Answer Keys

1	C	**2**	B	**3**	A	**4**	B	**5**	C	**6**	A	**7**	B
8	D	**9**	C	**10**	C	**11**	C	**12**	B	**13**	B	**14**	A
15	A	**16**	C	**17**	B	**18**	5.56	**19**	0.16	**20**	30	**21**	0.3
22	-0.25	**23**	D	**24**	D	**25**	B	**26**	B	**27**	A	**28**	B
29	A	**30**	C	**31**	B	**32**	D	**33**	D	**34**	A	**35**	A
36	10	**37**	2.828	**38**	360	**39**	99.8	**40**	C	**41**	D	**42**	B
43	A	**44**	B	**45**	D	**46**	1.142	**47**	0.125	**48**	628	**49**	0.0209
50	0.095	**51**	435	**52**	D	**53**	C	**54**	D	**55**	B	**56**	C
57	C	**58**	D	**59**	B	**60**	C	**61**	D	**62**	C	**63**	C
64	A	**65**	A										

Explanations:-

2. -Power transformer(s) are found at generating stations.
-A very important feature of distribution transformer is all-day efficiency.
-Pulse transformer is used for thyristor firing.
-Isolation transformer generally has turns ratio 1 :1.

3. $r_2 = 0.018\,\Omega\,/\,ph$

$x_2 = 0.08\,\Omega\,/\,ph$

$S_{fl} = 0.04$

$N_r = N_S(1-s) = 0.96\,N_S$

at halffull load speed, $\frac{N_r}{2} = 0.48\,N_S = N_S(1-s) \rightarrow s = 0.52$

$$T_{efl} = \left(\frac{3V^2}{\omega s}\right)\frac{1}{\left[\left(\frac{r_2}{s}\right)+x_2^2\right]}\left(\frac{r_2}{s}\right)$$

$$\left[V_1^2\right]\left[\frac{1}{\left(\frac{0.018}{0.04}\right)^2+(0.08)^2}\right]\frac{0.018}{0.4} = V_2^2\,\frac{1}{\left[\left(\frac{0.018}{0.52}\right)^2+(0.08)^2\right]}\,\frac{0.018}{0.52}$$

$2.154V_1^2 = 4.55V_2^2$

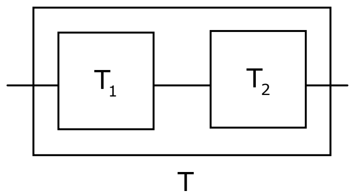
$1.466V_1 = 2.13\,V_2$

$\frac{V_1}{V_2} = 1.4526; \frac{V_2}{V_1} = 0.688$

$$\%\text{ reduction} = \frac{V_1 - V_2}{V_1} = 1 - \frac{V_2}{V_1} = 1 - 0.688 = 31.15\%$$

4. $L_{eq} = 4 + 8 + 6 - (2 \times 2) + (2 \times 4) = 22H$

6. $T_1 = \begin{bmatrix} A & B \\ C & D \end{bmatrix}$; $T_2 = \begin{bmatrix} A & B \\ C & D \end{bmatrix}$



$$T = \begin{bmatrix} A & B \\ C & D \end{bmatrix} \begin{bmatrix} A & B \\ C & D \end{bmatrix} = T_1 T_2$$

