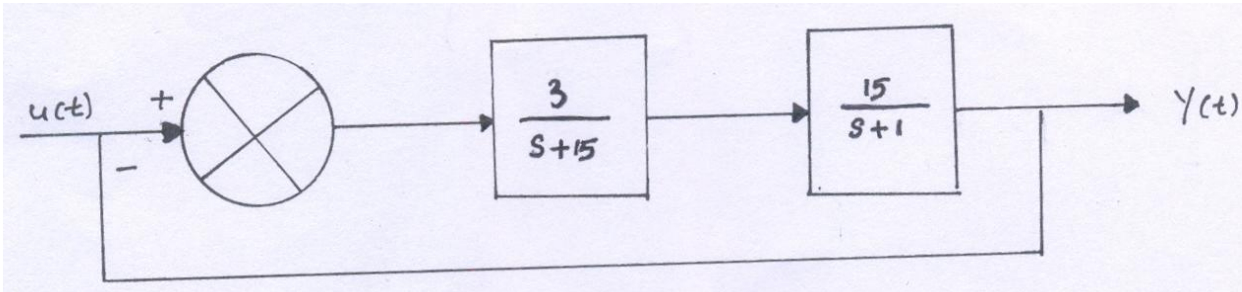
MOCK TEST 1: TIME DOMAIN PERFORMANCE OF I-ORDER & II-ORDER SYSTEMS

1. The block diagram shown in figure gives a unity feedback closed loop control system. The steady state error in the response of the above system to unit step input is

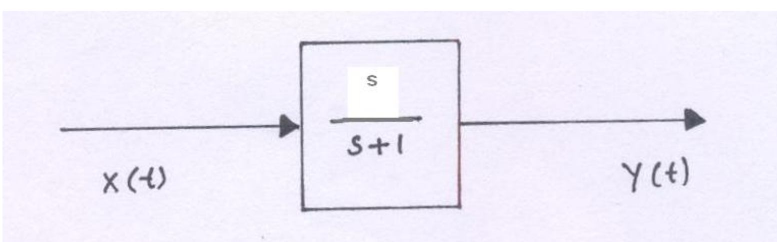


(a) 25%
(b) 0.75%
(c) 6%
(d) 33%

2. The unit impulse response of a second order-under damped system starting from rest is given by c(t)= 12.5 e^{-6t} sin 8 t, t$\geq$0. The steady-state value of the unit step response of the system is equal to

(a) 0
(b) 0.25
(c) 0.5
(d) 1.0

3. In the system shown in the figure, the input x(t)= sin t. in the steady state, the response y(t) will be



(a) $\frac{1}{\sqrt{2}}$ sin (t-45^0)
(b) $\frac{1}{\sqrt{2}}$ sin (t+45^0)
(c) Sin(t-45^0)
(d) Sin(t+45^0)

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4. If the closed-loop transfer function T(s) of a unity negative feedback system is given by

   $T(s) = a_{n-1}s+a_n / s^n + a_1 s^{n-1} + \dots + a_{n-1}s+a_n$

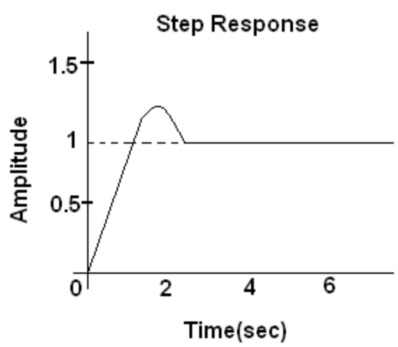
   Then the steady state error for a unit ramp input is

   (a) a_n/a_n-1
   (b) a_n/a_{n-2}
   (c) a_{n-2}/a_{n-2}
   (d) 0

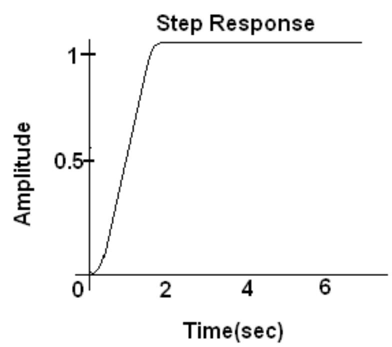
5. The transfer of a system is G(s) = $\frac{100}{(s+1)(s+100)}$. For a unit-step input to the system the approximate settling time for 2% criterion is

   (a) 100 sec
   (b) 4 sec
   (c) 1 sec
   (d) 0.01 sec

6. A second-order system has the transfer function $\frac{C(s)}{R(s)} = \frac{4}{s^2+4s+4}$. With r(t)as the unit-step function, the response c(t) of the system is represented by



