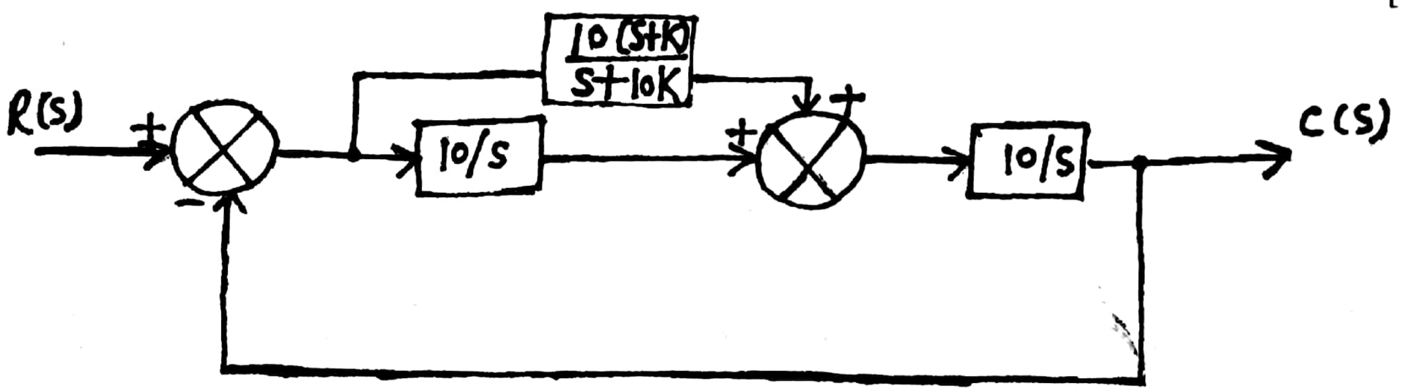

Fig.1

Q.3.Consider a lead lag network defined by,

$$Gc(s) = (K\,(s+1/T_1)(s+1/T_2))/((s+\beta/T_1)(s+1/\beta T_2))$$ [4]

Show that at frequency ω_1, where $\omega_1 = 1/(T_1T_2)^{1/2}$, The phase angle of $Gc(j\omega)$ becomes zero.

Q.4. Consider the system as shown in Fig.2 and investigate whether it is observable or not. [4]

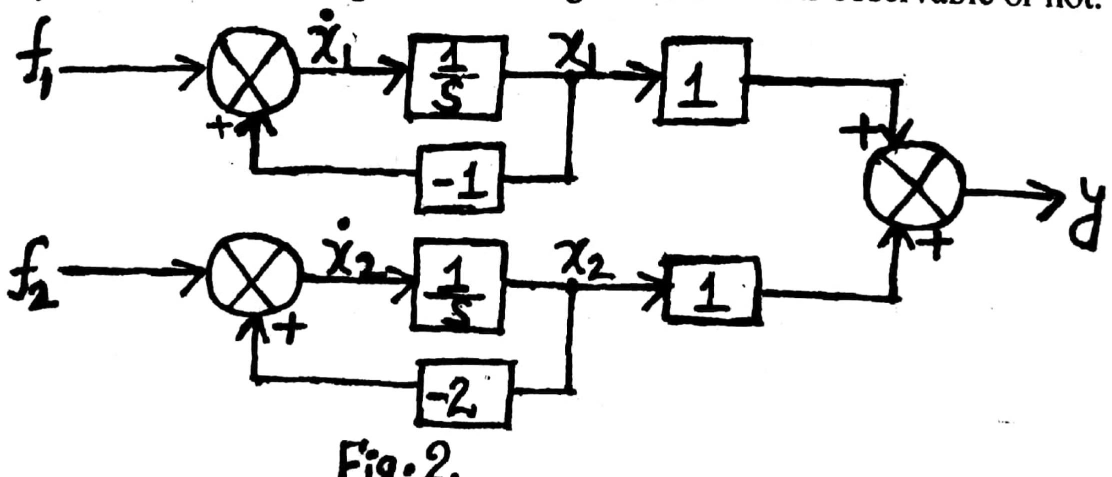

Fig.2

Q.5. A system is described by the following transfer function,

$$G(s) = (s+2)/(s^3+3s^2+2s+10),$$ [3]

Find the values of A, B, and C.