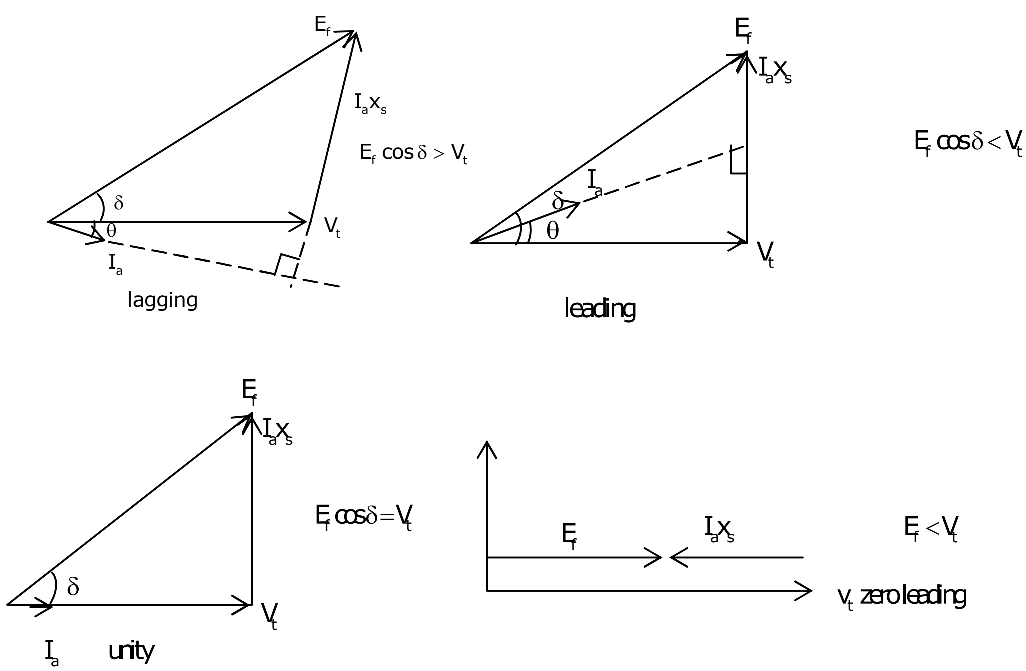
8. Error = 0 as simpon's rule gives exact value for polynomials whose degree ≤ 3

9. $f(z) = \dfrac{z - \sin z}{z^2} = \dfrac{z}{3!} - \dfrac{z^3}{5!} + \ldots\ldots$

$\therefore$ Residue of $f(z)$ at $z = 0$ is 0

$$\therefore \oint_c \frac{z - \sin z}{z^2}\, dz = 0$$

10. The phasor diagrm for alternator



11. $m = 5_{gm} = 0.005kg;\ E_g = mc^2 = 0.005 \times \left(3 \times 10^2\right)^2$

$E = 4.5 \times 10^{14}$ joules or watt – sec

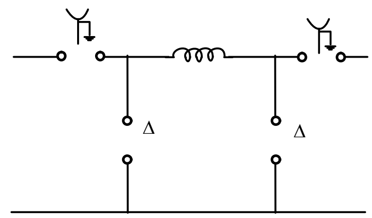
$= \dfrac{4.5 \times 10^4}{1000 \times 3600} = 12.5 \times 10^7\ \text{kWh}$

12. The zero sequence Network of Transformer representation

 Means connect →series

Y means opened series

Δ means closed →shunt



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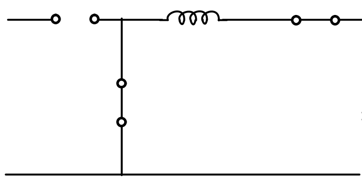


⇒ Δ / 

13. $X(s) = \dfrac{4}{(s+2)(s+4)} = \dfrac{2}{s+2} - \dfrac{2}{s+4} \Rightarrow$ Poles s=-2, -4

Given that ROC lies between lines passing through s=-2 and s=-4.
Hence x(t) will be two sided signal.

$\therefore\ x(t) = -2e^{-2t}.u(-t) - 2e^{-4t}u(t)$

at pole s=-2, $\text{Re}[s] < -2\ \Rightarrow$ Left side

at pole s= – 4 $\text{Re}[s] > -4 \Rightarrow$ Right side

14. $V_o = V \sin \omega t$

$\dfrac{dv_o}{dt} = V\omega \cos \omega t$

$\text{maximum output} = V\omega = 10 \times 10^6$

$V = \dfrac{10 \times 10^6}{2 \times \pi \times 2 \times 10^6} = 0.8V$

15. The closest scale marking w.r.t to the measured length is chosen. Here it is 231 cm (L).

Now with absolute certainty we can say that $L \pm 0.1$ cm. since 0.1 cm is the smallest measurement quantity in this scale.

