Answer keys

1	A	**2**	B	**3**	C	**4**	C	**5**	D	**6**	A	**7**	D
8	C	**9**	A	**10**	A	**11**	D	**12**	B	**13**	D	**14**	C
15	D	**16**	B	**17**	A	**18**	B	**19**	D	**20**	D	**21**	C
22	C	**23**	A	**24**	B	**25**	B	**26**	B	**27**		**28**	B
29	C	**30**	B	**31**	D	**32**	A	**33**	D	**34**	D	**35**	A
36	D	**37**	C	**38**		**39**	B	**40**	B	**41**	C	**42**	A
43		**44**	B	**45**	B	**46**	B	**47**	B	**48**	C	**49**	B
50	C	**51**	C	**52**	C	**53**		**54**	C	**55**	B	**56**	B
57	B	**58**		**59**		**60**	C	**61**	C	**62**	B	**63**	C
64	A	**65**	A	**66**	C	**67**	C	**68**	C	**69**	B	**70**	A
71		**72**		**73**		**74**		**75**		**76**	C	**77**	
78	B	**79**	C	**80**	C	**81**	B	**82**	D	**83**	C	**84**	D
85	A												

Explanation:-

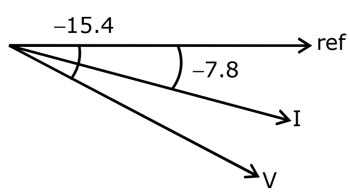
1. $(b - n + 1)$

   $b =$ No of branches
   $n =$ No of nodes

2. $Ith = \frac{Vth}{zth}$

   $= \frac{3.71\angle{-15.9}}{2.4\angle{-8.0}}$

   $= 1.54\angle{-7.8}$



   I lead V so it is a combination of Resistance and capacitance

3. When we apply $e^{-dt}\sin\omega t$ to LTI system O / P is of form $Ke^{-dt}\sin(\omega t + \phi)$,

   so, compare this equation with $Ke^{-\beta t}\sin(\upsilon t + \phi)$ so $\beta = \alpha$,
   $\upsilon = \omega$

4. $\int x^3 dx = \left.\frac{x^4}{4}\right|_0^1 = \frac{1}{4}$

5. It should satisfy the characteristic equation $\lambda^3 + \lambda^2 + 2\lambda + l = 0$

   $\Rightarrow P^3 + P^2 + 2P + 1 = 0 \Rightarrow P\left(P^2 + P + 2I + P^{-1}\right) = 0$

   $P \neq 0$ and $P^2 + P + 2I + P^{-1} = 0 \Rightarrow P^{-1} = -\left(P^2 + P + 2I\right)$

6. Rank is 4, so Q will have four linearly independent columns and four linearly independent rows.

7. $SY(s) + y(s) = 1$

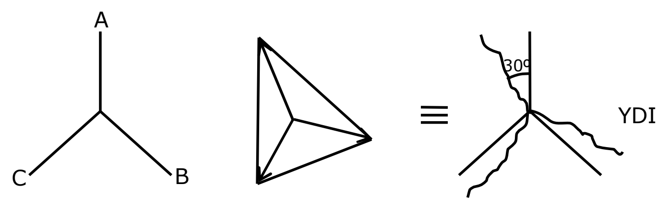
$Y(s) = \frac{1}{s+1}$

$e^{-t}u(t)$

8. Up to 5.7V, the diode is in reverse biased so, $V_0=V_i$ and diode is forward biased after V_i > 5.7 and reaches peak value and comes to again 5.7V, in this output voltage is 5.7V, after that again diode is in reverse bias so $V_0=V_i$

11. Theory bit

12.



