1. **Ans.(c)**

$b = 7,\ n = 5$

No. of loop, $\ell = b - n + 1 = 7 - 5 + 1 = 3$

2. **Ans. (d)**

$$dv = r^2 \sin\theta dr d\phi d\phi$$

3. **Ans.(c)**

Since field is sinusoidal varying and also the loop is rotating, so both type of motional and transformer emf are generated.

4. **Ans. (d)**

$$E = \sum_{-\infty}^{\infty} |x(n)|^2$$

$$= \sum_{0}^{\infty} \left(\frac{1}{2}\right)^{2n} \qquad = \sum_{0}^{\infty} \left(\frac{1}{4}\right)^{n}$$

$$= 1 + \frac{1}{4} + \left(\frac{1}{4}\right)^2 ---$$

$$E = \frac{1}{1 - \frac{1}{4}} = \frac{4}{3}$$

5. **Ans. (b)**

$$f(t) = 1 \text{ at } t = 0$$

$$\therefore \int_{-\infty}^{\infty} (t^2 + 1) f(t) dt = 0 + 1 = 1$$

6. **Ans. (a)**

$$(x-1)^2 + (y+3)^2 = 4$$

$$c = (+1, -3) \text{ and } R = \sqrt{4} = 2$$

7. **Ans. (b)**

$$L\left[e^{at}\right] = \frac{1}{s-a}$$

$$L\left[te^{at}\right] = \frac{1}{(s-a)^2}$$

8. **Ans. (a)**

Order= 2 degree =1

9. **Ans. (a)**

$$V_1 = I_1 Z_a + (I_1 + I_2) Z_c = I_1 (Z_a + Z_c) + I_2 Z_c$$

$$V_2 = I_2 Z_b + (I_2 + I_1) Z_c = I_1 (Z_c) + I_2 (Zb + Z_c)$$

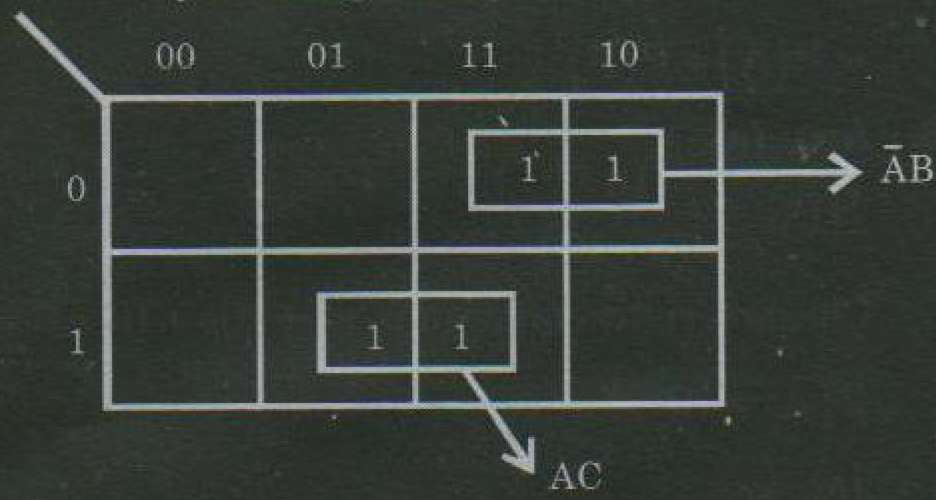
$$[2] = \begin{bmatrix} Za + Z_c & Z_c \\ Z_c & Zb + Z_c \end{bmatrix}$$