16. P [neither selected] = $\left(1 - \dfrac{8}{9}\right)\left(1 - \dfrac{5}{8}\right) = \dfrac{1}{24}$

17. We know that

$$M = \frac{SH}{\pi f} \Rightarrow H \ \alpha \ \frac{1}{s}$$

$$\frac{H_{old}}{H_{new}} = \frac{S_{new}}{S_{old}}$$

Machine – 1

$$\frac{5}{H_{new}} = \frac{100}{400}$$

$$H_{new} = 20 \text{ MJ/MVA}$$

Machine – 2

$$\frac{5}{H_{new}} = \frac{100}{200}$$

$$H_{2\ new} = 10 \text{ MJ/MVA}$$

$$\therefore H_{eq} = 20 + 10 = 30 \text{ MJ / MVA}$$

18. $\phi_2 = 0.95\phi_1, \quad E_1 = V_t,$

$$E_2 = V_t - 0.1V_t = 0.9V_t$$

$$\frac{E_1}{E_2} = \frac{\phi_1\ \omega_1}{\phi_2\ \omega_2} \Rightarrow \frac{1}{0.9} = \frac{1}{0.95} \times \frac{\omega_1}{\omega_2}$$

$$\Rightarrow \frac{\omega_1}{\omega_2} = \frac{0.95}{0.9} \Rightarrow \frac{\omega_1 - \omega_2}{\omega_2} = \frac{0.05}{0.9}$$

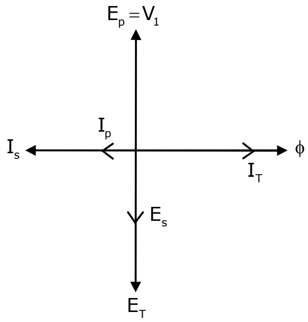
$\Rightarrow$ speed regulation = 5.56%

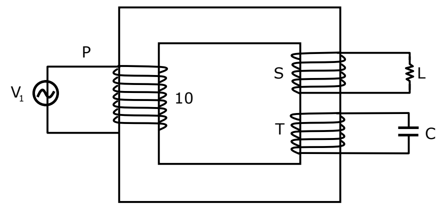
19. $w_n = \sqrt{25} = 5\text{rad / sec}; \ 2\xi w_n = 4 \Rightarrow \xi = \frac{4}{10} = 0.4$

Damping ratio with derivative feedback control is $\xi' = \xi + \frac{w_n k_t}{2}$

$$0.8 = 0.4 + \frac{5.k_t}{2} \Rightarrow k_t = 0.16$$

20. Neglecting the magnetizing and loss components (as it is ideal transformer) the phasor diagram is





E_s = induced voltage in secondary

E_T = induced in tertiary

I_s will lag E_s by $90°$ (load induction)

I_T will lead E_T by $90°$ (load capacitive)

Secondary AT $= 10 \times 50 = 500$ AT

Tertiary AT $= 20 \times 40 = 800$ AT

Resultant load mmf $= (800 - 500)$ AT $= 300$ AT

As the primary should neutralize load mmf so primary current $= \frac{300}{10} = 30A$

21. Overall $\eta = \frac{\text{Electrical o / p in heat units}}{\text{Heat of combustion}} = 28.66\%$

Heat equal of 1 kWh = 860 Kcal.

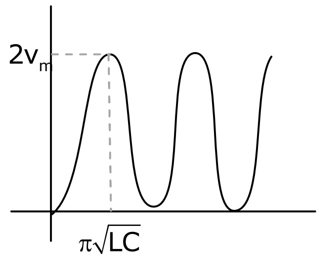
$\therefore$ Heat of combustion $= \frac{860}{0.2866} = 3000.69 \simeq 3000\,\text{Kcal}$

$\therefore$ Fuel consumption $= \frac{\text{Heat produced}}{\text{calorific value}} = \frac{3000}{10000} = 0.3\,\text{kg / kWh}$

