

ANSWERS

1.1 (b)	1.2 (b)	1.3 (c)	1.4 (d)	1.5 (d)	1.6 (d)	1.7 (c)	1.8 (a)	1.9 (a)	1.10 (a)
1.11 (b)	1.12 (b)	1.13 (a)	1.14 (d)	1.15 (c)	1.16 (d)	1.17 (b)	1.18 (b)	1.19 (b)	1.20 (c)
1.21 (c)	1.22 (c)	1.23 (a)	1.24 (c)	1.25 (d)	1.26 (a)	1.27 (c)	1.28 (d)	1.29 (c)	1.30 (a)
1.31 (a)	1.32 (a)	1.33 (c)	1.34 (a)	1.35 (d)	1.36 (b)	1.37 (c)	1.38 (b)	1.39 (d)	1.40 (b)
1.41 (b)	1.42 (a)	1.43 (b)	1.44 (c)	1.45 (b)	1.46 (*)	1.47 (c)	1.48 (b)		

EXPLANATIONS

EE.1.

1.1. $C(t) = -te^{-t} + 2e^{-t},$
($t \geq 0$)

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

$$C(s) = \frac{G(s)}{1+G(s)},$$

$$G(s) = \frac{C(s)}{1-C(s)} = \frac{\frac{2s+1}{(s+1)^2}}{1-\frac{2s+1}{(s+1)^2}} = \frac{2s+1}{s^2}$$

1.2. $\frac{C(s)}{R(s)} = \frac{G(s)}{1+G(s)},$

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

$$\omega_n = 1, \quad \omega_d = \frac{1}{2}, \quad \zeta = \frac{1}{2}$$

$$M_p = e^{-\xi\sqrt{1-\zeta^2}} = e^{(-\pi/2)/\sqrt{1-(1/4)}} \\ = e^{-\pi/\sqrt{3}} = 0.163$$

1.4. $\frac{C(s)}{R(s)} = \frac{1}{1+s}, \quad \frac{C(j\omega)}{R(j\omega)} = \frac{1}{1+j\omega}$

$$\text{From } r(t) \sin t, \quad \omega = 1, \quad \left| \frac{C(j\omega)}{R(j\omega)} \right| = \frac{1}{\sqrt{1+1}} = \frac{1}{\sqrt{2}}$$

$$\left| \frac{C(j\omega)}{R(j\omega)} \right| = -\tan^{-1} 1 = -\frac{\pi}{4}$$

$$\therefore \text{SS value of } c(t) = \frac{1}{\sqrt{2}} \sin \left(t - \frac{\pi}{4} \right)$$

1.5. The Periodic time = 4 ms = 4×10^{-3} sec.

$\therefore$ Fundamental frequency

$$= \frac{10^3}{4} = 250 \text{ Hz}$$

$\therefore$ Frequency of the 5th harmonic

$$= 250 \times 5 = 1250 \text{ Hz}$$

1.6. As the element absorbs power, let it be R_x .

$$i = 1 = \frac{6}{R_x + 1}$$

$$R_x = 5 \Omega$$

$$P = \left(\frac{6}{6} \right)^2 2 \times 5 = 5 \text{ W.}$$

For 5 A,

$$P = 5^2 \times 5 = 125 \text{ W}$$

For $3 + \sqrt{14}$,

$$P = 227 \text{ W}$$

For $3 - \sqrt{14}$,

$$P = 2.75 \text{ W.}$$

Hence none of the above is correct

1.7. $P = \frac{1}{2} (1 - \cos 2\omega t) = 100 \text{ Hz}$

1.8. Voltage across the capacitor at any time t

$$v_c = V (1 - e^{-t/RC}) \\ = 1 - e^{-t/RC}$$

since $V = 1 \text{ volt}$

$$\therefore \frac{dv_c}{dt} = \frac{1}{RC} e^{-t/RC}$$

At $t = 0^+, \quad \frac{dv_c}{dt} = \frac{1}{RC}$

1.9. $R = \frac{8}{4 \times 10^{-3}} = 2000 \Omega.$

$$\text{Time constant} = \frac{L}{R} = \frac{6 \times 10^{-3}}{2 \times 10^3} = 3 \mu \text{ sec.}$$