13. It is a predefined statement

15. $\ell = 200\text{km}$

$\beta = 0.00127\text{radias per km}$

$\lambda = \frac{2\pi}{\beta} = \frac{2\pi}{0.00127} = 4947.39\text{km}$

$\frac{\ell}{\lambda} = \frac{300}{4947.39} = 6.06\%$

16. $Z_P = Zs - Zm$ $\quad 48 = Zs - zm$

$Z_o = Zs + 2Zm$ $\quad 15 = Zs + 2zm$

$Zs = 26\Omega$

$Zm = 11\Omega$

17. $\phi = Tan^{-}\left(\frac{X_2}{R}\right) = Tan^{-1}\left(\frac{50}{50}\right) = 45^o$

$\therefore$ Below 45º of firing angle the out put voltage V_0 is not controlable

18. Line voltage is free from triplex harmonics

19. Linear system holds superposition theorem
Causal system means h(t) = 0 for t < 0

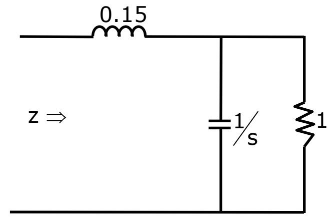
20. In O.C. test pf is low, so we use low pf meters and In S.C. test pf is high, so we use high pf meters.

$$\left(\text{S.C.Test test } \frac{2kVA}{230v} = 8.69A. \text{ so we use } 10A\text{meter}\right)$$

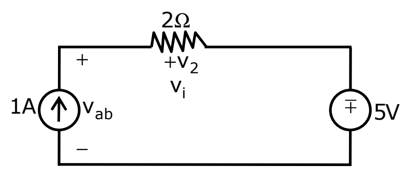
21. $R = 6, C = \frac{2\times1}{2+1} = \frac{2}{3}, \tau = RC = \frac{6\times2}{3} = 4$

22. $Z = (0.1s) + \left(1/\frac{1}{s}\right)$

equating imaginary pout to zero
$\omega = 3\text{rad}/\text{sec}$



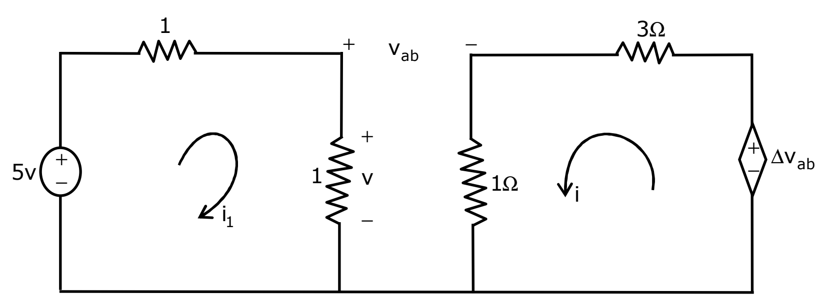
23. $i = 1A$
$v_2 = 1\times2 = 2v$
$-v_{ab} + v_2 - 5 = 0$
$v_{ab} = 2.5 = -3v$



24. $C = \frac{\epsilon_0 A}{d}, C = \frac{\epsilon_0 A}{\frac{d_1}{\epsilon_1} + \frac{d_2}{\epsilon_2}} = \frac{8.85\times10^{-12}\times500\times500\times10^{-6}}{\frac{4\times10^{-3}}{8} + \frac{2\times10^{-3}}{2}} = 1475PF$

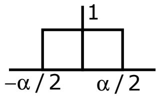
25. $L = \frac{N^2\mu_0\mu_r A}{\ell} \Rightarrow \frac{(300)^2\times\mu_0\times\mu_r\times\left(300\times10^{-3}\right)^2}{300\times10^{-3}} \because \ell = 0.3m$

26. $-5 + 2i_1 = 0$
$i_1 = 2.5$
$v = 2.5\text{volt}$
$-2.5 + v_{ab} + i = 0$
$v_{ab} + i_1 = 2.5$
$-4v_{ab} + 3i + i = 0$
$i = v_{ab}$
$i + 1 = 2.5$
$i = \frac{2.5}{2} = 1.25$