22. $X(z) = \left(\frac{0.5}{1 - 2z^{-1}}\right) z^{-1}$; ROC includes unit circle $\Rightarrow$ Left handed system

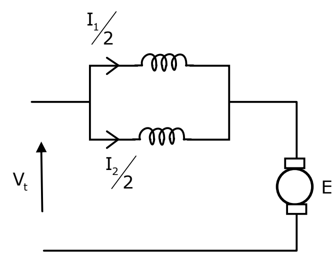
$X(n) = -0.5(2)^{n-1} u(-n);\ X(0) = -\frac{1}{4} = -0.25$

23. Restriking Voltage $v(t) = V\left(1-\cos\frac{t}{\sqrt{LC}}\right)$



$\therefore$ Peak value $= 2V_m$; Time $= \pi\sqrt{LC}$ sec

24. $\phi_1 = K\frac{I_1}{2} + K\frac{I_1}{2} = KI_1$



$\phi_2 = KI_2 + KI_2 = 2KI_2$

$T_{e1} = K_a\phi_1 I_1$; $T_{e2} = K_a\,\phi_2 I_2$

$T_{e1} = T_{e2}\ \therefore\ \frac{\phi_1}{\phi_2} = \frac{I_1}{2I_2} = \frac{\sqrt{2}}{2} = \frac{1}{\sqrt{2}}$

$\Rightarrow KI_1^2 = 2KI_2^2$

$\Rightarrow I_1 = \sqrt{2}\ I_2$

$\frac{E_1}{E_2} = \frac{\phi_1\omega_1}{\phi_2\omega_2} \Rightarrow 1 = \frac{1.\omega_1}{\sqrt{2}.\omega_2} \Rightarrow \omega_2 = \frac{\omega_1}{\sqrt{2}}$

25. Since, A is real involutary matrix

$\therefore A^{-1}$ exists

$\therefore$ The equations have unique solution.

26. The power delivered to the load is $= 20 \times 0.8$ kW $=$ 16kW

The transformation ratio of auto transformer $k = \frac{200}{250} = \frac{4}{5}$

We know inductionally delivered power = (1-k) x total power delivered

=3.2kW

Conductionally delivered power = k x total power delivered

= 12.8kW

27. Annual fixed charges $= 95\times10^5 \times 10\% = 9.5\times10^5$

Total running charges $= \left(9\times10^5 + 6\times10^5\right) = 15\times10^5$

Total annual cost $= \left(9.5\times10^5 + 15\times10^5\right) = 24.5\times10^5$

$$\text{Annual load factor} = \frac{\text{No. of units delivered}}{\text{max.demand}\times 8760}$$

$$\therefore \text{No.of units delivered} = 0.5\times 40000\times 8760 = 17.52\times10^7$$

$$\therefore \text{cost per unit} = \frac{\text{Total annual cost}}{\text{No.of units delivered}} = \frac{24.5\times10^5}{17.52\times10^7}\times100 = 1.398 \text{ paise}$$

28. Poles f(z)=tanz are given by $z=(2n+1)\frac{\pi}{2}$, n is integer and each (simple pole) denoted by 'a'.

$$\therefore \operatorname{Res} f(z) = \frac{\sin a}{-\sin a} = -1$$
$$z = a$$

29. Necessary condition for the system to be linear is if $x(t)=0 \Rightarrow y(t=0)$ but in $y(t)=2x(t)+4.5$ above condition is not satisfied . Hence the system is non-linear.

30. Slots per pole per phase q=3
Slots per pole = 3×3=9

So slot pitch $\gamma = \frac{180^\circ}{9} = 20^\circ$

coil span $= 8\times20^\circ = 160^\circ$

Coil is short pitched by 20°

distribution factor

$$K_d = \frac{\sin\frac{q\gamma}{2}}{q\sin\frac{\gamma}{2}} = \frac{\sin\frac{3\times20^\circ}{2}}{3\sin\frac{20^\circ}{2}} = 0.959$$

