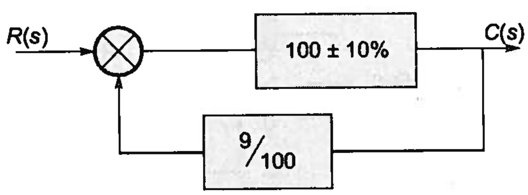
1 Introduction to Control Systems

Multiple Choice Questions

Q.1 **(A)** The closed loop gain when a feedback of $\frac{9}{100}$ is introduced in the system shown.



(a) $10 \pm 1\%$ (b) $10 \pm 10\%$
(c) $100 \pm 10\%$ (d) $100 \pm 1\%$

(B) When there is a 10% change in the feedback, the overall gain of the system would be

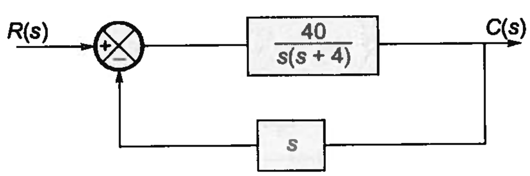
(a) $10 \pm 9\%$ (b) $10 \pm 1\%$
(c) $100 \pm 9\%$ (d) $100 \pm 1\%$

Q.2 Negative feedback in a closed-loop control system **DOES NOT**

(a) reduce the overall gain
(b) reduce bandwidth
(c) improve disturbance rejection
(d) reduce sensitivity to parameter variation

[GATE-2015]

Q.3 The feedback control system is shown in figure.



The sensitivity of CL system with respect to forward path function (G) will be

(a) 0.01 (b) 0.1
(c) 1 (d) 10

Q.4 The impulse response of the system is

$$C(t) = -te^{-t} + 2e^{-t}\ (t > 0)$$

The open loop T.F. will be

(a) $\frac{2s+1}{(s+1)^2}$ (b) $\frac{2s+1}{s^2}$
(c) $\frac{2s+1}{(s+1)}$ (d) $\frac{(2s+1)}{s}$

Q.5 The impulse response of a *LTI* system under initially relaxed condition is

$$h(t) = e^{-t} + e^{-2t}$$

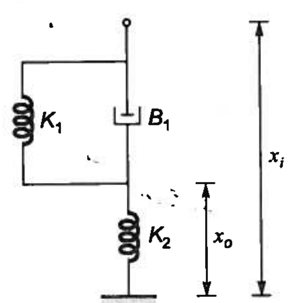
The response of the system for step input will be

(a) $[1 + e^{-t} + e^{-2t}]\, u(t)$
(b) $[e^{-t} + e^{-2t}]\, u(t)$
(c) $[1.5 - e^{-t} - 0.5\, e^{-2t}]\, u(t)$
(d) $[e^{t} + e^{2t}]\, u(t)$

Q.6 Which among the following is a valid step response of a initially relaxed system?

(a) $1 - 2e^{-t} + e^{-2t}$ (b) $1 + 2e^{-t} - e^{-2t}$
(c) $1 - 2e^{-t} - e^{-2t}$ (d) $1 + 2e^{-t} + e^{-t}$

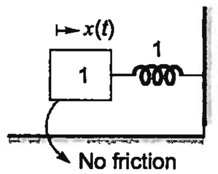
Q.7 Find the transfer functions of the mechanical system shown?



(a) $\dfrac{K_1+B_1s}{sB_1+K_1+K_2}$ (b) $\dfrac{K_1+B_1s}{(B_1+K_1)s+K_2}$

(c) $\dfrac{B_1s}{sB_1+K_1+K_2}$ (d) $\dfrac{K_1}{s(B_1+K_1)+K_2}$

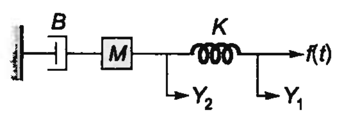
Q.8 For unit impulse force the resulting oscillation would be



(a) $\sin\sqrt{2t}$ (b) $\sin t$

(c) $\frac{1}{2}\sin t$ (d) $\sqrt{2}\sin t$

Q.9 The mechanical system is described by



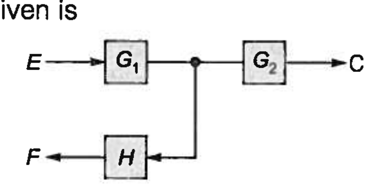
(a) $M\dfrac{d^2Y_1}{dt^2}+B\dfrac{dY_1}{dt}=K(Y_2-Y_1)$

