

Control Objective Solution

1. (B) By using closed loop control system, internal disturbances are reduced.
2. (D) Generalized/Dynamic error coefficients

$$e(t) = C_0 r(t) + C_1 \frac{dr}{dt} + C_2 \frac{d^2 r}{dt^2} + C_3 \frac{d^3 r}{dt^3} + \dots + C_n \frac{d^n r}{dt^n}$$

$C_0, C_1, C_2, \dots, C_n \rightarrow$ Dynamic error coefficients

3. (A) In position control system, tachometer feedback improves stability and in speed control system, improves accuracy. It increases damping of the system

4. (B)

5. (C) $G(s)H(s) = \frac{+k}{(s+1)(s+2)}$ ($k < 0 \rightarrow$ for f/b system)

$$\frac{C(s)}{R(s)} = \frac{k}{(s+1)(s+2) - k} \quad \left[\frac{G(s)H(s)}{1 - G(s)H(s)} \right]$$

6. (C)

7. (A) $G(s) = \frac{4 \times 5(1+s/4)}{0.25 \times 25s(4s+1) \left(\frac{s^2}{25} + \frac{4s}{25} + 1 \right)}$

$$k = \frac{16}{5} = 3.2$$

8. (C)

9. (C)

10. (B) $H(s) = \frac{1}{s(s+4)}$

$$|H(s)| = \frac{1}{\omega \sqrt{\omega^2 + 16}} = \frac{1}{3 \times 5} = \frac{1}{15}$$

11. (C) $P_1 = \frac{h_1}{s} = \frac{b_1}{s} \rightarrow \Delta_1 = \left(1 + \frac{a_1}{s} \right)$

$$P_2 = \frac{h_0}{s^2} = \Delta_2 = 1$$

$$\Delta = 1 + \frac{a_1}{s} + \frac{a_0}{s^2}$$

$$\frac{C(s)}{u(s)} = \frac{\frac{b_1}{s} \left(1 + \frac{a_1}{s} \right) + \left(\frac{b_0 - b_1 a_1}{s^2} \right)}{1 + \frac{a_1}{s} + \frac{a_0}{s^2}}$$

12. (A)

13. (C) $N = 0 \rightarrow$ Encirclements since $|G(s)H(s)| < 1$.

if $P = 0$

then $z = 0$

Here closed loop system will be stable.

14. (B)

15. (B) $H(s) = \frac{1+3s}{1+s}$

$$\alpha = \frac{1}{3}$$

$$\phi_m = \sin^{-1} \left(\frac{1-\alpha}{1+\alpha} \right) = \sin^{-1} \left(\frac{1}{2} \right) = 30^\circ$$

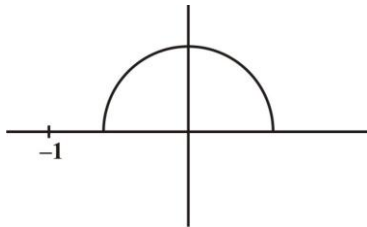
16. (A) $H(s) = \frac{1}{s+1}$

$$\frac{1}{\sqrt{\omega_b^2 + 1}} = \frac{1}{\sqrt{2}}$$

$$\omega_b = 1 \text{ rad/sec}$$

$$f_b = \frac{1}{2\pi} \text{ Hz.}$$

17. (D)



$$\left(\frac{s+z}{s-p} \right) \text{ from}$$

$$N = 0$$

$$P = 1$$

$$|G(s)H(s)| = .5$$

$$GM = 2$$

$$= 6 \text{ dB}$$

18. (B) III order system Becomes II order then it behaves like PHASE LEAD.