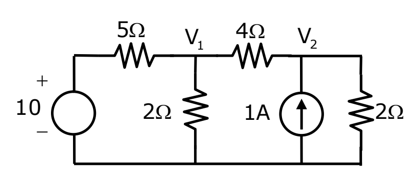
pitch factor $k_p = \cos\frac{\varepsilon}{2} = \cos\frac{20^\circ}{2} = 0.98$

windng factor $k_w = k_d.k_p = 0.94$

31. Applying KCL at V_1 and V_2

$$\frac{V_1-10}{5}+\frac{V_1}{2}+\frac{V_1-V_2}{4} = 0 \qquad ....1$$

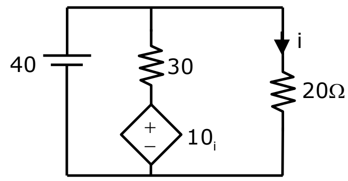
$$\frac{V_2-V_1}{4}+\frac{V_2}{2} = 1 \qquad ....2$$



By solving (1) and (2), we will get

$V_1 = 2.7V$, $V_2 = 2.23V$

32. $t = 0^{-} \quad \therefore i(0) = \frac{40}{20} = 2A$



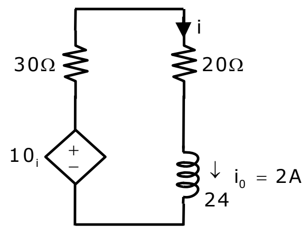
at $t = 0^{+}$ the circuit becomes

$10\, i(t) = 30i(t) + 20i(t) + 2\frac{di}{dt}$

$2\frac{di}{dt} + 40\, i(t) = 0$

$i(t) = k\, e^{-20t}$

$i(t) = 2e^{-20t} \quad i(0) = 2A$



33. Time period $T = t_{on} + t_{off} = (1+1.5) = 2.5$msec, Duty cycle $\alpha = \frac{T_{on}}{T} = \frac{1}{2.5} = 0.4$

Form-factor (FF) $= \frac{\text{RMS Value}}{\text{Average Value}} = \frac{\sqrt{\alpha}.E_{dc}}{\alpha.E_{dc}} = \frac{1}{\sqrt{\alpha}} = \frac{1}{\sqrt{0.4}} = 1.58$

Ripple factor (RF) $= \sqrt{(FF)^2 - 1} = \sqrt{\frac{1}{\alpha} - 1} = \sqrt{\frac{1-\alpha}{\alpha}} = \sqrt{\frac{1-0.4}{0.4}} = 1.23$

34. Using Green's theorem,

$\oint xdy - ydx = 2 \times \text{area of the ellipse } 3x^2 + 2y^2 = 1 = \sqrt{\frac{2}{3}}\, \pi$

35. $2y\frac{dx}{dy} = 2 - x \;\Rightarrow\; \frac{dx}{dy} + \frac{1}{2y}x = \frac{1}{y}$ is a linear equation

$\text{I.F} = e^{\int \frac{1}{2y}dy} = \sqrt{y} \;\therefore \text{solution is } x.\sqrt{y} = \int \frac{1}{y}\sqrt{y}dy + c$

$= 2\sqrt{y} + c$ ....(1), passing through (0,1) gives $c = -2 \;\therefore x\sqrt{y} = 2\sqrt{y} - 2$

36. 10 – bit Ring counter ≡ Mod – 10 counter

4 – bit parallel counter ≡ Mod – 16 counter

Mod – 25 Ripple counter ≡ Mod – 25 counter

4 – bit Johnson counter ≡ Mod – 8 counter

$\therefore x_1 = 320\,KHz / 10 = 32\ KHz;\ \ x_2 = 32/16 = 2\,KHz$

$x_3 = 2\,KHz/25 = 80Hz;\ x_4 = 80Hz/8 = 10\,Hz$

37. $T(s) = \frac{C(s)}{R(s)} = \frac{16}{16 + s(s+4)}$;

$$T(J\omega) = \frac{16}{16 - \omega^2 + 4J\omega} = \frac{16}{\sqrt{(16-\omega^2)^2 + (4\omega)^2}} \angle -\tan^{-1}\left(\frac{4\omega}{16-\omega^2}\right)$$

$$\frac{d}{d\omega}\sqrt{(16-\omega^2)^2 + (4\omega)^2} = 0 \Rightarrow \frac{d}{d\omega}\sqrt{\omega^4 - 16\omega^2 + 256} = 0$$

$$4\omega^3 - 32\omega = 0 \to \omega = \sqrt{8} = 2\sqrt{2}rad/sec = 2.828rad/sec$$