(b) $M\dfrac{d^2Y_2}{dt^2}+B\dfrac{dY_2}{dt}=K(Y_2-Y_1)$

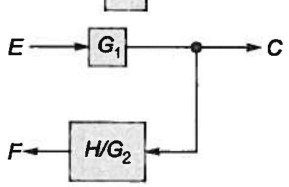
(c) $M\dfrac{d^2Y_1}{dt^2}+B\dfrac{dY_1}{dt}=K(Y_1-Y_2)$

(d) $M\dfrac{d^2Y_2}{dt^2}+B\dfrac{dY_2}{dt}=K(Y_1-Y_2)$

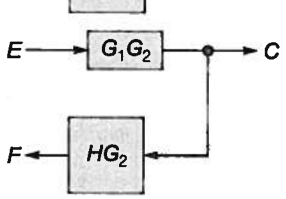
Q.10 The equivalent of the block diagram in the figure is given is



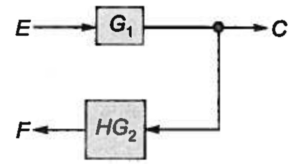
(a)



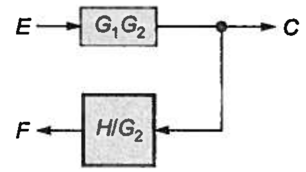
(b)



(c)



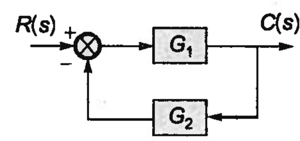
(d)



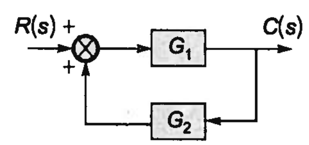
[GATE-2001]

Q.11 Consider the following block diagrams:

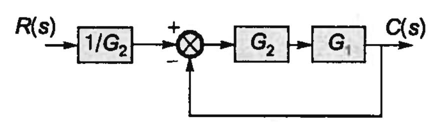
1.



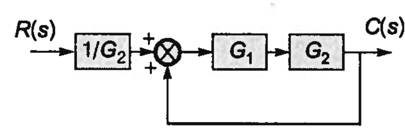
2.



3.



4.



Which of these block diagrams can be reduced to transfer $\dfrac{c(s)}{R(s)}=\dfrac{G_1}{1-G_1G_2}$?

(a) 1 and 3 (b) 2 and 4

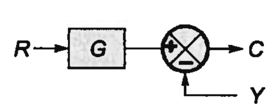
(c) 1 and 4 (d) 2 and 3

[ESE-2001]

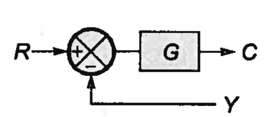
Q.12 Match **List-I (Block Diagram)** with **List-II (Transformed Block Diagram)** and select the correct answer:

List-I

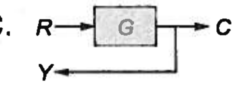
A.



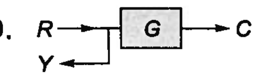
B.



C.

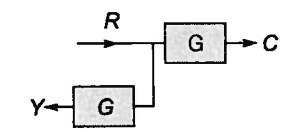


D.

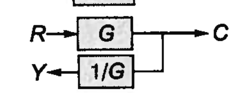


List-II

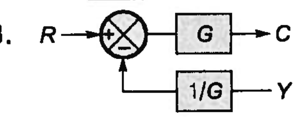
1.



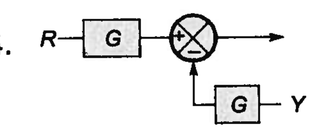
2.



3.



4.



Codes:

	A	B	C	D
(a)	3	4	2	1
(b)	4	3	1	2
(c)	3	4	1	2
(d)	4	3	2	1

[ESE-2003]

Q.13 By performing cascading and/or summing/differencing operations using transfer function blocks $G_1(s)$ and $G_2(s)$, one CANNOT realize a transfer function of the form

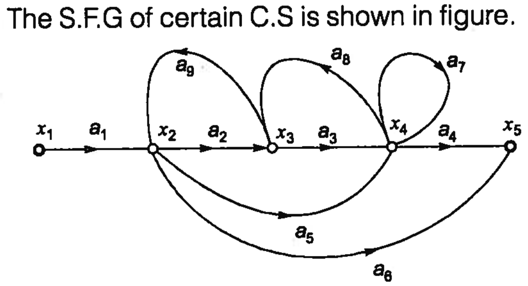
(a) $G_1(s)\,G_2(s)$

(b) $\dfrac{G_1(s)}{G_2(s)}$

(c) $G_1(s)\left(\dfrac{1}{G_1(s)}+G_2(s)\right)$

(d) $G_1(s)\left(\dfrac{1}{G_1(s)}-G_2(s)\right)$ **[GATE-2015]**

Q.14 The S.F.G of certain C.S is shown in figure.