Q.6. Find the Time response of the system described by equation, [3]

$$\dot{x}(t) = \begin{bmatrix} -1 & 1 \\ 0 & -2 \end{bmatrix} x(t) + \begin{bmatrix} 0 \\ 1 \end{bmatrix} u(t) \text{ and } x(0) = \begin{bmatrix} -1 \\ 0 \end{bmatrix},\ u(t) = 1,\ t > 1$$

Q.7. The open loop transfer function of a control system is given by

$$G(s) = K/(s(s+2)(s+10)),$$

Determine the value of K so that the system may be stable with gain margin equal to 6 dB and phase margin equal to 45^0. [4]

Q.8. A unit step input is applied to a unity feedback control system whose open-loop transfer function is given by, $G(s) = K/(s(sT+1))$, Determine the values of K and T given that maximum overshoot M_P = 26% and resonant frequency, ω_r = 8 rad/sec. Calculate the resonant peak M_r, gain crossover frequency and phase margin. [4]

Q.9. Consider the transfer function, $G(s) = Ks^3/((s+1)(s+2))$, using Nyquist stability criterion determine whether the closed loop system is stable or not. [4]

Q.10. The block diagram of an automatic control system is shown in Fig. 3. Obtain its transfer function by use of signal flow graph . [4]

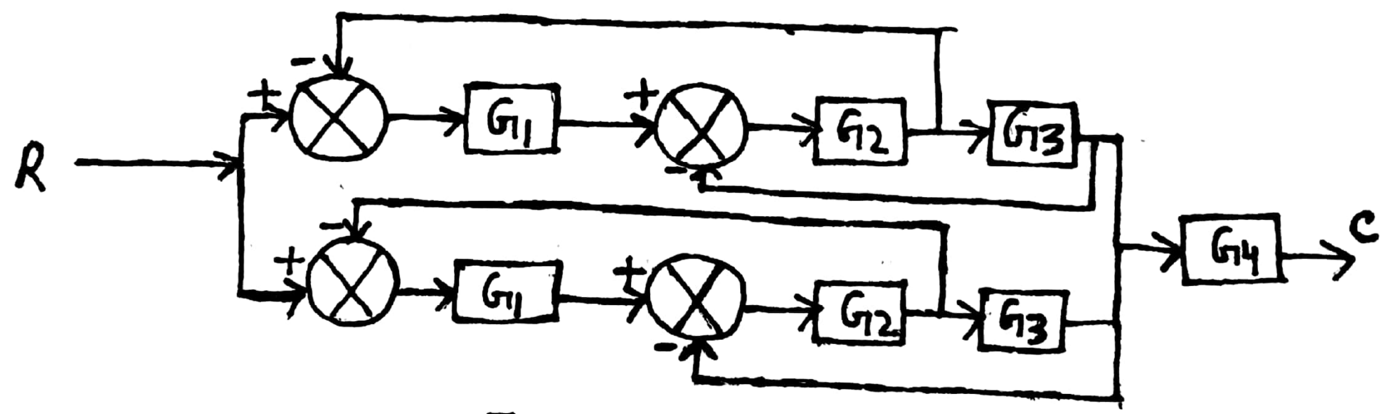

Fig.3

Q.11. Determine the ratio C/R for Fig. 4, using block diagram reduction technique. [4]