38. For Inductor $Q_{sh} = \frac{V^2}{\omega L_{Ph}}$

$$\therefore Q_{sh}\ \alpha\ V^2$$

$$\frac{Q_{sh1}}{Q_{sh2}} = \left(\frac{V_1}{V_2}\right)^2 = \frac{50}{40.5} = \left(\frac{400/\sqrt{3}}{V_2/Ph}\right)^2$$

$$\Rightarrow \frac{V_2}{ph} = 207.84\,kV;\ V_2 = \sqrt{3} \times 207.8 = 360kV$$

39. voltmeter resistance

$R_v = V_{FSD} \times \text{sensitivity} = 10 \times 10 = 100\,\Omega$

$R_m = 0.2\,\Omega$

$R_s = 100 - 0.2 = 99.8\,\Omega$

40. The pole zero pattern given in the figure is an all pass filter

41. $k_a.\frac{d\phi}{dt} = c(t)$ Taking Laplace transform $E(s) = k_a s\phi(s) \Rightarrow \frac{E(s)}{\phi(s)} = k_a.s$

42. $p = \frac{1}{100}, n = 15 \text{ and } \lambda = \frac{15}{100} = 0.15$

$P[\text{atmost one defective tyre}] = P(X = 0) + P(X = 1)$

$= e^{-0.15}(1 + 0.15)$ (using poisson distribution)

$= e^{-0.15}(1.15)$

Approximate number of lots containing atmost one deective tyre

$= 100 \times e^{-0.15}(1.15) = 69.75 \simeq 70$

43. Nullity of A=1 $\Rightarrow$ rank of A=2

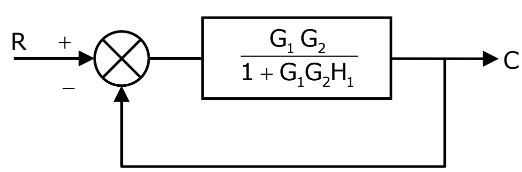
$\Rightarrow |A| = 0 \Rightarrow k = 4$

44. $I = \int_0^{\infty}\int_y^{\infty} \frac{e^{-x}}{x} dxdy$

$\Rightarrow I = \int_0^{\infty}\int_0^{x} \frac{e^{-x}}{x} dydx$ (using change of order of integration)

$= \int_0^{\infty} e^{-x}\, dx = 1$

45.



$\frac{C}{R} = \frac{G_1 G_2}{1 + G_1 G_2H_1 + G_1 G_2}$

46. When fault occurs, the line is isolated, after sometime by auto reclosing the breaker is closed (from data)

$P_{max} = \frac{EV}{x_{eq}}$

$x_{eq} = 0.25 + (0.4 \parallel 0.04) + 0.6$

$= 0.25 + 0.2 + 0.6 = 1.05$

$P_{max} = \frac{1.2 \times 1.0}{1.05} = 1.142$

47. Method − 1 $\Delta I = \frac{V_s D(1 - D)}{f_L} = \frac{100 \times 0.5 \times 0.5}{1000 \times 20 \times 10^{-3}} = 0.125A$