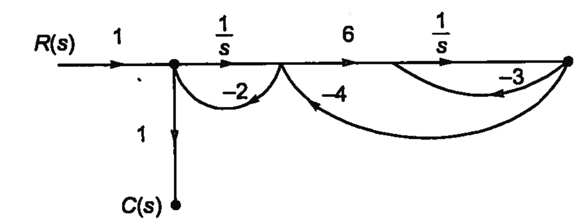
1. $x_2=a_1x_1+a_9x_3$
2. $x_3=a_2x_2+a_8x_4$
3. $x_4=a_3x_3+a_5x_2$
4. $x_5=a_4x_4+a_6x_2$

Which of the following equations are correct?

(a) 1, 2 and 3 (b) 1, 3 and 4

(c) 2, 3 and 4 (d) 1, 2 and 4

Q.15 The signal flow graph of a system is shown in the figure. The transfer function $\dfrac{C(s)}{R(s)}$ of the system is



(a) $\dfrac{6}{s^2+29s+6}$ (b) $\dfrac{6s}{s^2+29s+6}$

(c) $\dfrac{s(s+2)}{s^2+29s+6}$ (d) $\dfrac{s(s+27)}{s^2+29s+6}$

[GATE-2003]

Q.16 An electrical system and its signal-flow graph representations are shown in the figure (a) and (b) respectively. The values of G_2 and H, respectively, are

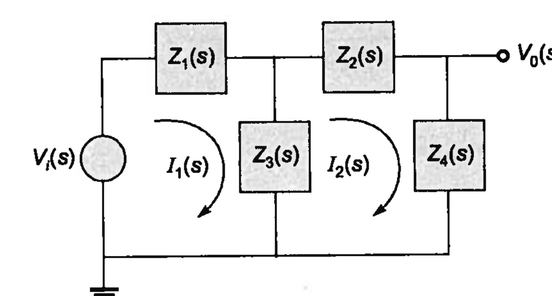


Figure (a)

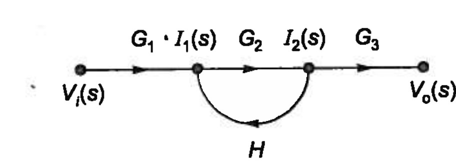


Figure (b)

(a) $\dfrac{Z_3(s)}{Z_2(s)+Z_3(s)+Z_4(s)},\dfrac{-Z_3(s)}{Z_1(s)+Z_3(s)}$

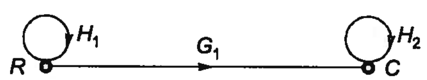
(b) $\dfrac{-Z_3(s)}{Z_2(s)-Z_3(s)+Z_4(s)}, \dfrac{-Z_3(s)}{Z_1(s)+Z_3(s)}$

(c) $\dfrac{Z_3(s)}{Z_2(s)+Z_3(s)+Z_4(s)}, \dfrac{Z_3(s)}{Z_1(s)+Z_3(s)}$

(d) $\dfrac{-Z_3(s)}{Z_2(s)-Z_3(s)+Z_4(s)}, \dfrac{Z_3(s)}{Z_1(s)+Z_3(s)}$

[GATE-2001]

Q.17

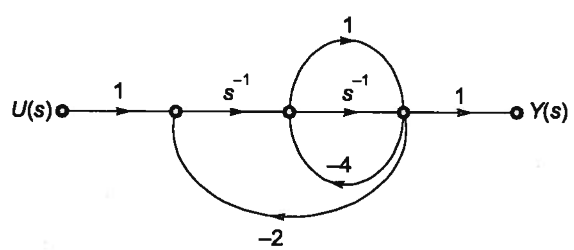


For the S.F.G. the defined input is $R(s)$ and defined output is $C(s)$. Find the transfer function.

(a) $\dfrac{G_1}{1-H_1-H_2}$ (b) $\dfrac{G_1}{1+H_1+H_2}$

(c) $\dfrac{G_1}{1-H_1}$ (d) $\dfrac{G_1}{1-H_2}$

Q.18 The signal flow graph for a system is given below. The transfer function $\dfrac{Y(s)}{U(s)}$ for this system is

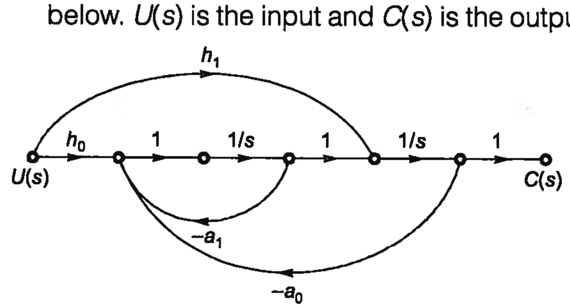


(a) $\dfrac{s+1}{5s^2+6s+2}$ (b) $\dfrac{s+1}{s^2+6s+2}$

(c) $\dfrac{s+1}{s^2+4s+2}$ (d) $\dfrac{1}{5s^2+6s+2}$

[GATE-2013]

Q.19 The signal flow graph of a system is shown below. $U(s)$ is the input and $C(s)$ is the output.



