MSMF GATE CENTRE

CONTROL SYSTEMS

1. Consider the following properties of state transition matrix, $\phi(t)$. Assuming system matrix A and identity matrix, I, the incorrect expression of the following is

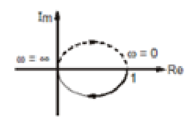
a) $\phi(t_1+t_2)=\phi(t_1).\phi(t_2)$

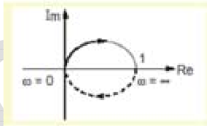
b) $\dfrac{\phi(t_1)}{\phi(t_2)}=\phi(t_1-t_2)$

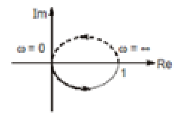
c) $\phi(t_1)=A\phi(t_1)$

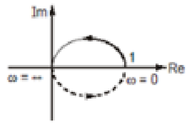
d) $\int_{-\infty}^{0} f(t)=\dfrac{I}{A}$

2. The transfer function is $G(s)=\dfrac{s}{1+s}$ Nyquist plot is

a) 

b) 

c) 

d) 

3. The transfer function of ZOH (zero order hold) is

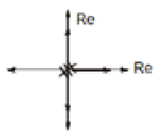
a) $1-e^{Ts}$ b) $1-e^{-TS}$ c) $\dfrac{1-e^{Ts}}{s}$ d) $\dfrac{1-e^{-Ts}}{s}$

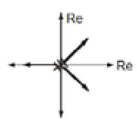
4. The open loop transfer function of a unity feedback system is $G(s)=\dfrac{60(s+2)}{(s+3)(s+4)}$

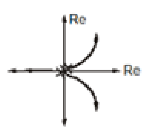
The steady state error for input $10u(t)$ is

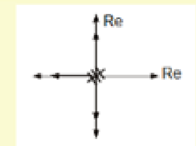
a) 1 b) $\dfrac{10}{11}$ c) $\dfrac{10}{9}$ d) 0

5. For $G(s)H(s)=\dfrac{K}{s^3}$, the root locus plot will be

a) 

b) 

c) 

d) 

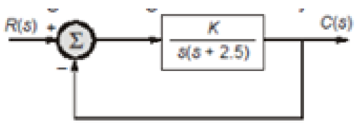
6. The dominant poles of a control system are located at $s=(-1\pm 2j)$. The damping ratio of the system is

a) 0.447 b) 0.5 c) 0.707 d) 1

7. The transfer function of a multi-input, multi-output system with the state representation of $X = AX + Bu, Y = CX + Du$, Where X represent the state, Y the output and U the input vector, will be given by

a) $C(SI - A)^{-1}B$ b) $C(SI - A)^{-1}B + D$ c) $C(SI - A)B + D$ d) $C(SI - A)^{-1}BD$

8. The gain margin of the unity feedback system as shown below is



a) $\frac{5K}{2}$ b) 0 c) 1 d) ∞

9. The unit step response of a second order control system with unity negative feedback is given by $c(t) = 1 - \frac{e^{-1.2t}}{0.8}\left(\sin 1.6t + \tan^{-1}\frac{4}{3}\right)$. The transfer function $\frac{C(s)}{R(s)}$ is

a) $\frac{0.8}{s^2 + s + 0.8}$ b) $\frac{4}{s^2 + 2.4s + 4}$ c) $\frac{4}{s^2 + s + 4}$ d) $\frac{4}{s^2 + 4s + 2.4}$

10. Consider the following statements about Root locus

S_1 : The root locus is symmetrical wityh respect to both (real and imaginary) axis.

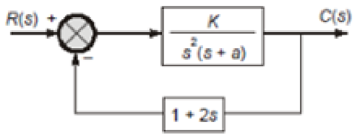
S_2 : The root locus start from (K = 0) from the open loop poles/zeros and terminates $(K = \infty)$ on either finite open loop zeros or infinity.

S_3 : If root locus intersect at imaginary axis, the points of intersection are conjugate.