Method-2

$$I_{max} = \frac{V_s}{R}\left[\frac{1-e^{\frac{-\tan}{T_a}}}{1-e^{\frac{-T}{T_a}}}\right] = 20\left[\frac{1-e^{-0.0125}}{1-e^{-0.025}}\right] = 10.062499$$

$$V_S = 100$$

$$R = 5\Omega$$

$$T_a = \frac{L}{R} = \frac{0.2}{5} = \frac{1}{25}$$

$$t_{on} = 500\times10^{-6}$$

$$\frac{t_{on}}{T_a} = \frac{500\times10^{-6}}{\frac{1}{25}} = 0.0125$$

$$\frac{T}{T_a} = \frac{10^{-3}}{\frac{1}{25}} = 0.025$$

48. Efficiency $\eta = \dfrac{V_2I_2\ \cos\theta_2}{V_2I_2\ \cos\theta_2\ +P_c+P_{cu}}$

At rated condition

$V_2I_2 = 30\,\text{KVA}$

$$\therefore 0.95 = \frac{30\times0.8}{30\times0.8+P_c+P_{cu}} \quad \text{and} \quad 0.95 = \frac{30\times\frac{1}{2}\times1}{30\times\frac{1}{2}\times1+P_c+\left(\frac{1}{2}\right)^2 P_{cu}}$$

Solving 2 equations, core-loss $P_c = 0.632\,k$

Ohmic-loss at rated condition $P_{cu} = 0.628\,kW$

49. pu value of $r_e = \dfrac{\text{ohmic loss at rated condition}}{\text{Rated VA}}$

$$= \frac{628}{30000} = 0.0209$$

50. Given N_V=5.4; N_H= 9.2

$$\frac{\text{volt}}{\text{div}} = 50\times10^{-3}\ ;\ \frac{\text{sec}}{\text{div}} = 1\times10^{-3}$$

$$V_{rms} = \frac{V_{p-p}}{2\sqrt{2}} \qquad V_{p-p} = N_v\frac{\text{volt}}{\text{div}} = 5.4\times50\times10^{-3} = 0.27\ V$$

$$\therefore V_{rms} = \frac{0.27}{2\sqrt{2}} = 95.45\,mv = 0.0954\ V$$

51. Given N_V=5.4; N_H= 9.2

$$\frac{\text{volt}}{\text{div}} = 50\times10^{-3}\ ;\ \frac{\text{sec}}{\text{div}} = 1\times10^{-3}$$

$$\text{Frequeny, } f = \frac{1}{T_{1c}}$$

$$T_{2c} = N_H \frac{\text{Time}}{\text{div}} = 9.2\times1\times10^{-3} = 9.2\ \text{msec}$$

$$T_{1c} = \frac{9.2}{4} = 2.3\ \text{msec}$$

$$f = \frac{1}{2.3\times10^{-3}} = 434.78 = 435\ \text{Hz}$$

52. Characteristic equation is

$$s^4 + 20s^3 + 15s^2 + 2s + k = 0$$

By R – H table

s^4	1	15	k
s^3	20	2	0
s^2	$\frac{298}{20}$	k	0
s^1	$(29.8-20k)\frac{20}{298}$	0	
s^0	k		

$$29.8 - 20k > 0 \Rightarrow k < \frac{29.8}{20} \Rightarrow k < 1.49$$

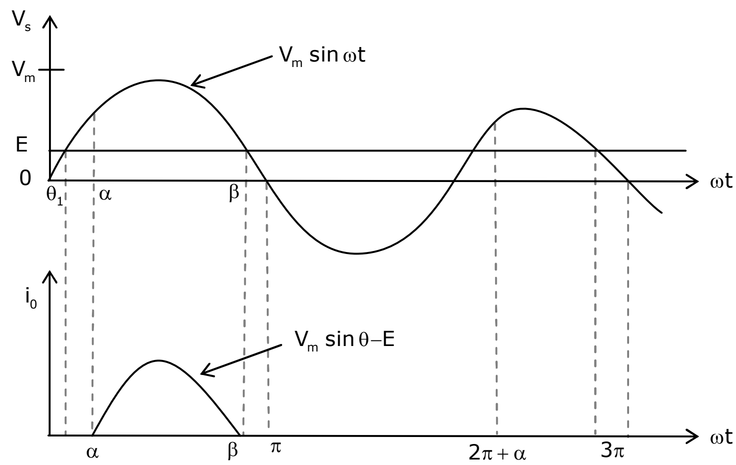
53. K = 1.49

Auxiliary equation becomes

$$\frac{298}{20}s^2 + k = 0 \Rightarrow 14.9s^2 + 1.49 = 0 \Rightarrow -\omega^2 14.9 = -1.49 \Rightarrow \omega$$

$$= \sqrt{0.1} = 0.316\ \text{rad/sec}$$

54 & 55.