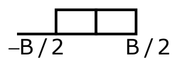


28. Hint: (i) Apply shifting, (ii) scaling and (iii) Time reversal

29. Non-causal because the signal is defined for t<0 also time invariant since y(n-k) = [x(n-K)] where $x(n) \rightarrow y(n)$

30. $\sin c\alpha t$ 

convolution in time dmin is ( ) in frequency

$\sin c\, Bt$ 

so it will be $\max(\alpha, B)$

32. $(1+j)^n \rightarrow$ $\boxed{H(z)}$ $\rightarrow$ $y(z) = x(z)H(z)$

$x(z)$ $y(n) = $

$\frac{z}{z-(1+j)}_{\{|z|>1|1+j|\}}$

$\because O/P$ is zero for $x(n) = (1+j)^n$ and the z. Transform of $x(n) = \frac{z}{z_1 - (1+j)}$

The ROC of $\left(1 - \frac{1}{2}z^{-1}\right)H(z)$

implies it has 1 pole and 1 zero

33. $\text{Re sides of } z^P.\times(z) = \frac{1}{(n-1)!}\frac{d^n}{dz^{n-1}} z^P \times (z)^{(z-a)^n}\Big|_{z=a}$ where

$(z-a)^n$ at $(z=a)$ $\quad$ n = order of pole

given problem

$$n = 2_{\text{Re sides}}\left(z^{n-1}\times(z)\right) = \frac{1}{(2-1)!}\frac{d}{dz}\left(z^{n-1}\times(z)\right)/z = a$$

$$= \frac{1}{1!}\frac{d}{dz}\left(z^{n-1}\right)\frac{z}{(z-a)^2}(2-a)^2$$

$$= \frac{d}{dz}\left(z^n\right)\Big|_{z=a} = nz^{n-1}\Big|_{z=a} = na^{n-1}$$

34. $f(x) = \left(x^2 - 4\right)^2$

$f^1(x) = 2\left(x^2-4\right).2x$

$f^1(x) = 0 \Rightarrow 4x\left(x^2-4\right) = 0, \Rightarrow x = 0, 2, -2$

$f^{11}(x) = 12x^2 - 16$

$x = 0 \quad f^{11} = -16 \rightarrow \max$

$x = -z \; f^{11} = -64 \rightarrow \max$

$x = z \quad f^{11} = 0 \quad f^{111} = 24x$

$x = z \quad f^{111} = 24 \times 2 = 48 \rightarrow \max$

35. $x_{n+1} = x_n - \frac{f(x_n)}{f^1(x_n)}$ $\quad f(x_n) = e^{x_n} - 1$

$x_1 = x_0 - \frac{f(x_0)}{f^1(x_0)}$ $\quad f^1(x_n) = e^{x_n} = -1 - \frac{e^{-1}}{e^{-1}} = 0.71828$

36. $A^+ = \left(A^TA\right)^{-1} A^T = A^{-1}\left(A^T\right)^{-1}\left(A^T\right) = A^{-1}$

A by checking options

$AA^+A = AA^{-1}A = A \therefore AA^+A \neq A^+$

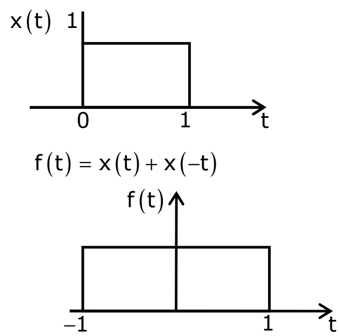
37. $x = \frac{h}{2}\left[y_0 + 2y_2\right]$

