POSTAL
BOOK PACKAGE
2025

CONTENTS

ELECTRICAL ENGINEERING

Objective Practice Sets

Control Systems

1 CHAPTER Introduction

Q.1 A control system is represented by $y(t) = x(t + T)$ with $T > 0$. Is the system causal?
(a) Yes (b) No
(c) Not necessarily (d) None of these

Q.2 $s(t)$ is step response and $h(t)$ is impulse response of a system. Its response $y(t)$ for any input $u(t)$ is given by

(a) $\frac{d}{dt}\int_0^t s(t-\tau)\,u(\tau)\,d\tau$

(b) $\int_0^t s(t-\tau)\,u(\tau)\,d\tau$

(c) $\int_0^t \int_0^t s(t-\tau_1)\,u(\tau_1)d\tau_1\,d\tau$

(d) $\int_0^t h(t-\tau)u(\tau)d\tau$

Q.3 Consider the following statements:
Statement 1: The difference between the output response and the reference signal is called actuating signal.
Statement 2: If the initial conditions for a system are inherently zero, it means system is at rest or no energy stored in any of its parts.
(a) Statement 1 is wrong, 2 is correct
(b) Statement 1 is correct, 2 is wrong
(c) Both the statement are correct
(d) Both the statements are wrong

Q.4 A certain LTI system has input $r(t)$ and output $c(t)$. If the input is first passed through a block whose T.F. is e^{-s} and then applied to system. The modified output will be
(a) $c(t)\,u(t-1)$ (b) $c(t-1)\,u(t)$
(c) $c(t-1)\,u(t-1)$ (d) none of these

Q.5 For the given transfer function what will be the initial value $F(s) = \dfrac{(2s+1)}{s(4s+3)}$?
(a) $\frac{1}{3}$ (b) $\frac{1}{2}$
(c) $\frac{2}{3}$ (d) 0

Q.6 The compensator $G(s) = \dfrac{16(1+30s)}{(1+5s)}$ would provide gain at high frequency,
(a) 24.08 dB (b) 55.45 dB
(c) 91.28 dB (d) 39.65 dB

Q.7 The final value of the function $F(s) = \dfrac{5}{s(s^2+s+2)}$ is equal to ________.

Q.8 The voltage across an element in a circuit is given by $V(s) = \dfrac{1}{s(s+\alpha)}$. If $v(\infty)$ is equal to 4 V then the value of $v(t)$ at $t = 1$ sec is ____________ V.

Q.9 **Assertion (A):** A linear system gives a bounded output if the input is bounded.
Reason (R): The roots of the characteristic equation have all negative real parts and response due to initial conditions decay to zero as time t tends to infinity.
(a) Both A and R are true and R is the correct explanation of A
(b) Both A and R are true but R is NOT the correct explanation of A
(c) A is true but R is false
(d) A is false but R is true

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Answers Introduction

1. (b) 2. (d) 3. (d) 4. (c) 5. (b) 6. (d) 7. (2.5) 8. (0.885) 9. (d)

Explanations Introduction

1. (b)

$$y(t) = x(t+T)$$

Taking Laplace transform,

$$Y(s) = X(s)e^{sT}$$

$$H(s) = \frac{Y(s)}{X(s)} = e^{sT}$$

Taking inverse Laplace transform

$$h(t) = \delta(t+T),\ T > 0$$

Thus, $h(t) \neq 0$, $t < 0$, its an impulse at $t = -T$.
System is causal if $h(t) = 0$, $t < 0$.

2. (d)

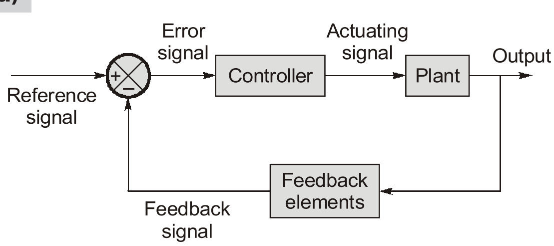
$$y(t) = x(t) \otimes h(t)$$

$$y(t) = u(t) \otimes h(t)$$

$$y(t) = \int_{-\infty}^{\infty} h(t-\tau)\, u(\tau) dt$$

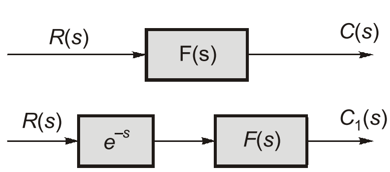
$$y(t) = \int_{0}^{t} h(t-\tau)\, u(\tau) d\tau$$

3. (d)



Error signal = Reference – Output

4. (c)



$$C(s) = F(s)\, R(s)$$

$$C_1(s) = R(s) \cdot e^{-s} \cdot F(s)$$

$$C_1(s) = C(s)\, e^{-s}$$

$$\because \quad L^{-1}[F(s)\, e^{-as}] = f(t-a)\, u(t-a)$$

$$\therefore \quad c_1(t) = c(t-1)\, u(t-1)$$

5. (b)

By initial value theorem $\lim\limits_{t \to 0} f(t) = \lim\limits_{s \to \infty} sF(s)$

where $F(s)$ is Laplace transform of $f(t)$.