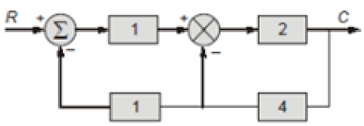
S_4 : For higher values of K, root locus can be approximated by asymptotic lines and these asymptotic lines intersect at a point on Real axis.

a) S1, S2, S3 and S4 b) S3 and S4 c) S2, S3 and S4 d) S1 and S2

11. For the system shown below, the gain constant 'K' is such that, for K > 0 the system is stable, then the value of 'a' should be greater than __________________



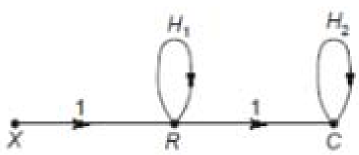
12. Consider the block diagram representation of a system shown in the following figure



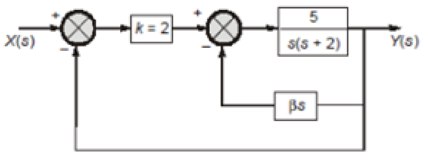
The value of $\frac{C}{R}$ is _________________

13. The signal flow graph representation of a system is shown in the figure below.

If $H_1 = -4, H_2 = 4, then \frac{C}{R} =$

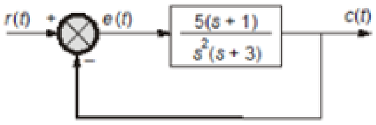


14. For the control system shown below, the value of β to make the damping ratio ζ of the system equal to 0.5 is ___________________

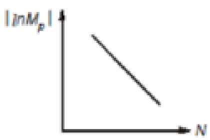
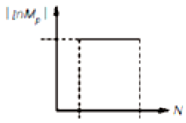
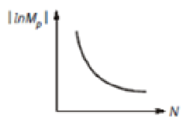


15. The state variable representation of an LTI system has system matrix A given by $A=\begin{bmatrix}0 & 1\\ -2 & -4\end{bmatrix}$. The characteristic equation is given by $\frac{s^2}{A'}+\frac{s}{B'}+1=0$. Then $A'+B'$ is _____

16. A control system shown in the figure has input $r(t)=(1+2t)u(t)$. The steady state value of the error of $e(t)$ is equal to ____________



17. $|InM_p|\,Vs\,N$ graph, where M_p is peak overshoot of an under damped second order system and N is the number of cycles completed before reaching steady state is

a) 
b) 
c) 
d) 

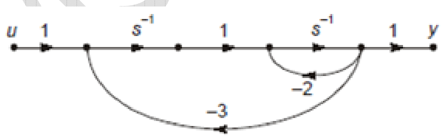
18. For a unity feedback control system, the open loop transfer function is given by $G(s)=\frac{e^{-2s}}{s(s+p)}$. If the system is stable, then the possible value of p is

a) 1.3 b) 2.01 c) 2 d) 1

19. If the maximum phase (ϕ_m) provided by the compensator is 30^{o} and this is achieved at $\sqrt{3}$ rad/sec. The transfer of the compensator is

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

20.



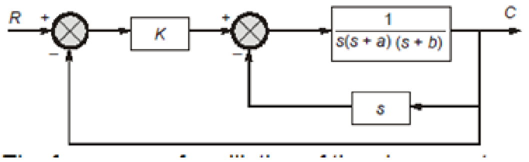
For the above signal flow graph the state equations are given as $\dot{X} = AX + Bu, y = CX$, Then matrix A is ___________

a) $\begin{bmatrix}-2 & 1\\ -3 & 0\end{bmatrix}$ b) $\begin{bmatrix}2 & 1\\ 3 & 0\end{bmatrix}$ c) $\begin{bmatrix}0 & -2\\ 1 & -3\end{bmatrix}$ d) $\begin{bmatrix}2 & 3\\ 1 & 0\end{bmatrix}$

21. Determine sensitivity 'S' for overall closed loop transfer function $\frac{C(s)}{R(s)}$, with respect to forward path transfer function G(s)

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

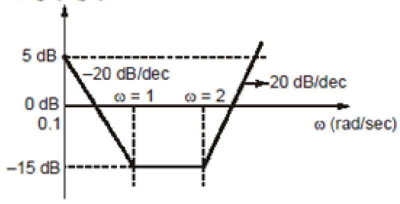
22. Consider the unity feedback system which employs rate feedback as shown in the figure.



The frequency of oscillation of the above system is

a) $\sqrt{ab}+1\ rad/\sec$ b) $\sqrt{ab}$ rad/sec c) $\sqrt{ab+1}\ rad/\sec$ d) $ab+1\ rad/\sec$

23. The asymptotic bode magnitude plot of a transfer function is shown in the figure. The gain crossover frequency is $|G(j\omega)H(j\omega)|$



a) 0.1816 rad/sec b) 11.22 rad/sec c) both (a) and (b) d) None of these

24. A system has forward path transfer function $G(s)$ and feedback transfer function $H(s)$ given by $G(s)=\frac{5e^{-4s/7}}{s+1}, H(s)=1$. The gain margin of the system is (Assume $\tan\theta=\theta$)