Assuming, $h_1 = b_1$ and $h_0 = b_0 - b_1 a_1$, the input-output transfer function, $G(s) = \dfrac{C(s)}{U(s)}$ of the system is given by

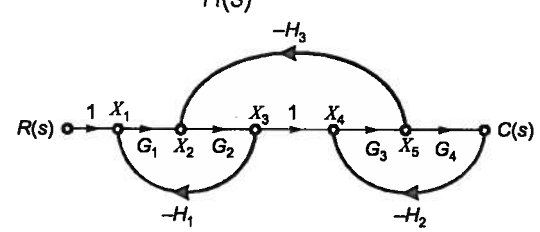
(a) $G(s) = \dfrac{b_0 s + b_1}{s^2 + a_0 s + a_1}$

(b) $G(s) = \dfrac{a_1 s + a_0}{s^2 + b_1 s + b_0}$

(c) $G(s) = \dfrac{b_1 s + b_0}{s^2 + a_1 s + a_0}$

(d) $G(s) = \dfrac{a_0 s + a_1}{s^2 + b_0 s + b_1}$

Q.20 For the signal flow graph shown in the figure, the value of $\dfrac{C(s)}{R(s)}$ is



(a) $\dfrac{G_1G_2G_3G_4}{1-G_1G_2H_1-G_3G_4H_2-G_2G_3H_3+G_1G_2G_3G_4H_1H_2}$

(b) $\dfrac{G_1G_2G_3G_4}{1+G_1G_2H_1+G_3G_4H_2+G_2G_3H_3+G_1G_2G_3G_4H_1H_2}$

(c) $\dfrac{1}{1+G_1G_2H_1+G_3G_4H_2+G_2G_3H_3+G_1G_2G_3G_4H_1H_2}$

(d) $\dfrac{1}{1-G_1G_2H_1-G_3G_4H_2-G_2G_3H_3+G_1G_2G_3G_4H_1H_2}$

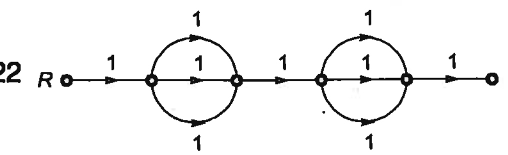
[GATE-2015]

Numerical Data Type Questions

Q.21 The open-loop DC gain of a unity negative feedback system with closed-loop transfer function $\dfrac{s+4}{s^2+7s+13}$ is________.

[GATE-2001]

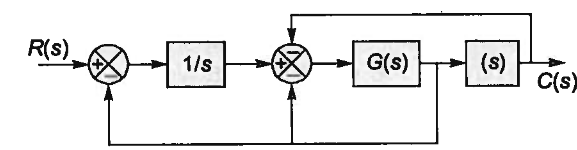
Q.22



The overall gain C/R will be ____.

Try Yourself

T1. The block diagram of a system is shown in the figure.



If the desired transfer function of the system is

$$\frac{C(s)}{R(s)} = \frac{s}{s^2+s+2}$$

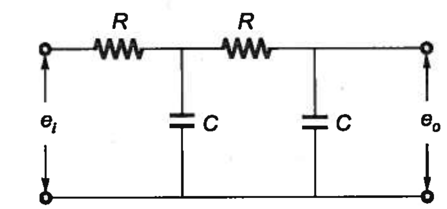
then $G(s)$ is

(a) 1 (b) s

(c) $\dfrac{1}{s}$ (d) $\dfrac{-s}{s^3+s^2-s-2}$

[Ans: (b)]

T2. The transfer function of the network shown below is



$\left[\text{Ans: } \dfrac{1}{s^2T^2+3sT+1}\right]$

T3. The transfer function of a low-pass RC network is

(a) $RCs(1 + RCs)$ (b) $\dfrac{1}{(1+RCs)}$

(c) $\dfrac{RC}{(1+RCs)}$ (d) $\dfrac{s}{(1+RCs)}$

[Ans: (b)]