10. **Ans. (d)**

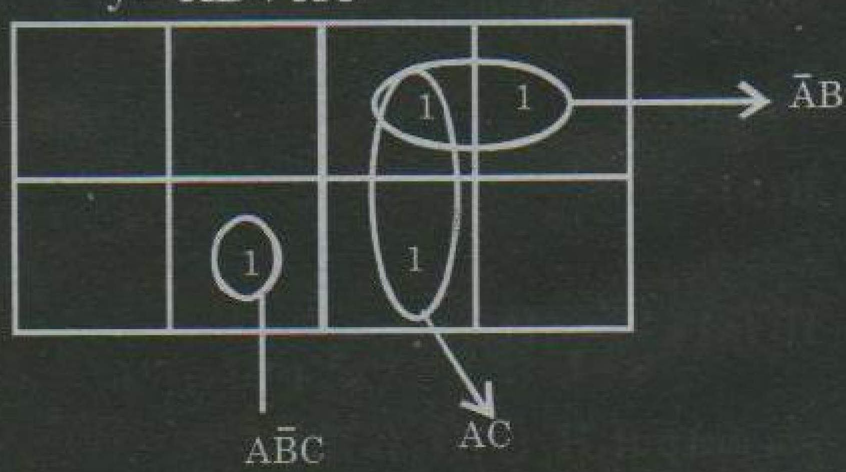
$$Y = (A + B)(\bar{A} + C)$$

$$= \bar{A}B + AC + BC$$

By drawing K-map



$$y = \bar{A}B + AC$$



$$y = \bar{A}B + BC + A\bar{B}C$$

11. Ans. (c)
Class C is used for tuned amplifier application

12. Ans. (d)
VMOS are specially designed in vertical plane so that channel resistance is less, so higher current and power rating can be achieved

13. Ans. (a)

$$\text{Gain} = -\frac{R_f}{R_1}$$

When the rheostat is adjusted for minimum resistance value,

$$G_1 = \frac{-500}{15} = -33.3$$

Similarly, when rheostat is adjusted for maximum value,

$$G_2 = \frac{-500}{15+10} = -20$$

Range is -20 to -33.3

14. Ans. (a)

15. Ans. (c)

Since $P(A \cap B) = 0$

$$\therefore P(A \cup B) = P(A) + P(B) - P(A \cap B)$$

$$= P(A) + P(B)$$

16. Ans. (a)

$$H(s) = \frac{10}{s(s+10)}$$

Characteristic equation is $s^2 + 10s + 10 = 0$

$$2\{\omega_n = 10$$

$$\{\omega_n = 5$$

For 2% setting time, $t_s = \frac{2}{\{\omega_n} = \frac{2}{5} = 0.4$

17. Ans. (c)

$$R(s) = 1$$

$$H_1(s) = \frac{s}{s+1}, H_2(s) = \frac{1}{s^2+1}$$

so, output, $H_1(s)H_2(s)R(s)$

$$Y(s) = \frac{s}{(s^2+1)(s+1)}$$

$$\Rightarrow Y(s) = -\frac{1}{2(s+1)} + \frac{\frac{s}{2} + ½}{s^2+1}$$

$$\Rightarrow y(s) = \frac{-1}{2}e^{-t} + \frac{1}{2}\cos t + \frac{1}{2}\sin t$$

18. Ans. (a)

19. Ans. (b)
Voltage, V = E/Q = 50/20= 2.5 Volt.

20. Ans. (a)
Memory less and casual

21. Ans. (d)

$$e^{-at}u(t) \Rightarrow \frac{1}{(s+a)}$$

$$te^{-at}u(t) \Rightarrow \frac{1}{(s+a)^2}$$

ROC is $Re(s) > -Re(a)$

22. Ans. (b)

It is the Fourier transform of rectangular pulse.

23. Ans. (d)

$$FOM = \frac{3}{2}m_f^2$$

24. Ans. (d)

$$|A - \lambda I| = 0 \Rightarrow (1-\lambda)(2-\lambda) - 12 = 0 \Rightarrow \lambda = -2, 5$$

25. Ans. (d)

$$Z = \overline{\overline{(A \oplus \bar{B})} \oplus \overline{(A \oplus \bar{B})}}$$