39. $F(s) = \int_{-\alpha}^{\alpha} f(t)e^{ist}dt$

$= \int_{-1}^{1}(1)e^{ist}dt$

$= 2\sin cs$

$= 2\sin c\left(\frac{\omega}{2\pi}\right)$

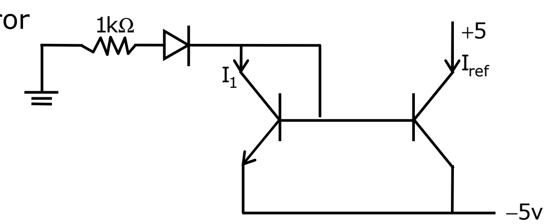


40. The both transfer for a cont mirror

$S_0 \quad I_1 = I_{ref}$

$I_1 = \frac{0 - 0.7 - 0.7 + 5}{1}$

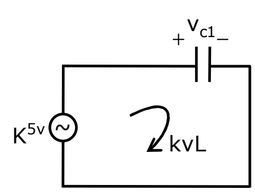
$= 3.6mA$

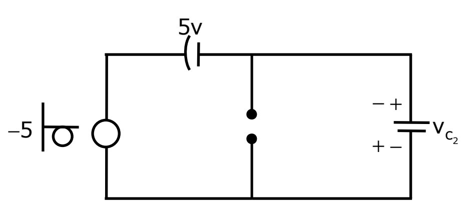


41. $v_1\left(0^-\right) = v_1(0t) = 0v$

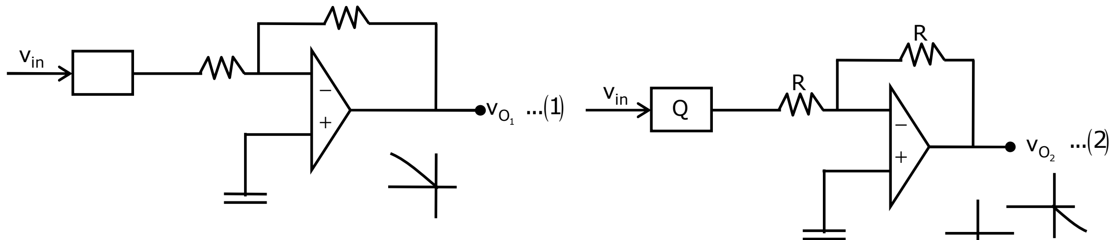
at the half cycle after $t = 0$

at $-v_c$ half cycle $v_{c_1} = 5v$





42. Combine two waveforms

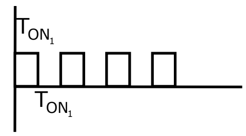


(1) + (2) So (A) is Answer

44. Here monoshot o/p's Q_1 and Q_2 has pulse widths of T_{ON_1} and T_{0N_2}.

So, when triggered according to truth table given Q_1 responds to T_{0N_2} and Q_2 for T_{ON_1} and waveform will be

$$f = \left(\frac{1}{T_{0N_1} + T_{0N_2}}\right), \text{Duty cycle} = \left(\frac{T_{0N_2}}{T_{0N_1} + T_{0N_2}}\right)$$



45. DAD SP

PCHL

After first instruction HL − 2700H

PCHL HL contes exchanged with PC

so, PC = 2700 Sp = 2700

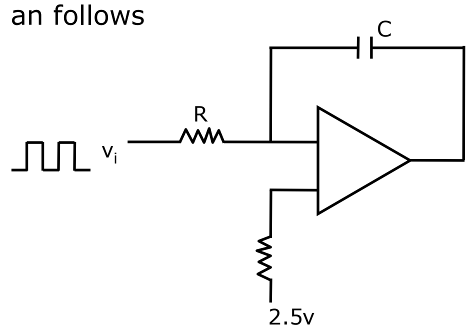
46. The first op-amp is a square wave generator and now after adjusting voltage at +ve terminal to 2.5v the second op-amp an follows

Now

$$\frac{v_i - 2.5}{R} = e\frac{d(2.5 - v_0)}{at}$$

$$\frac{1}{RC}\int v_i - 2.5 = 2.5 - V_o$$

so triangle wave shifts upward



47. $S = \frac{1500 - 1425}{1500} = 0.05$, effective rotor resistance $= \frac{7.8}{2 - 0.05}\left(\because \frac{7.8}{2 - S}\right)$

