Control Objective Solution

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

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

$C_0, C_1, C_2, -----, C_n \rightarrow$ 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) $G(s)H(s) = \frac{+k}{(s+1)(s+2)}$ $\quad (k < 0 \rightarrow \text{for f/b system})$

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

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

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then z = 0

Here closed loop system will be stable.

14. (B)

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

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

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

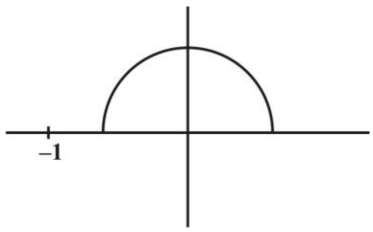
16. (A) $H(s)=\frac{1}{s+1}$

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

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

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

17. (D)



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

N = 0

P = 1

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

$GM=2$

= 6 dB

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

19. (D)

20. (C)

21. (B) Characteristic equation becomes $s^2+2\xi w_n s+w_n^{\,2}$ so $s^2+2s+2=0$

22. (A)

23. (B)

24. (D)

25. (C)

26. (B)

27. (A)

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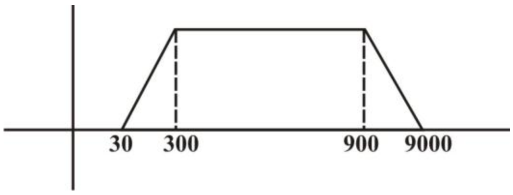
28. (D) $\xi w_n = 1 \,\&\, w_d = \sqrt{3}$

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)

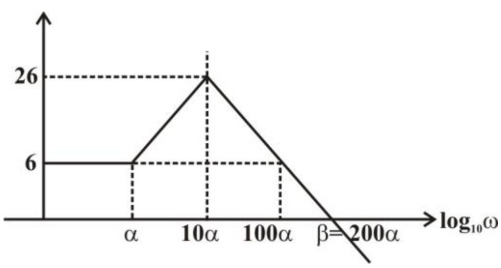
37. (A) B.W. is the noise filtering characteristic of the system.

38. (C) Roots coincide – critical damping

39. (D) Damping is inversely proportional to gain

40. (A)

41. (C)



42. (C) System is unstable

∴ Phase lead and lag – lead will be used.

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43. (B) $\frac{3}{\xi\omega_n} = 3\text{m}\sec$

T = 1 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)

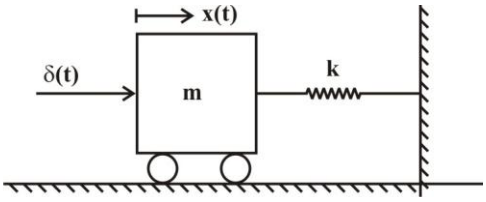
48. (C)

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) $G(s)H(s) = \frac{e^{-ST_D}}{s}$

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

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

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

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

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

57. (C)

58. (C)

59. (A)

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

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

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

$$9-4k_c<1$$

$$k_c>2$$

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