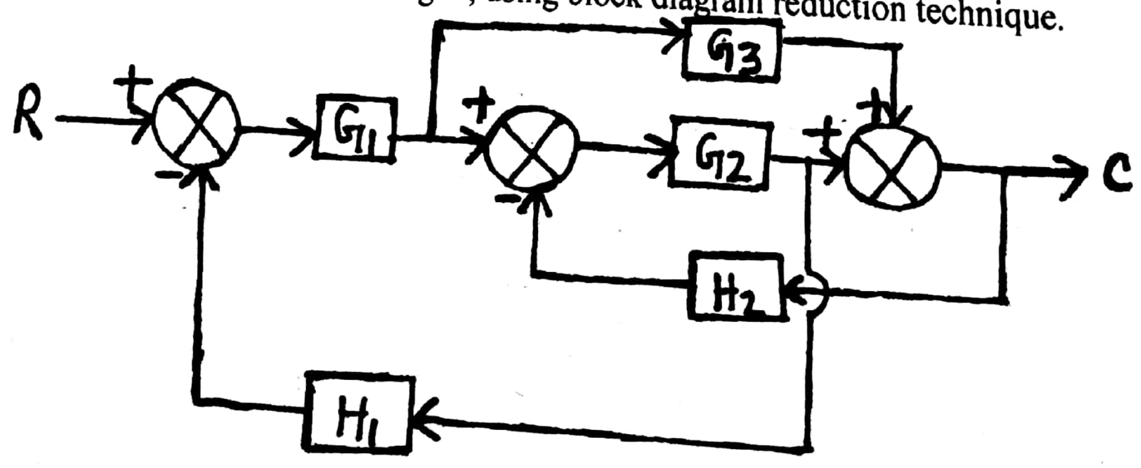

Fig. 4

Q.12. Sketch the asymptotic Bode plot for the transfer function given below,

$$G(s)H(s) = 2(s+0.25)/(s^2(s+1)(s+0.5)),$$

from the Bode plot determine, the phase crossover frequency, the gain crossover frequency, the gain margin, and the phase margin. Is the system stable? [4]

Q.13. The magnitude plot of the open loop transfer function G(*s*) of a certain system is shown in Fig. 5. determine G(*s*) if it is known that the system is of minimum phase type and estimate the phase at each of the corner frequencies. [4]

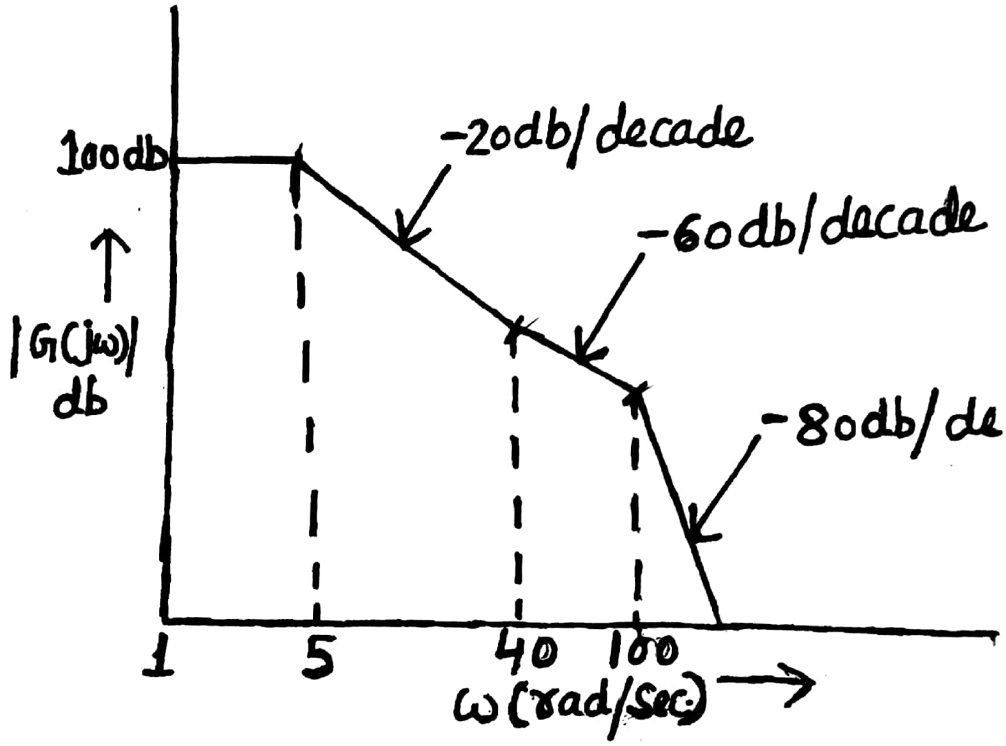

Fig. 5