$$= (A \odot \bar{B}) \odot (A \odot \bar{B})$$

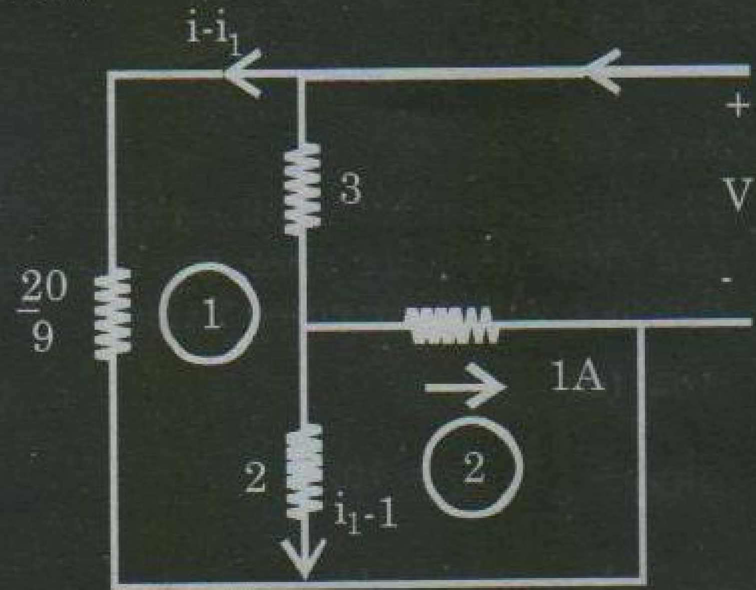
$$X = A \odot \bar{B}$$

$$\therefore Z = X \odot X$$

$$= XX + \bar{X}\bar{X}$$

$$= X + \bar{X} = 1$$

26. Ans. (a)



Apply KVL in loop (1),

$$\frac{20}{9}(i-i_1)-2(i_1-i)-3i_1=0$$

$$\Rightarrow \frac{20}{9}i-\frac{65}{9}i_1=-2$$

$$2(i_1-1)-1=0$$

$$\Rightarrow i_1=\frac{3}{2}A$$

$$\therefore \frac{20}{9}i=-2+\frac{65}{9}i_1$$

$$=-2+\frac{65}{9}\times\frac{3}{2}\Rightarrow i=3.995\text{ A}$$

Also, $V=3i_1+1$

$$=3\times\frac{3}{2}+1=5.5V$$

27. Ans. (d)

Truth table is as following

$Q_2(+)$	$Q_1(+)$	$Q_0(+)$
1	0	1
0	1	0
1	0	1
0	1	0
1	0	1

101 repeats after two cycle. Frequency will be f/2.

28. Ans. (c)

For the positive half cycle, didoe D, is forward biased and output will be sine wave plus 5V dc voltage level.

In negative half cycle upto – 5 V amplitude, Diode D is forward biased and below -5V, it will be reverse biased, so no output will be observed

29. Ans. (d)

$$H=\frac{I}{2\pi r}a\phi$$

$$r=5$$

$$H=\frac{10\pi}{10\pi}a\phi=a\phi$$

So, (d) is incorrect

30. Ans. (b)

$$C=\left(\frac{r}{1+r},0\right) \qquad R=\frac{1}{1+r}$$

31. Ans. (a)

32. Ans. (c)

$$f_\varepsilon(\varepsilon)=\frac{1}{2\Delta}$$

$$\text{Variance}=\int_{-\infty}^{\infty}\varepsilon^2 f_\varepsilon(\varepsilon)d\varepsilon$$

$$=\int_{-\Delta}^{\Delta}\frac{\varepsilon 2}{2\Delta}d\varepsilon$$

$$=\frac{1}{2\Delta}\int_{-\Delta}^{\Delta}\varepsilon^2 d\varepsilon$$

$$=\frac{1}{2\Delta}\left[\frac{\varepsilon^3}{3}\right]^{\Delta}$$

$$=\frac{1}{6\Delta}\left(\Delta^3+\Delta^3\right)=\frac{2\Delta^3}{6\Delta}=\frac{\Delta^2}{3}$$

33. Ans. (a)

$$\text{Estep}(\infty)=1+CA^{-1}B$$

$$A^{-1}=\begin{bmatrix}-2 & -\frac{1}{3}\\ 1 & 0\end{bmatrix}$$

$$\text{estep}(\infty)=1+\begin{bmatrix}1 & 1\end{bmatrix}\begin{bmatrix}-2 & \frac{1}{3}\\ 1 & 0\end{bmatrix}\begin{bmatrix}0\\1\end{bmatrix}=1-\frac{1}{3}=\frac{2}{3}$$

34. Ans. (c)

Directly form statement of green's theorem

35. Ans. (a)

Applt taylor's theorem.

36. Ans. (b)

Clearly, logic shows NOR gate implementation with RTL technology.

37. Ans. (c)

For $R_1 = 0, R_2 = 0$, circuit acts as voltage follower $V_0 = V_i$

38. Ans. (a)

Initial value

$$x(n)\Big|_{n=0} = \lim_{3\to\infty} X(z) = 2$$

Final value is

$$x(\infty) = \lim_{|z|\to 1} \times \left(1 - z^{-1}\right)\left(2 + 3z^{-1} + 4z^{-2}\right)$$

$$= 2 + 1 + 1 - 4 = 0$$

39. Ans. (a)

$$Z_{in} = \frac{Z_0\left[Z_L + jZ_0 \tan\beta\ell\right]}{Z_0 + jZ_L \tan\beta\ell}$$

