GATE - 2009

Answer Keys

1	D	**2**	A	**3**		**4**	A	**5**	A	**6**	A	**7**	B
8	D	**9**	D	**10**	D	**11**	D	**12**	C	**13**	D	**14**	C
15	C	**16**	B	**17**	B	**18**	A	**19**	C	**20**	A	**21**	C
22		**23**	C	**24**	B	**25**		**26**		**27**	C	**28**	D
29		**30**		**31**	D	**32**		**33**	B	**34**	A	**35**	B
36	A	**37**	B	**38**	A	**39**	D	**40**	C	**41**	C	**42**	B
43	B	**44**	A	**45**		**46**	C	**47**		**48**		**49**	
50		**51**	D	**52**	B	**53**	A	**54**	C	**55**	A	**56**	
57	D	**58**	D	**59**	C	**60**	A						

1. (D)

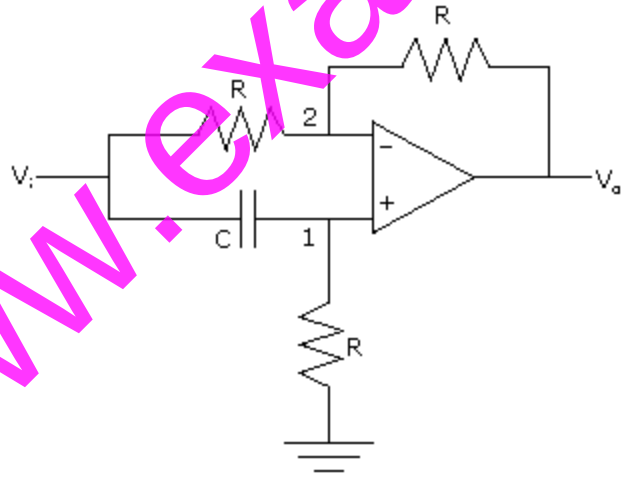
$$\left|e^{j(x+jy)}\right| = \left|e^{-y+jx}\right| = e^{-y}\left|e^{jx}\right| = e^{-y}\left[\left|\cos x + j\sin x\right|\right] = e^{-y}$$

4. (A)

$$\frac{x}{\sqrt{x^2+y^2+z^2}}, \frac{y}{\sqrt{x^2+y^2+z^2}}, \frac{z}{\sqrt{x^2+y^2+z^2}} \Rightarrow (x, y, z)$$

Given r=1, ∴

6. (A)



$$V_+ = \left[\frac{sCR}{1+sCR}\right]V_i$$

$$V_- = V_+$$

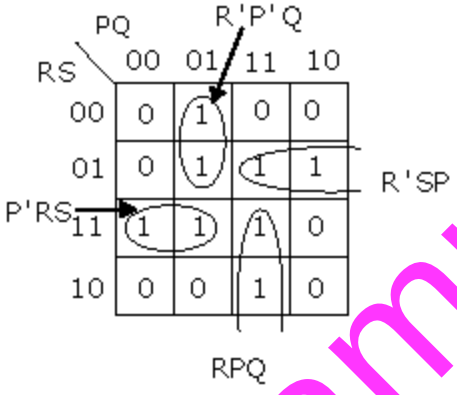
$$\frac{V_i - \frac{sCRV_i}{1+sCR}}{R} = \frac{\frac{sCR}{1+sCR}V_i - V_o}{R} \Rightarrow \frac{V_o}{V_i} = \frac{sCR-1}{sCR+1}$$

gain = 1, Hence it is APF

7. (B)

It is an AND gate

8. (D)



9. (C)

JK	Q(t+1)
00	Q(t)
01	0
10	1
11	$\overline{Q(t)}$

10. (C)

$(1.375)_{10} = (1.011)_2$

$0.375 \times 2 = 0.75$

$0.75 \times 2 = 1.5$

$0.5 \times 2 = 1$

12. (C)

For $2\sin(2\pi)$, $T_1 = \frac{2\pi}{2\pi} = 1s$

$3\sin(3\pi t)$, $T_2 = \frac{2\pi}{3\pi} = \frac{2}{3}s$

$LCM\left(1, \frac{2}{3}\right) = 2\,sec$

13. (D)