19. (D)

20. (C)

21. (B) Characteristic equation becomes $s^2 + 2\xi\omega_n s + \omega_n^2$ so $s^2 + 2s + 2 = 0$

22. (A)

23. (B)

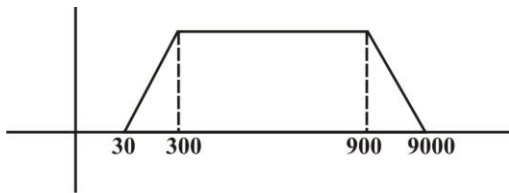
24. (D)

25. (C)

26. (B)

27. (A)

28. (D) $\xi\omega_n = 1$ & $w_d = \sqrt{3}$
 29. (B) Division is not possible
 30. (C)



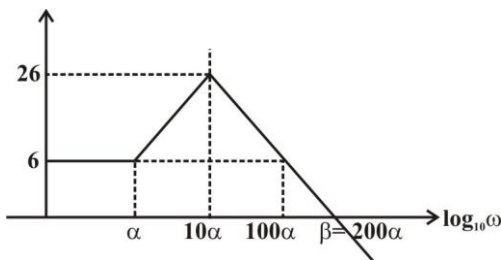
$$f_H - f_L = 9000 - 30$$

$$= 8970 \text{ Hz}$$

31. (B)

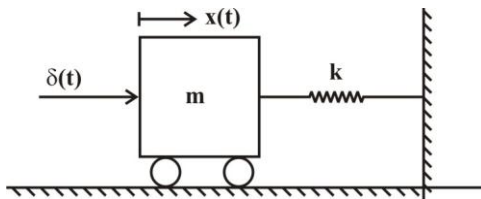
| | | | |
|-------|-------|----|----|
| s^5 | 1 | 3 | -4 |
| s^4 | 2 | 6 | -8 |
| s^3 | 8 | 12 | 0 |
| s^2 | 3 | -8 | |
| s^1 | 100/3 | 0 | |
| s^0 | -8 | | |

32. (C)
 33. (C)
 34. (A) $s^3 + 2s^2 + 6s + 12 = 0$
 $(s + 2)(s^2 + 6) = 0$
 $\xi\omega_n = 0$
 $\delta = 0$
 35. (C)
 36. (B)
 37. (A) B.W. is the noise filtering characteristic of the system.
 38. (C) Roots coincide – critical damping
 39. (D) Damping is inversely proportional to gain
 40. (A)
 41. (C)



42. (C) System is unstable
 \therefore Phase lead and lag – lead will be used.

43. (B) $\frac{3}{\xi\omega_n} = 3\text{m sec}$
 $T = 1\text{ m sec.}$
44. (D) Non-minimum \rightarrow zero at right hand side (at least)
 \rightarrow Magnitude & phase are uniquely related.
45. (C)
46. (B) Sensitivity \uparrow , Gain \downarrow (due to $-ve$ f/b system)
47. (C)
48. (C)
49. (B) Repeated roots an origin or imaginary axis \rightarrow unstable
50. (B)
51. (D)
52. (C)



$$\delta(t) = m\ddot{x} + kx$$

$$1 = Ms^2X(s) + kX(s)$$

$$X(s) = \frac{1}{Ms^2 + k}$$

$$= \frac{1/M}{s^2 + (k/M)}$$

53. (C) Sum of Eigen values = Trace
 Product of Eigen values = Determinant

54. (C)

55. (D) $e_{ss} = \frac{1}{1+k_p} \quad \frac{1}{1+k} = 0.2$

$$k_p = k \quad k = 4$$

56. (C) $G(s)H(s) = \frac{e^{-sT_D}}{s}$

$$\phi = -90^\circ - \omega T_D \times \frac{180^\circ}{\pi}$$

$$\omega_{gc} = \text{GCF} = 1$$

$$\text{PM} = 90 - T_D \times \frac{180}{\pi}$$

$$90 > \frac{180T_D}{\pi}$$

$$T_d < \frac{\pi}{2}$$

57. (C)

58. (C)

59. (A)

60. (C) $1 + \frac{k_c}{s(s+3)} = 0$

$$s^2 + 3s + k_c = 0$$

$$s = \frac{-3 \pm \sqrt{9 - 4k_c}}{2} < -1$$

$$9 - 4k_c < 1$$

$$k_c > 2$$