So, Initial value $= \lim\limits_{s \to \infty} \dfrac{s(2s+1)}{s(4s+3)}$

$$= \lim_{s \to \infty} \frac{2\left(1+\frac{1}{s}\right)}{4\left(1+\frac{3}{4s}\right)} = \frac{2}{4}\frac{(1+0)}{(1+0)}$$

$$= \frac{1}{2}$$

6. (d)

Sinusoidal transfer function is given by

$$G(j\omega) = \frac{16(1+j30\omega)}{(1+j5\omega)}$$

Solving, we get

$$G(j\omega) = \frac{16 \times j\omega\left(\frac{1}{j\omega}+30\right)}{j\omega\left(\frac{1}{j\omega}+5\right)}$$

At $\omega \to \infty$ (high frequency)

$$G(j\omega)_{\omega \to \infty} = \frac{16 \times \left(\frac{1}{\infty}+30\right)}{\left(\frac{1}{\infty}+5\right)} = 96$$

$$\text{Gain in dB} = 20 \log 96$$

$$\text{gain} = 39.65 \text{ dB}$$

7. (2.5)

$$F(s) = \frac{5}{s(s^2+s+2)}$$

$$\text{Final value} = \lim_{s \to 0} s\, F(s)$$

$$= \lim_{s \to 0} \frac{5s}{s(s^2+s+2)} = \frac{5}{2}$$

8. (0.885)

$$V(s) = \frac{1}{s(s+\alpha)}$$

By $v(\infty) = \lim\limits_{t \to \infty} v(t) = \lim\limits_{s \to 0} sV(s)$

2
CHAPTER

Block Diagram and Transfer Function

MCQ and NAT Questions

Q.1 Consider the following open-loop transfer function:

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

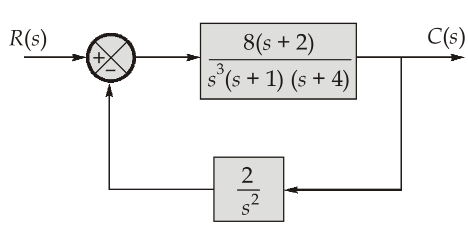
The characteristic equation of the unity negative feedback will be

(a) $(s + 1)(s + 4) + K(s + 2) = 0$
(b) $(s + 2)(s + 1) + K(s + 4) = 0$
(c) $(s + 1)(s - 2) + K(s + 4) = 0$
(d) $(s + 2)(s + 4) + K(s + 1) = 0$

Q.2 The transfer function of three blocks connected in cascade is given by $\frac{(s+1)}{s(s+2)(s+3)}$. If block 1 has transfer function of $\frac{1}{s(s+2)}$ and block 2 has transfer function of $\frac{(s+2)}{(s+3)}$ then the transfer function of the 3rd block is

(a) $(s + 1)(s + 2)$ (b) $\frac{(s+1)}{(s+2)}$
(c) $\frac{(s+1)}{s(s+3)}$ (d) $\frac{(s+1)^2}{(s+2)^2}$

Q.3 The type of the control system represented by the block diagram shown below is



(a) Type-2 (b) Type-3
(c) Type-4 (d) Type-5

Q.4 The closed-loop transfer function of a unity feedback control system is $\frac{25}{s^2+10s+25}$. What is the open loop transfer function of the system?

(a) $\frac{25}{s^2+10s}$ (b) $\frac{25}{s^2+25}$
(c) $\frac{25}{s+25}$ (d) $\frac{25}{s+10}$

Q.5 For a transfer function $H(s) = \frac{P(s)}{Q(s)}$, where $P(s)$ and $Q(s)$ are polynomials in s.

Then:

(a) the degree of $P(s)$ is always greater than the $Q(s)$.
(b) the degree of $P(s)$ and $Q(s)$ are same.
(c) degree of $P(s)$ is independent of degree of $Q(s)$.
(d) the maximum degree of $P(s)$ and $Q(s)$ differ at most by one.