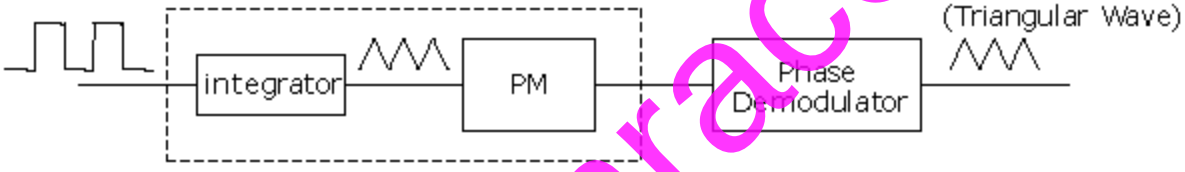
$x(t)=\sin t$

$\omega = 1$

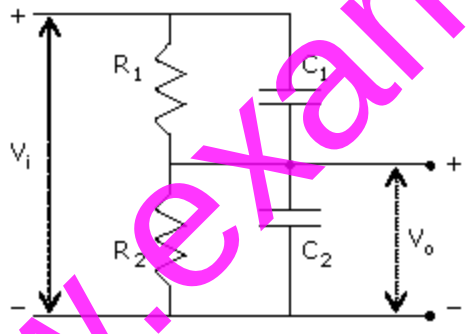
$$\frac{1}{\sqrt{1+\omega^2}} \angle -\tan^{-1}\omega = \frac{1}{\sqrt{2}} \angle (-\pi/4)$$

$$\therefore \text{ output} = \frac{1}{\sqrt{2}} \sin\left(t-(\pi/4)\right)$$

14. (C)



16. (B)



$K = \frac{V_i}{V_o}$; $C_2 = C_1[K-1]$; $R_2 = \frac{R_1}{K-1}$

$K = 10$

$R_2 = 1M\Omega$

$C_2 = 45pF$; $C_1 = \frac{45pF}{9} = 5pF$

17. (B)

$I_{fs} = 1mA;\ R_m = 100\Omega$

$V = 10V$

$V = I_m (R_m + R_s)$

$$R_s = \frac{V}{I_{fs}} - R_m = \frac{10}{1mA} - 100 = 10,000 - 100 = 9.9k\Omega$$

21. (C)

$$\begin{bmatrix} -3 & 0 \\ 0 & -1 \end{bmatrix}$$

Hence eigen values are -3,-1

24. (B)

$x^3 = j = e^{j\pi/2}$

$$x = e^{j\pi/6} = \cos 30 + j\sin 30 = \frac{\sqrt{3}}{2} + j\frac{1}{2}$$

28. (D)

$R_L = 2\Omega$, max power transfer thereon

$p_{max} = 6.125W$

31. (D)

For thermistor,

$$R_{T_1} = R_{T_2} e^{B\left(\frac{1}{T_1} - \frac{1}{T_2}\right)}$$

For P: $\beta = 3000k$, At $T_2 = 298K$, $R_{T_2} = 2k\Omega$

For Q, $\beta = 3000k$, AT $T_2 = 298k$, $R_{T_2} = 2k\Omega$

At $T_1 = 373k$,

$$R_{T_1P} = (2k)e^{4000\left[\frac{1}{373} - \frac{1}{298}\right]} \quad \ldots\ldots\ldots (1)$$

$$R_{T_1Q} = (2k)e^{3000\left[\frac{1}{373} - \frac{1}{298}\right]} \quad \ldots\ldots\ldots (2)$$

$$\frac{\text{Eqn. 1}}{\text{Eqn. 2}} = 0.509$$

33. (B)

By KCL at V_-,

$$\frac{V_i}{1k} = \frac{0 - V_o}{10k} + \frac{0 - [3.2 - V_o]}{10k} \Rightarrow V_o = -6.6V$$

34. (A)