For shorted line, $Z_L = 0$

$$Z_{in} = j20\tan\beta\ell$$

For $\ell = \frac{\lambda}{8}$

$$\therefore Z_{in} = j20\tan\frac{2\pi}{\lambda}\times\frac{\lambda}{8} = jZ0$$

So, option (a) is in correct

40. Ans. (d)

$$I = 2\pi i\left(z^2 - 4z + 4\right)_{z=-i}$$

$$= 2\pi i\left((-i)^2 - 4(-i) + 4\right)$$

$$= 2\pi(-4 + 3i)$$

41. Ans. (b)

Since $P(A) + P(B) + P(C) = 1$

$$\Rightarrow P(A) + 0.6\,P(A) + 0.2P(A) = 1$$

$$\Rightarrow P(A) = \frac{10}{18} = 5/9$$

42. Ans. (d)

$$g_m = g_{m0}\left(1 - \frac{V_{GS}}{V_P}\right)$$

$$g_{m0} = \left|\frac{2I_D}{V_P}\right|$$

43. Ans. (a)

The instruction XRA will set the Z flag. LXI and DCX does not alter the flag. HENCE, this loop will be executed 1 times.

44. Ans. (d)

$$I_{CQ} = \frac{1}{2} I_{c\ sat} = 4mA$$

$$R_c = \frac{V_{Rc}}{I_{ca}} = \frac{V_{cc} - V_c}{I_{ca}}$$

$$= \frac{28 - 18}{4} = 2.5\ k\Omega$$

$$I_{C\ sat} = \frac{V_{cc}}{R_c + R_E}$$

$$\Rightarrow R_C + R_E = \frac{V_{cc}}{I_{c\ sat}} = \frac{28V}{8mA} = 3.5k\Omega$$

$$R_E = 3.5k\Omega - R_c$$

$$= 3.5 - 2.5 = 1k\Omega = 1000\Omega$$

45. Ans. (c)

FOR ASTABLE OPERATION

$$f = \frac{1.44}{(R_A + 2R_B)C} = 640\ Hz$$

46. Ans. (b)

$$F = F_1 + \frac{F_2 - 1}{A_1}$$

$$= 1.59 + \frac{4 - 1}{15.9} = 1.59 + \frac{3}{15.9}$$

$$= 1.779$$

Indecibels,

$$F_{dB} = 10\log_{10}(F)$$

$$= 10\log_{10}(1.779)$$

$$= 2.5\ dB$$

47. Ans. (a)

For sinusoidal waveform

$$\left(\frac{S}{N}\right)dB = 1.8 + 6n$$

$\therefore 40 = 1.8 + 6n$

$\Rightarrow n = 6.366$

so, $n = 7$

48. Ans. (c)

$V_1 = V_s = 500I_1 \quad ...(1)$

$V_2 = -2000I_2 \quad ...(2)$

Also, h parameters are defined by

$V_1 = h_{11}I_1 + h_{12}I_2 \quad ...(a)$

$I_2 = h_{21}I_1 + h_{22}V_2 \quad ...(b)$

From equation (1) and (a),

$\therefore 10^{-2} - 500I_1 = 1000I_1 + 0.003V_2$

$\Rightarrow 0.003V_2 = 10^{-2} - 1500I_1 \quad ...(3)$

From equation (2) and (b),

$$\frac{V_2}{-2000} = 100I_1 + 50\times10^{-6}V_2$$

$\Rightarrow I_1 = -5.5\times10^{-6}V_2$

Solving (3) and (4),

$0.003V_2 = 10^{-2} + 1500(5.5\times10^{-6})V_2 \quad ...(4)$

$\Rightarrow V_2 = -1.905V$

49. Ans. (a)

$$Z_{11} = \frac{\Delta h}{h_{22}} = \frac{1000\times50\times10^{-6} - 0.003\times100}{50\times10^{-6}} = -5000\ \Omega$$

$$Z_{12} = \frac{h_{12}}{h_{22}} = 60\ \Omega$$

$$Z_{21} = \frac{-h_{12}}{h_{22}} = -2\times10^{6}\ \Omega$$

$$Z_{22} = \frac{1}{h_{22}} = 20\times10^{3}\ \Omega$$

50. Ans. (b)

$$e_{ss} = \lim_{t\to\infty} e(t) = \lim_{s\to0} sE(s)$$

$$= \lim_{t\to\infty} \frac{sR(s)}{1+G(s)H(s)}$$

put $K_t = 0$ and $K_a = 5$

$$G(s) = \frac{5}{s(0.5s+1)}, H(s) = 1, R(s) = \frac{1}{s^2}$$

$$\therefore e_{ss} = \lim_{t\to\infty} \frac{s\frac{1}{s^2}}{1+\frac{5}{s(0.5s+1)}} = \frac{1}{5} = 0.2$$