A



B

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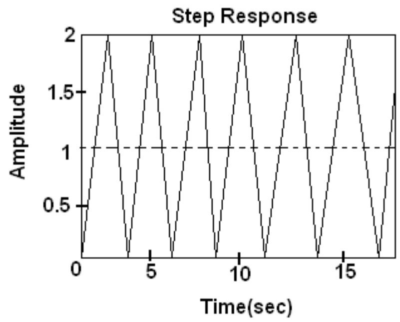
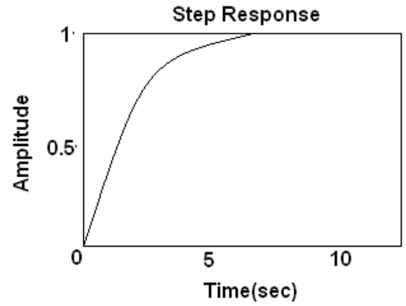


C

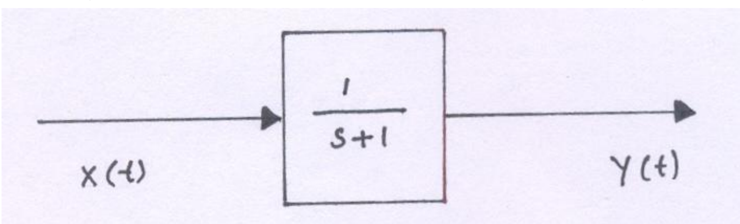


D

7. A casual system having the transfer function H(s) = $\frac{1}{s+2}$ is excited with 10u(t). the time at which the output reaches 99% of its steady state value is

(a) 2.7 sec
(b) 2.5 sec
(c) 2.3 sec
(d) 2.1 sec

8. In the system shown below, x(t) =(sin t) u (t). In steady-state, the response y(t) will be



(a) $\frac{1}{\sqrt{2}}$ sin (t-$\frac{\pi}{4}$)
(b) $\frac{1}{\sqrt{2}}$ sin (t+$\frac{\pi}{4}$)
(c) $\frac{1}{\sqrt{2}}$ e^{-t} sin t
(d) Sin t- cos t

9. The unit impulse response of a system is h(t) =e^{-t}, $t \geq 0$
For this system, the steady-state value of the output for unit step input is equal to

(a) -1
(b) 0
(c) 1

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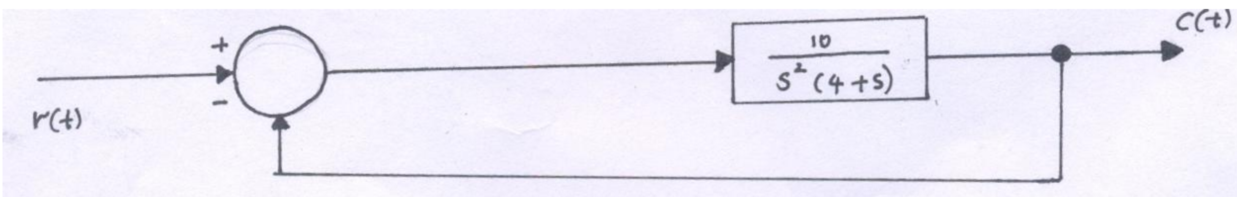
(d) ∞

10. A linear, time-invariant, casual continuous time system has a rational transfer function with simple poles at s =-2 and s =-4, and one simple zero at s =-1. A unit step u(t) is applied at the input of the system. At steady state, the output has constant value of 1. The impulse response of this system is

(a) [exp (-2t) +exp (-4t)] u(t)
(b) [-4exp(-2t) + 12exp(-4t)-exp(-t)]u(t)
(c) [-4exp(-2t) + 12exp(-4t)]u(t)
(d) [-0.5exp(-2t) +1.5exp(-4t)]u(t)

11.



The steady-state error resulting from an input r(t) = 2+3t+4t^2 for given state is

(a) 2.4
(b) 4.0
(c) 0
(d) 3.2

12. The transfer function of alinear time invariant system is given as
G(s) = 1/ s^2 +3s + 2
The steady state value of the output of the system for a unit impulse input applied at the time instant t= 1 will be

(a) 0
(b) 0.5
(c) 1
(d) 2

13. A second order control system is defined by the following differential equation:

$$4\frac{d^2c(t)}{dt^2} + 8\frac{dc(t)}{dt} + 16c(t) = 16 \text{ u(t)}$$

The damping ratio and natural frequency for this system are respectively

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(a) 0.25 and 2 rad/s
(b) 0.50 and 2 rad/s
(c) 0.25 and 4 rad/s
(d) 0.50 and 4 rad/s

14. For a second-order system with the closed-loop transfer function T (s)= $\frac{9}{s^2+4s+9}$ the settling time for 2-percent band, in seconds, is

(a) 1.5
(b) 2.0
(c) 3.0
(d) 4.0

15. If the characteristic equation of a closed-loop system is $s^2+2s=2=0$, then the system is

(a) Overdamped
(b) Critically damped
(c) Underdamped
(d) Undamped

16. Consider a system with the transfer function G(s) = $\frac{s+6}{ks^2+s+6}$. Its damping ratio will be 0.5 when the value of k is

(a) 2/6
(b) 3
(c) 1/6
(d) 6

17. The transfer function Y(s)/U(s) of a system described by the state equations x(t) = -2x (t) +2u (t) and y(t) = 0.5x (t) is

(a) 0.5/ (s-2)
(b) 1/(s-2)
(c) 0.5/(s+2)
(d) 1/(s+2)

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18. A system described by the following differential equation $\frac{d^2y}{dt^2}+3\frac{dy}{dt}+2y=x(t)$ is initially at rest. For input x(t) = 2u(t), the output y(t) is

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

19. In the derivation of expression for peak percent overshoot, $M_p = \exp\left(\frac{-\pi\zeta}{\sqrt{1-\zeta^2}}\right)$ x 100%, which one of the following conditions is NOT required?