48. Hint: core losses 1200w are also considered

49. Hint: $E_{rs} = -N_2 \frac{d\theta}{dt}$; t = 0 to 1 the o/p voltage is – ve and constant value
t = 1 to 2 the o/p voltage is zero
t = 2 to 2.5 the o/p voltage is + ve and constant

50. Direct

51. $$\frac{SIL_1}{SIL_2} = \frac{\frac{v^2}{\sqrt{\frac{L_1}{C_1}}}}{\frac{v^2}{\sqrt{\frac{L_2}{C_2}}}} = \frac{\sqrt{\frac{L_2}{C_2}}}{\sqrt{\frac{L_1}{C_1}}} = \frac{\sqrt{\frac{(1-0.3)L}{C}}}{\frac{L}{C}} = \sqrt{0.7},\ SIL_2 = \frac{SIL_1}{\sqrt{0.7}}$$

52. $$\frac{dC_1}{dP_{G_1}} = \frac{dC_2}{dP_{G_2}}$$

$1 + 0.11\,P_{G_1} = 30.06\,P_{G_2}$ ......(1)

$P_{G_1} + P_{G_2} = 250$ ......(2)

solve (1) & (2)

54. Remove e_4 then loss $= (5)^2 z + (3)^2 z + (2)^2 z = 25 + 9 + 4 = 36z$

e_3 then loss z $111^2 z + (7)^2 z + (2)^2 z = 1 + 49 + 4 = 54z$

So, if we remove C_3 then system will operate with minimum loss.

55. Hint : $Pf = \frac{2\sqrt{2}}{\pi}\omega\varepsilon\alpha$

57. $E_{b_1} = 220 - (2.5 \times 20) = 170$

$$\frac{E_{b_1}}{E_{b_2}} = \frac{1000}{600}$$

$$E_{b_2} = \frac{600}{1000} \times 170 = 102$$

$V = 102 + 50 = 152$

duty cycle $= \frac{152}{250} = 0.608$

60. $\frac{T_{st}}{T_{max}} = \frac{2a}{1+a^2}$

$1 = \frac{2 \times a}{1+a^2} \Leftrightarrow a = 1$

$\frac{R_2}{x_2} = \frac{1}{1.5} = 0.666$

$V = 0.66 \times 400 = 266.6V$

$\text{frequency} = sf = 0.666 \times 50 = 33.3Hz$

61. $\frac{2V_m}{\pi}\cos\alpha = -130 \Leftrightarrow \alpha = 129^o$

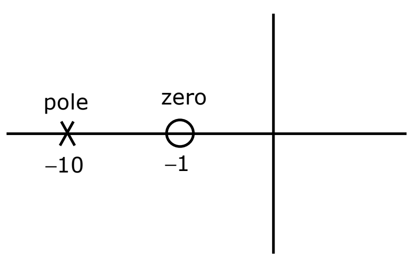
62. $T_{WD} = \sqrt{\frac{\pi^2}{9} - 9} = 0.31 = (31\%)$, Rms value $= \frac{2 \times 10 \times \sqrt{3}}{\sqrt{2} \times \pi} = 7.8$

63. $V_0 = V_s \times \frac{1}{(1-0.5)} = \frac{20}{0.5} = 40V$, since poweris constant $20 \times 4 = 40 \times I_d$, $I_d = 2A$

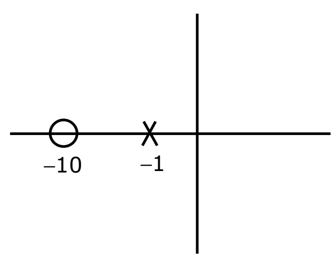
64. $\frac{C(S)}{R(S)} = G(S) \qquad R(S) = 1$

$\underset{x \to \infty}{Lt}\, C(t) = \underset{s \to 0}{Lt}\, SC(t)$

65. $C_1 = \frac{10(S+1)}{(S+10)} \qquad C_2 = \frac{S+10}{10(S+1)}$



lead compensator



lag compensator

66. At starting the stop is -40dB/decode $\therefore$ At starting we have 2 poles and in next portion the stop is changes from -40dB/decode to -20dB/decode (i.e. we have one zero and next portion the stop is changes from (-20dB/decode to 0 dB/decode)(i.e. one zero)

$\therefore$ Total we have 2 poles and 2 zeros.

