FULL LENGTH [ECE/EE]

Control Systems

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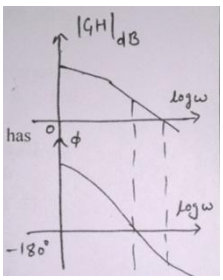
1. The transfer function of second order real system with a perfect flat magnitude response of a unity has a pole at $(2 - j3)$. List all the poles and zeroes.
   (a) Poles at $(2 \pm j3)$, no zeroes
   (b) Poles at $(\pm 2 - j3)$, one zero at origin
   (c) Poles at $(2 - j3)$, $(-2 + j3)$, zeroes at $(-2 - j3)$, $(2 + j3)$
   (d) Poles at $(2 \pm j3)$, zeroes at $(-2 \pm j3)$
2. For the system governed by the set of equations $\frac{dx_1}{dt} = 2x_1 + x_2 + u$, $\frac{dx_2}{dt} = -2x_1 + u$ and $y = 3x_1$.
   Then transfer function $\frac{Y(s)}{U(s)}$ is given by
   (a) $\frac{3(s+1)}{s^2-2s+2}$ (b) $\frac{3(2s+1)}{s^2-2s+1}$ (c) $\frac{(s+1)}{s^2-2s+1}$ (d) $\frac{3(2s+1)}{s^2-2s+2}$
3. The polar plot of $\frac{1}{s^3(s+5)(s+20)}$ will intersect the real axis at
   (a) $\omega = 5$ rad/s (c) $\omega = 20$ rad/s
   (b) $\omega = 10$ rad/s (d) $\omega = 100$ rad/s
4. The phase margin of system with OLTF $G(s)H(s) = \frac{\pi e^{-s}}{s}$
   (a) 0° (b) -90° (c) 90° (d) None
5. The Bode plot of a unity Negative feedback system is as shown. The system has
   (a) +ve P.M. & -ve G.M.
   (b) +ve P.M. & +ve G.M.
   (c) -ve P.M. & -ve G.M.
   (d) -ve P.M. & +ve G.M.



6. A system is described by the following equations having unity –ve feedback
$$A = \begin{bmatrix} 0 & 1 \\ -3 & -6 \end{bmatrix}, B = \begin{bmatrix} 0 \\ 1 \end{bmatrix} \& C = [1 \quad 1]$$
   The steady state error for unit step input is
   (a) $\frac{2}{3}$ (c) ∞
   (b) $\frac{1}{3}$ (d) 0
7. Which of the following is the transfer function of a load compensation network
   (a) $\frac{s+6}{s+8}$ (c) $\frac{s(s+5)}{s+8}$
   (b) $\frac{s+8}{s+5}$ (d) $\frac{s+8}{s(s+6)}$
8. The Nyquist plot of system having OLTF $G(S)H(S) = 1000$

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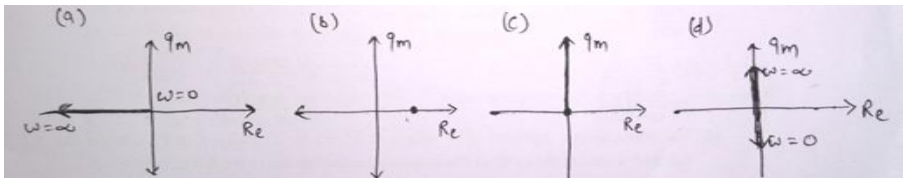
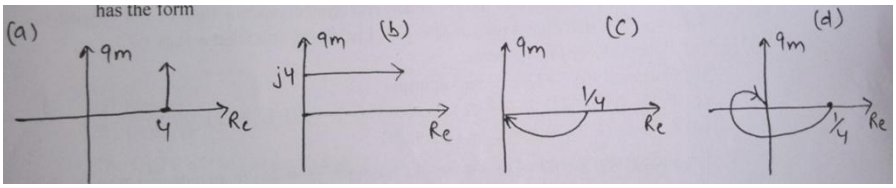


9. For the OLTF $h(j\omega) = 4 + j\omega$, the corresponding Nyquist plot for the +ve frequency has the form



10. In the system shown in figure, the input $x(t) = \sin t$. The response y(t) will be

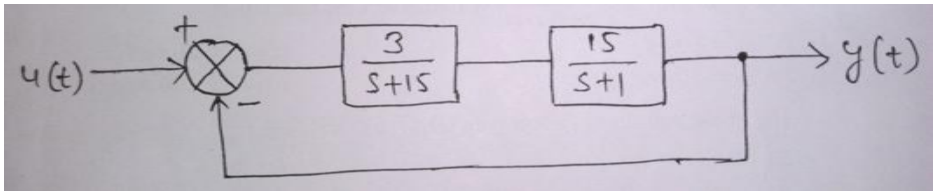
(a) $\frac{1}{\sqrt{2}}\sin(t - 45^\circ)$