51. Ans. (c)

Open loop transfer function is

$$G_e = \frac{\frac{K_a}{s(0.5s+1)}}{1+\frac{sK_t}{s(0.5s+1)}} = \frac{K_a}{s(0.5s+1+K_t)}$$

$$T(s) = \frac{G(s)}{1+G(s)} = \frac{K_a}{0.5s^2 + s(1+K_t) + K_a}$$

$$= \frac{2K_a}{s^2 + 2s(1+K_t) + 2K_a}$$

$\therefore \omega n_n^2 = 2K_a \Rightarrow \omega_n = \sqrt{2K_a}$

$2\xi\omega_n = 2(1+K_t)$

$$\xi = 1 + \frac{K_t}{\sqrt{2K_a}} = 0.7 \quad ...(1)$$

$$e_{ss} = \lim_{s\to0} \frac{sR(s)}{1+G_e(s)}, R(s) = \frac{1}{s^2}$$

$$e_{ss} = \frac{1+K_t}{K_a} = 0.2 \quad ...(2)$$

$\therefore$ solving equation (1) and equation (2) we get

$K_a = 24.5, K_t = 3.9$

52. Ans. (c)

by voltage divider theorem,

$$V_B = \frac{4.7}{4.7+4.7}(-20) = -10V$$

53. Ans. (b)

$V_{BE} = V_B - V_E$

$\Rightarrow V_E = V_B - V_{BE}$

$= 10 - 0.7 = -10.7\,V$

$$\therefore I_E = \frac{V_E + 20}{2.2}$$

$$= \frac{-10.7 + 20}{2.2}$$

$$= 4.22 \text{ mA}$$

54. Ans. (b)

Taking fourier transform both sides,

$$j\omega y(j\omega) + 5y(j\omega) = 2 \times (j\omega)$$

$$\Rightarrow \frac{4(j\omega)}{x(j\omega)} = \frac{2}{j\omega + 5}$$

$$\Rightarrow H(\omega) = \frac{2}{5 + j\omega}$$

$$\Rightarrow h(t) = 2e^{-5t}u(t)$$

Step response is output of system when we apply x(t) = u(t)

$$\therefore g(t) = h(t) \otimes u(t)$$

$$= \int_{-\infty}^{\infty} h(t)u(t-z)dz$$

$$= \int_0^t 2e^{-5z}dz = 2\left[\frac{-1}{5}e^{-5z}\right]_0^t$$

$$= \frac{2}{5}\left(1 - e^{-5t}\right)u(t)$$

55. Ans. (a)

Final value step response

$$g(\infty) = \frac{2}{5}\left[1 - e^{-5(\infty)}\right]u(\infty)$$

$$= \frac{2}{5}$$

Step response at $t = t_0$ is

$$g(t_0) = \frac{2}{5}\left[1 - e^{-5t_0}\right]$$

But the given step response is

$$g(t_0) = \frac{2}{5}\left[1 - \frac{1}{e^2}\right]$$

By comparison, $t_0 = \frac{2}{5}$ sec

56. Ans. (a)

Since philatelist collects stamps, similarly Numismatist collects coins

57. Ans. (b)

Let the cost of one screw driver and hammer is Re 1 each

New prices of s.d = Rs. 1.05

Hammer = Rs. 1.03

Cost 3 unit each = 3(1.05 + 1.03) = Rs. 6.24

Original price of 3 unit each = Rs. 6

∴ percentage increase

$$= \frac{6.24 - 6}{6} \times 100 = 4\text{per}$$

58. Ans. (d)

59. Ans. (a)

60. Ans. (c)

61. Ans. (d)

Let capacity be x

$$\therefore \frac{5}{8}x - \frac{x}{4} = 6$$

$$\Rightarrow \frac{5x - 2x}{8} = 6$$

$$\Rightarrow 3x = 48$$

$$= x = 16$$

62. Ans. (c)

63. Ans. (c)

$$\text{Average} = \frac{80 + 70 + 60 + 80}{4} = 72.5$$

64. Ans. (d)

They will meet every 35 minute(LCM of 5 and 7)

65. Ans. (b)

$$\sqrt{0.3} = 0.54 \leftarrow \text{greatest}$$

$$\frac{2}{5} = 0.4$$

$$0.01\,\pi = 0.03$$

◆◆◆