67. $$\frac{C(S)}{R(S)} = \frac{\dfrac{K}{S(S+3)(S+10)}}{1+\dfrac{K}{S(S+3)(S+10)}} = \frac{K}{\left(S^2+3S\right)(S+10)+K} = \frac{K}{S^3+13S^2+30S+K}$$

C.E $S^3+13S^2+30S+K=0$

$1\times K = 30\times 13 = 390$

$0 < K < 390$

68. $$\frac{C(S)}{R(S)} = \frac{\omega_n{}^2}{S^2+2\xi\omega_n s+\omega_n{}^2}$$

$\omega_n = 10 \quad 2\xi\omega_n = 20$

$\xi = 1$ so critical damped

69. $$\frac{fy}{fx} = \frac{\text{No. of horizontol tangencies}}{\text{No. of vertical tangencies}},\ fx = \omega,\ fy = \frac{\omega}{2}$$

70. $(z = 500) = Z_{BC}\times Z_{AD}$

76. Area upto 5sec i.e. $A_1+A_2+A_3 = \left(\frac{1}{2}\times 2\times 4\right)+\left(\frac{1}{2}\times 3\times 2\right)+(3\times 2) = 13GC,\left(\because i = \frac{dq}{dt}\quad q=\int idt\right)$

78. $T.F = C(SI-A)^{-1}B+D$

79. $e_{ss} = \frac{1}{K}$

80. Hint : $$\frac{V_0}{V_i} = \frac{SC}{SC+\dfrac{1}{R_A}}\text{ put } SC = J\omega$$

$$\left|\frac{V_0}{V_i}\right| = \frac{\omega C}{\sqrt{\left(\dfrac{1}{R_A}\right)^2+\omega^2C^2}} = \frac{1}{\sqrt{1+\dfrac{1}{\left(\omega^2CR_A\right)}}}$$

$\omega\to 0\ \left|\frac{V_0}{V_i}\right| = 0,\ \omega\to\infty\ \left|\frac{V_0}{V_i}\right| = 1$ so high pass filter.

81. From the given circuit

82. $I = I_{sh} + I_a$

$15 = \frac{240}{80} + I_a$

$I_a = 12A$

At plugging the net voltage across armature resistance is =V+E_b

$E_b = 2400 - 12 \times 0.5 = 234 = 240 + 234 = 474v$

83. $Ia_2 = 1.25 \times I_a = 1.25 \times 12 = 15A, R = \frac{234}{15} - 0.5 = 15.1\Omega$

84. $V = E + I_a\ x_s$

$v = 1\underline{|0}$

$I_a = 0.6\underline{|0}$

$x_s = 1\underline{|90}$

$1\underline{|0} = E + 0.6\underline{|0}1\underline{|90}$

$E_f = 1 - j0.6 = 1.17\underline{|-30.96}$

$= 1.17,\ 30.96$ lag

85. $I_a = 1.2Ia_1 = 1.2 \times 0.6 = 0.72$

$(Ia_2x_s)^2 = E_f^{\ 2} + U_t^{\ 2} - 2E_fV_t \cos\delta$

$(0.72 \times 1)^2 = 1.17^2 + 1^2 - 2 \times 1.17 \times 1 \times \cos\delta$

$\cos\delta = 0.79 \Rightarrow \delta = 37.73$

$\sin\delta = 0.6120$

$\frac{E_f v_t}{x_s} \sin\delta = v_t Ia_2 \cos\theta \Rightarrow \cos\theta = 0.994$

$E_f \cos\delta = 1.17x0.79 = 0.924$

$E_f \cos\delta < V$, hence PF is 0.994 lagging