(a) System is linear and time invariant
(b) The system transfer function has a pair of complex conjugate poles and no zeroes
(c) There is no transportation delay in the system
(d) The system has zero initial conditions

20. If the closed-loop transfer function of a control system is given as

$T(s) = \frac{s-5}{(s+2)(s+3)}$, then it is

(a) An unstable system
(b) An uncontrollable system
(c) A stable system with oscillations
(d) A stable system without oscillations

21. **Group I** lists a set of four transfer functions. Group 2 gives a list of possible step responses y(t). match the step responses with the corresponding transfer functions.

Group I

$P = \frac{25}{s^2+25}$ $Q = \frac{36}{s^2+20s+36}$

$R = \frac{36}{s^2+12s+36}$ $S = \frac{36}{s^2+7s+49}$

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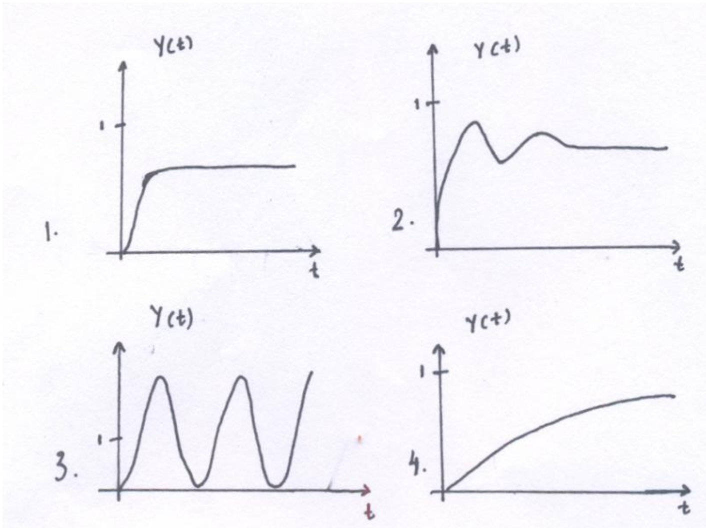
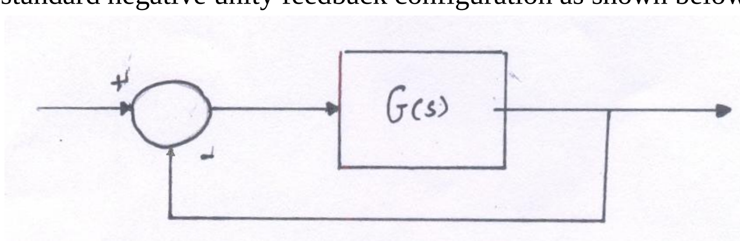
Group II



(a) P-3, Q-1, R-4, S-2
(b) P-3, Q-2, R-4, S-1
(c) P-2, Q-1, R-4, S-3
(d) P-3, Q-4, R-1, S-2

22. A certain system has transfer function G(s) = $\dfrac{s+8}{s^2+\alpha s-4}$, where α is a parameter. Consider the standard negative unity feedback configuration as shown below.



Which of the following statements is true?
(a) The closed loop system is never stable for any value of α
(b) For some positive values of α, the closed loop system is stable, but not for all values
(c) For all the positive values of α, the closed loop system is stable
(d) The closed loop system is stable for all values of α, both positive and negative

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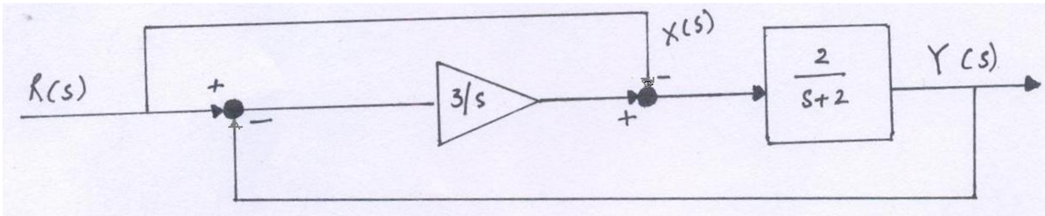
23. When subjected to a unit step input, the closed loop control system shown in the figure will have a steady state error of



(a) -1.0
(b) -0.5
(c) 0
(d) 0.5

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