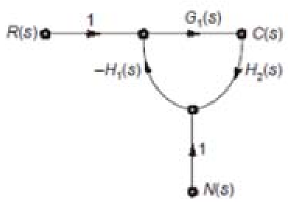
a) $-8\ dB$ b) $7dB$ c) $-7\ dB$ d) $8\ dB$

25. An open loop transfer function with unity feedback system is $G(s)=\frac{K}{s^3+4s^2+5s}$

The value of K at one of the breakaway or break-in points of the root locus for the above system

a) 1.667 b) 0.5 c) 1 d) 1.852

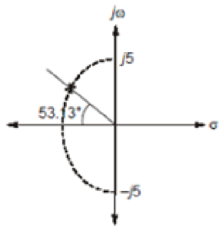
26. The signal flow graph of a closed loop system is shown in figure, the noise transfer function $\frac{C(s)}{N(s)}$ is approximately given by



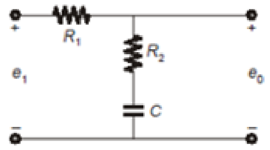
a) $\frac{1}{G_1(s)H_2(s)}$ for $|G_1(s)H_1(s)H_2(s)|<<1$ b) $\frac{1}{H_2(s)}$ $for |G_1(s)H_1(s)H_2(s)|>>1$

c) $\frac{1}{H_1(s)H_2(s)}$ $for\ |G_1(s)H_1(s)H_2(s)|>>1$ d) $\frac{1}{G_1(s)H_1(s)H_2(s)}$ $for\ |G_1(s)H_1(s)H_2(s)|<<1$

27. A second order control system with unity feedback is given by $\frac{C(s)}{R(s)} = \frac{\omega_0^2}{s^2 + 2\xi\omega_0 s + \omega_0^2}$. One pole (s_1) of transfer function $\frac{C(s)}{R(s)}$ is located as shown. The time at which first undershoot occurs is ____________ sec

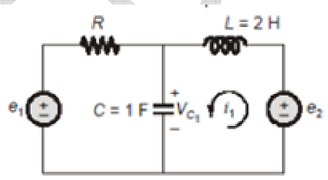


28. The electrical network of a phase lag compensator is shown below, if $R_1 = 2R_2$, the maximum phase lag provided by circuit is ϕ_m. The value of $\cos\phi_m$ is ____________

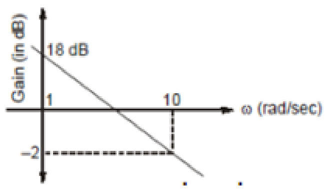


29. The root locus branches for the open loop transfer function $G(s) = \frac{K}{s(s+1)(s+2)}$ of a unity feedback control system intersects s – plane imaginary axis at $\pm j$ ____________________

30. For the electrical network shown in figure, the state equations are given as $X = AX + Bu$, $Y = CX$.
Consider i_1 and V_{C_1} as state variable X_1 and X_2 respectively, then $\det[A]$ is, where det is determinant



31. The Bode plot of a transfer function $G(s)$ is shown



The gain (20 $\log_{10}|G(s)|$) is 18 dB and -2 dB at 1 rad/sec and 10 rad/sec respectively. The value of gain at $\omega = 5$ rad/sec is ____________ dB

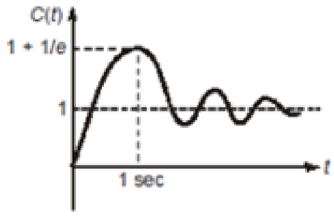
32. The state equation of a system are given below

$$X_1 = pX_1 + X_2 + u$$

$$X_2 = -3x_1 + u$$

If the system is found to be uncontrollable then value of p is ______________

33. Consider the following unit step response $c(t)$ of a second order unify feedback control system with transfer function $\frac{C(s)}{R(s)} = \frac{\omega_0^2}{s^2 + 2\xi\omega_0 s + \omega_0^2}$. The settling time for 2% tolerance is _______ sec



Answers :

1.d	2.b	3.d	4.b	5.b	6.a
7.b	8.d	9.b	10.b	11. 0.5	12. 0.117 (0.10 – 0.20)
13. 0.2 (0.15 – 0.25)		14. 0.232 (0.20 – 0.25)		15. 2.5 (2.30 – 2.80)	
16. 0	17. C	18.b	19. C	20.a	21. B
22.c	23. C	24.c	25.d	26.b	27. 1.57 (1.50 – 1.60)
28. 0.866 (0.80 – 0.90)		29. 1.41 (1.30 – 1.50)		30. 0.5	
31. 4.02 (4.00 – 4.10)		32. -4	33. 4		