(b) $\frac{1}{\sqrt{2}}\sin(t + 45^\circ)$

(c) $\sin(t - 45^\circ)$

(d) $\sin(t + 45^\circ)$

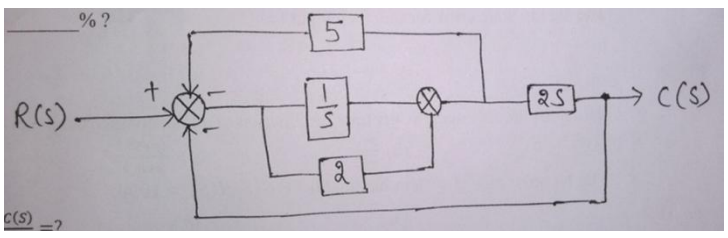
11. The steady state error of given control system is_____?



12. For a second order system overshoot = 10% and peak t_p = 5 sec. Then the value of damping factor is _____?

13. The forward path gain of unity feedback system is $G(S) = \frac{10(1+4S)}{S^2(1+S)}$. If the system is subjected to an input $r(t) = 1 + t + \frac{t^2}{2}$, t > 0, the steady state error of the system will be _____% ?

14.



Then $\frac{C(S)}{R(S)}$ =?

(a) $\frac{2S(S+1)}{2S^2+3S+5}$

(b) $\frac{2S(2S+1)}{4S^2+13S+5}$

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(c) $\frac{2S(2S+1)}{2S^2+3S+5}$ (d) $\frac{3S(2S-1)}{4S^2+13S+S}$

15. The characteristic equation of a system is $S^3 + 10S^2 + 18S + K = 0$. What is the value of K so that the roots of characteristics equation lies to the left of line S = -1 is _____?

16. An open loop system having OLTF is $G(S)H(S) = \frac{S-1}{(S+2)(S+3)}$ is
    (a) Stable & of the minimum phase type
    (b) Stable & of the non-minimum phase type
    (c) Unstable & of the minimum phase type
    (d) Unstable & of the non-minimum phase type

17. For polynomial $q(s) = S^5 + S^4 + 2S^3 + 2S^2 + 3S + 15$. The number of roots which lies in the right half of the s-plane is _____?

18. The compensator $G_c(S) = \frac{5(1+0.3S)}{1+0.1S}$ would provide minimum phase shift of
    (a) 30º (b) 45º (c) 60º (d) 120º

19. The state transition matrix $\phi(t)$ of system $\begin{bmatrix}\dot{X}_1\\ \dot{X}_2\end{bmatrix} = \begin{bmatrix}0 & 1\\ 0 & 0\end{bmatrix}\begin{bmatrix}X_1\\ X_2\end{bmatrix}$ is
    (a) $\begin{bmatrix}t & 1\\ 1 & 0\end{bmatrix}$ (b) $\begin{bmatrix}1 & 0\\ t & 0\end{bmatrix}$ (c) $\begin{bmatrix}1 & 1\\ 1 & t\end{bmatrix}$ (d) $\begin{bmatrix}1 & t\\ 0 & 1\end{bmatrix}$

20. The second order dynamic system is $\dot{X} = PX + QU$ & $Y = RX$ has the matrix $P = \begin{bmatrix}-1 & 1\\ 0 & -3\end{bmatrix}, Q = \begin{bmatrix}0\\ 1\end{bmatrix}, R = [0 \quad 1]$. The system has the following controllability and observability properties.
    (a) Controllable & observable
    (b) Not Controllable but observable
    (c) Controllable but not observable
    (d) Not controllable & not observable

21. Consider an LIT with transfer function $\frac{C(S)}{R(S)} = H(S) = \frac{1}{S(S+4)}$, If input to the system is correct and the steady state output is A Sin $(3t + \alpha)$, then the value of 'A' & 'α' is
    (a) $\frac{1}{30}$ & $36^{\circ}.86^{\circ}$ (c) $\frac{3}{4}$ & $53^{\circ}.13^{\circ}$
    (b) $\frac{1}{15}$ & $36^{\circ}.86^{\circ}$ (d) $\frac{3}{4}$ & $53^{\circ}.13^{\circ}$