Input resistance $= \frac{V_i}{I}$

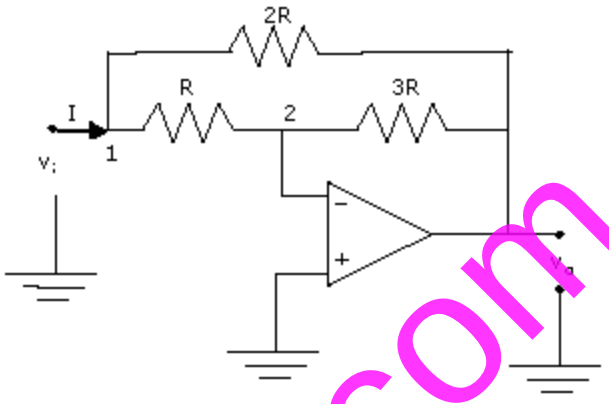
$I = \frac{V_i - 0}{R} + \frac{V_i - V_o}{2R}$ KCL at node 1.

$\frac{V_i - 0}{R} = \frac{0 - V_o}{3R} = \frac{-V_o}{3R}$ KCL at node 2.

$V_o = -3V_i$

$I = \frac{V_i}{R} + \frac{V_i + 3V_i}{2R} = \frac{2V_i}{R} + \frac{V_i}{R} = \frac{3V_i}{R}$

$\frac{V_i}{I} = R/3$



35. (B)

It is a limited circuit

It makes a transition from +5V to -5V.

$30\left(1 - e^{-t/RC}\right) = 5 \times \frac{4.7}{9.4}$ = Voltage across bottom 4.7kΩ

$= V_+$

$R = 10k\Omega;\ C = 1\mu F;$ $\boxed{t = 8.7m\ sec}$

38. (A)

XRAA → A = 00H

40. (C)

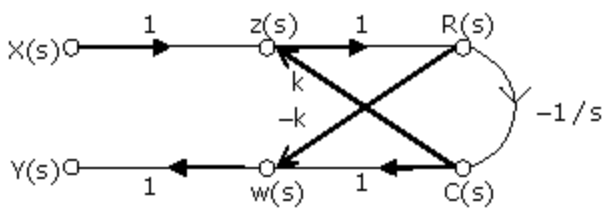
$3 + 2\sin t \cos 2t = 3 + \left[\sin(t + 2t) + \sin(t - 2t)\right]$

$= 3 + \sin 3t - \sin t$

It is of $a + b\sin\theta + c\sin 3\theta$

RMS value $= \sqrt{a^2 + \left(\frac{b}{\sqrt{2}}\right)^2 + \left(\frac{c}{\sqrt{2}}\right)^2} = \sqrt{9 + \left(\frac{1}{\sqrt{2}}\right)^2 + \left(\frac{1}{\sqrt{2}}\right)^2} = \sqrt{10}$

44. (A)



$Z(s) = kC(s) + X(s)$ $\qquad W(s) = C(s) - kR(s)$

$y(s) = W(s)$

$C(s) = \frac{-1}{s}R(s)$

$R(s) = Z(s)$

$$\therefore y(s) = c(s) - kz(s)$$

$$= \frac{-1}{s} C(s) - kZ(s)$$

$$= -\left[\frac{1+ks}{s}\right] Z(s) = X(s)$$

$$Z(s) = k\left(-\frac{1}{s}\right) Z(s) + X(s)$$

$$\left(1+\frac{k}{s}\right) Z(s) = X(s)$$

$$\boxed{\therefore \frac{Y(s)}{X(s)} = \frac{-(1+ks)}{k+s}}$$

46. (B)

Characteristic equation is

$$|sI - F| = 0$$

$$\left|\begin{pmatrix} s & 0 \\ 0 & s \end{pmatrix} - \begin{pmatrix} 0 & 1 \\ -4 & -2 \end{pmatrix}\right| = \begin{vmatrix} s & -1 \\ 4 & s+2 \end{vmatrix} = s(s+2) + 4 = 0$$

$$= s^2 + 2s + 4 = 0; \quad \boxed{\varepsilon = 0.5}$$