



**POSTAL
BOOK PACKAGE**

2024

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**ELECTRONICS
ENGINEERING**

Objective Practice Sets

Control Systems

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Introduction

MCQ and NAT Questions

- 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** When a human being tries to approach an object, his brain acts as
 (a) an error measuring device
 (b) a controller
 (c) an actuator
 (d) an amplifier
- Q.4** Which one of the following is an example of open loop system
 (a) Washing machine
 (b) Respiratory system of animal
 (c) Stabilisation of air pressure entering into mask
 (d) Execution of program by computer
- Q.5** Which is not an example of closed loop system?
 (a) Radar tracking system
 (b) Electric iron
 (c) Missile launching system
 (d) Traffic light controller

- Q.6** 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 statements are correct
 (d) Both the statements are wrong

- Q.7** The Laplace transform at a transportation lag of 2 seconds is given as :

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

- Q.8** 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.9** Let $F(s)$ be the Laplace transform of a signal $f(t)$.

If $F(s) = \frac{K}{(s+1)(s^2+4)}$, then $\lim_{t \rightarrow \infty} f(t)$ is given by

- (a) $K/4$ (b) zero
 (c) infinite (d) undefined

- Q.10** For the given transfer function what will be the

initial value $F(s) = \frac{(2s+1)}{s(4s+3)}$?

- (a) $\frac{1}{3}$ (b) $\frac{1}{2}$
 (c) $\frac{2}{3}$ (d) 0

Q.11 The compensator $G(s) = \frac{16(1+30s)}{(1+5s)}$ would provide gain at high frequency,
 (a) 24.08 dB (b) 55.45 dB
 (c) 91.28 dB (d) 39.65 dB

Q.12 The final value of the function $F(s) = \frac{5}{s(s^2 + s + 2)}$ is equal to _____.

Q.13 The voltage across an element in a circuit is given by $V(s) = \frac{1}{s(s+\alpha)}$. If $v(\infty)$ is equal to 4 V then the value of $v(t)$ at $t = 1$ sec is _____ V.

Q.14 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



Answers Introduction

1. (b) 2. (d) 3. (b) 4. (a) 5. (d) 6. (d) 7. (c) 8. (c) 9. (b)
 10. (b) 11. (d) 12. (2.5) 13. (0.885) 14. (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 $h(t) = 0, t < 0$.

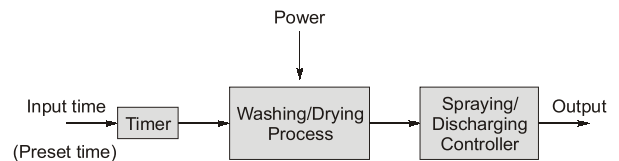
2. (d)

$y(t) = x(t) \otimes h(t)$
 $y(t) = u(t) \otimes h(t)$
 $y(t) = \int_{-\infty}^{\infty} h(t - \tau) u(\tau) d\tau$
 $y(t) = \int_0^t h(t - \tau) u(\tau) d\tau$

3. (b)

When a human being tries to approach an object, his brain acts as a controller because his brain controls the activity of the human.

4. (a)

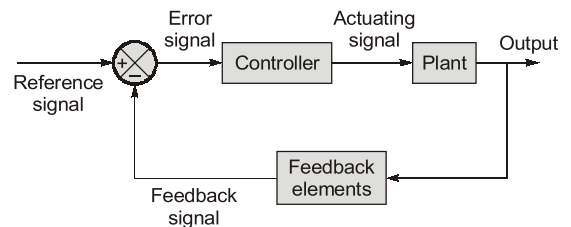


In the block diagram of a washing machine, input and output are unrelated, in the above. Thus washing machine is an example of open loop system.

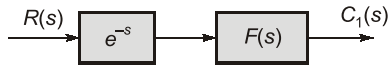
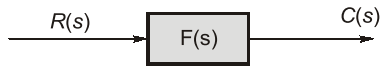
5. (d)

Since all the system except (d) depend on the target or output. Hence, output/target provides feedback to the system. While traffic light controller does not take any output consideration.

6. (d)



Error signal = Reference – Output

7. (c)Transportation lag = e^{-st_d} where t_d is time delayHere, $t_d = 2$ secThus, lag = e^{-2s} **8. (c)**

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

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

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

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

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

9. (b)

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

We know by Final value theorem

$$\lim_{t \rightarrow \infty} f(t) = \lim_{s \rightarrow 0} sF(s)$$

$$= \lim_{s \rightarrow 0} \frac{sK}{(s+1)(s^2+4)} = 0$$

10. (b)By initial value theorem $\lim_{t \rightarrow 0} f(t) = \lim_{s \rightarrow \infty} sF(s)$ where $F(s)$ is Laplace transform of $f(t)$.

$$\begin{aligned} \text{So, Initial value} &= \lim_{s \rightarrow \infty} \frac{s(2s+1)}{s(4s+3)} \\ &= \lim_{s \rightarrow \infty} \frac{2\left(1 + \frac{1}{s}\right)}{4\left(1 + \frac{3}{4s}\right)} = \frac{2}{4} \frac{(1+0)}{(1+0)} \\ &= \frac{1}{2} \end{aligned}$$

11. (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 $\omega \rightarrow \infty$ (high frequency)

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

Gain in dB = $20 \log 96$

gain = 39.65 dB

12. (2.5)

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

$$\text{Final value} = \lim_{s \rightarrow 0} sF(s)$$

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

13. (0.885)

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

$$\text{By } v(\infty) = \lim_{t \rightarrow \infty} v(t) = \lim_{s \rightarrow 0} sV(s)$$

By final value theorem

$$v(\infty) = \frac{1}{\alpha} = 4$$

$$\alpha = \frac{1}{4}$$

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

By partial fraction

$$V(s) = \frac{1}{\alpha} \left[\frac{1}{s} - \frac{1}{s+\alpha} \right]$$

$$V(s) = 4 \left[\frac{1}{s} - \frac{1}{s+\alpha} \right]$$

By inverse Laplace transform

$$v(t) = 4[1 - e^{-\alpha t}] = 4[1 - e^{-t/4}]$$

$$\begin{aligned} v(t=1 \text{ sec}) &= 4[1 - e^{-1/4}] \\ &= 0.885 \text{ V} \end{aligned}$$

14. (d)

Assertion is wrong as it is applicable only for the BIBO (Bounded Input Bounded Output) stable system.

Moreover if the system is unbounded then assertion will be wrong.