22. A stable LTI system has transfer function $H(S) = \frac{1}{S^2+S-6}$. To make this system casual it needs to be cascaded function with another LTI system having a transfer function $H_1(S)$ is
    (a) S+3 (b) S-2 (c) S-6 (d) S+1

23. The OLTF of a unity –ve feedback is $G(S)H(S) = \frac{10(S+1)}{S(S-3)}$. The unit step response is
    (a) $1 + 1.67e^{-2t} + 2.67e^{-5t}$ (c) $1 - 1.67e^{-2t} - 2.67e^{-5t}$
    (b) $1 + 1.67e^{-2t} - 2.67e^{-5t}$ (d) $1 - 1.67e^{-2t} + 2.67e^{-5t}$

24. Which one of the following system produces undamped oscillation?
    (a) $\frac{1}{S(S+2)}$ (b) $\frac{1}{(S+1)^2}$ (c) $\frac{1}{S(S+5)^2}$ (d) $\frac{1}{S^2+20}$

25. The location of closed loop poles of the 2nd order system is -3.535 + j 3.535 peak time (t_p) of the system (in sec) is _____?

26. The given system is

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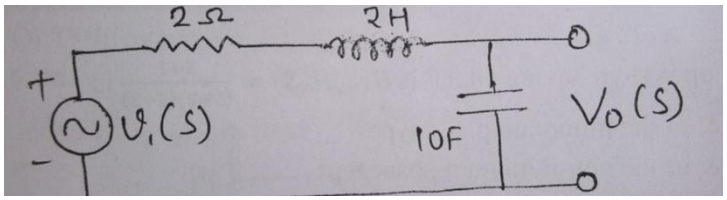


(a) Stable
(b) Unstable
(c) Marginally stable
(d) None of the above

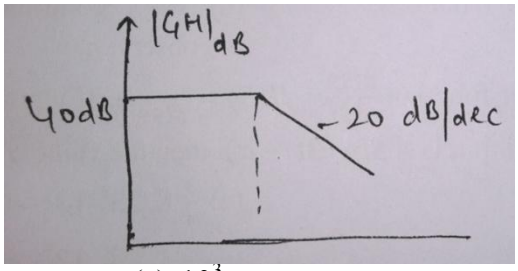
27. The OLTF of the system $G(S)H(S) = \frac{K(S+3)}{S(S+2)}$ is _____the center and the radius of the circle in root locus is _____?

(a) $(-3,0)$ & $\sqrt{3}$
(b) $(-5,0)$ & $\sqrt{3}$
(c) $(-3,0)$ & $\sqrt{5}$
(d) $(-3,0)$ & $\sqrt{10}$

28. The OLTF of unity –ve feedback system is $G(S)H(S) = \frac{K}{S(S+4)(S+5)}$. The jω crossover frequency is

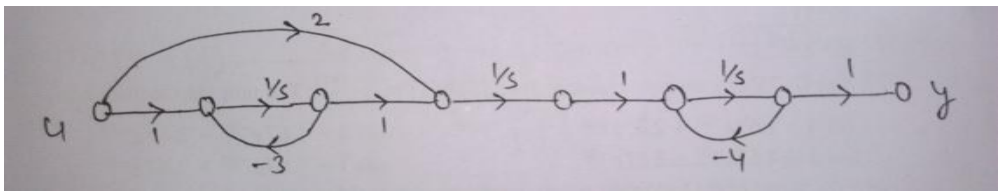
(a) $\sqrt{5}$ rad/s
(b) $2\sqrt{5}$ rad/s
(c) ∞
(d) 0

29. The bode plot for transfer function is given below. The value of gain parameter K is?



(a) 100
(b) $\frac{1}{100}$
(c) 10^3
(d) $\frac{1}{101}$

30. For the given system the state space equation is $\dot{x} = Ax + Bu$ the matrix A is



(a) $\begin{bmatrix} 0 & 1 & -4 \\ 1 & 0 & 0 \\ -3 & 0 & 0 \end{bmatrix}$
(b) $\begin{bmatrix} 0 & -1 & 4 \\ -1 & 0 & 0 \\ 3 & 0 & 0 \end{bmatrix}$
(c) $\begin{bmatrix} -4 & 1 & 0 \\ 0 & 0 & 1 \\ 0 & 0 & -3 \end{bmatrix}$
(d) $\begin{bmatrix} 4 & -1 & 0 \\ 0 & 0 & -1 \\ 0 & 0 & 3 \end{bmatrix}$

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