Q.6 The transfer function is applicable to

(a) linear and time variant system
(b) non-linear and time variant system
(c) linear and time invariant system
(d) non-linear and time invariant system

Q.7 The transfer function, $G(s) = \frac{10(s-5)}{s(s+1)(s+2)}$ represents

(a) A non-minimum phase transfer function
(b) A minimum phase transfer function
(c) An all pass transfer function
(d) None of these

Q.8 Consider the following statement and choose the correct option:

Statement 1: The transfer function is said to be strictly proper if the order of the denominator polynomial is greater than that of numerator polynomial.

Statement 2: The transfer function is said to be proper if the order of the denominator polynomial is equal to than that numerator polynomial.

Statement 3: The function is called improper if the order of the denominator polynomial is greater than that of numerator polynomial.

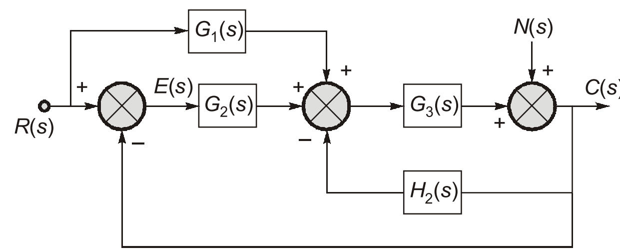
(a) $\dfrac{C(s)}{R(s)} = \dfrac{(G_1(s)+G_2(s))G_3(s)}{1+(G_1(s)+G_2(s))(H_1(s)+G_3(s))}$

(b) $\dfrac{C(s)}{R(s)} = \dfrac{(G_1(s)+G_2(s))G_3(s)}{1+G_1(s)H_1(s)+G_2(s)G_3(s)}$

(c) $\dfrac{C(s)}{R(s)} = \dfrac{G_1(s)+G_2(s)}{1+G_1(s)H_1(s)+G_2(s)H_1(s)}$

(d) $\dfrac{C(s)}{R(s)} = \dfrac{G_1(s)G_3(s)+G_2(s)G_3(s)}{1+G_1(s)H_1(s)+G_2(s)H_1(s)+G_1(s)G_3(s)+G_2(s)G_3(s)}$

Q.26 The block diagram of a control system is shown in figure.



Which of the following statements is/are true?

(a) $\left.\dfrac{C(s)}{R(s)}\right|_{N(s)=0} = \dfrac{G_1G_3+G_2G_3}{1+G_3H_1+G_2G_3}$

(b) $\left.\dfrac{C(s)}{N(s)}\right|_{R(s)=0} = \dfrac{G_1G_3+G_2G_3}{1+G_3H_1+G_2G_3}$

(c) $\left.\dfrac{C(s)}{N(s)}\right|_{R(s)=0} = \dfrac{1}{1+G_3H_1+G_2G_3}$

(d) $\left.\dfrac{C(s)}{R(s)}\right|_{N(s)=0} = \dfrac{1}{1+G_3H_1+G_2G_3}$

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Answers Block Diagram and Transfer Function

1. (a)	**2.** (b)	**3.** (d)	**4.** (a)	**5.** (c)	**6.** (c)	**7.** (a)	**8.** (a)	**9.** (b)
10. (d)	**11.** (c)	**12.** (b)	**13.** (b)	**14.** (d)	**15.** (b)	**16.** (d)	**17.** (c)	**18.** (1)
19. (31)	**20.** (10)	**21.** (1)	**22.** (–0.5)	**23.** (a,c)	**24.** (a,c,d)	**25.** (a,d)	**26.** (a,c)	

Explanations Block Diagram and Transfer Function

1. (a)

$$q(s) = 1 + G(s)H(s) = 0$$

$$q(s) = 1+\frac{K(s+2)}{(s+1)(s+4)} = 0$$

$$q(s) = (s+1)(s+4) + K(s+2) = 0$$

2. (b)

As the three blocks are connected in cascade the overall transfer function is given by the multiplication of individual blocks.

$$\therefore \quad x_1 \times x_2 \times x_3 = \frac{(s+1)}{s(s+2)(s+3)}$$

$$\frac{1}{s(s+2)}\times\frac{(s+2)}{(s+3)}\times x_3 = \frac{(s+1)}{s(s+2)(s+3)}$$

$$x_3 = \frac{(s+1)}{(s+2)}$$

3. (d)

The type of the system = Number of open loop poles at origin

$$\therefore \; G(s)H(s) = \frac{8(s+2)}{s^3(s+1)(s+4)}\times\frac{2}{s^2} = \frac{16(s+2)}{s^5(s+1)(s+4)}$$

$\therefore$ Type-5.

4. (a)

Transfer function of unity feedback system with forward path,

$$G'(s) = \frac{G(s)}{1+G(s)}$$

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

$$G(s)\,(s^2+10s+25) = 25(1+G(s))$$

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