Min firing angle to turn on SCR is Q_1

$V_m \sin\theta_1 = E$

$\left(240\sqrt{2}\right)\sin\theta_1 = 200 \rightarrow \theta_1 = 36.104°$

Max firing angle = $\beta = \pi - \theta_1 = 36.104°$

Given firing angle α is $45°$ $\left(\alpha > \theta_1\right)$

The battery charging requires only the average current I_0

$$I_0 = \left(\frac{1}{R}\right)\frac{1}{2\pi}\int_\alpha^\beta \left[V_m \sin\theta - E\right]dQ = \frac{1}{2\pi R}\left[V_m \cos\theta\Big|_\beta^\alpha - E\left(-\alpha+\beta\right)\right]$$

$$I_0 = \frac{1}{2\pi R}\left[V_m\left(\cos\alpha - \cos\beta\right) - E\left(\beta - \alpha\right)\right]$$

$$\therefore I_0 = \frac{1}{2\pi \times 10}\left[240\sqrt{2}\left[\cos 45 - \cos 143.896\right] - 200\left[143.896 - 45\right]\frac{\pi}{180}\right]$$

$$= \frac{1}{20\pi}\left[514.22 - 345.212\right] = 2.67\,A$$

$$V_s = \frac{V_m}{\sqrt{2}}, \; V_s^2 = \frac{V_m^2}{2}$$

$$I_{or} = \frac{1}{2\pi}\int_\alpha^\beta \left(\frac{V_m \sin\theta - E}{R}\right)^2 d\theta$$

$$= \frac{1}{2\pi R^2}\left[\int_\alpha^\beta \left[V_m^2 \sin^2\theta + E^2 - 2V_m E \sin\theta\right]\right] d\theta$$

$$= \frac{1}{2\pi R^2}\left[V_s^2\left(1 - \cos^2\theta\right) + E^2 - 2V_m E \sin\theta\right]$$

$$= \frac{1}{2\pi R^2}\left[V_s^2\left(\theta - \frac{\sin^2\theta}{2}\right)\Big|_\alpha^\beta + E^2(\beta - \alpha) - 2V_m E \cos\theta\Big|_\beta^\alpha\right]$$

$$= \frac{1}{2\pi R^2}\left[V_s^2 \; (\beta - \alpha) - \frac{V_s^2}{2}\left[\sin 2\beta - \sin 2\alpha\right] - 2V_m E\left(\cos\alpha - \cos\beta\right)\right]$$

$$= \frac{1}{2\pi(10)^2}\left[\left(240^2 + 200^2\right)\frac{[143.9 - 45]\pi}{180} - \frac{240^2}{2}\left[\sin(2\times 143.9) - \sin(2\times 45)\right] - 2.\left(240\sqrt{2}\right)200\left[\cos 45 - \cos 143.9\right]\right]$$

$$= \frac{1}{200\pi}\left[168470.3495 + 56221.32 - 205696.34\right] \Rightarrow I_{or} = \sqrt{30.23A} = 5.5A$$

Power delivered to $R_L = EI_0 + I_{or}^2 R = 200 \times 2.67 + 5.5^2 \times 10 = 836.5W$

$$\text{Supply p.f} = \frac{\text{Power delivered to load}}{\left[\text{Source voltage } V_s\right]\left[\text{RMS value of source current } I_{0r}\right]} = \frac{836.5}{240 \times 5.5} = 0.6337\,\text{lag}$$

60. Possible cases:
1^{st} Case: 2 men & 2 women
2^{nd} case: 3 men & 1 women
3^{rd} Case: 4 men only
Required number of ways = $6c_2 \times 5c_2 + 6c_3 \times 5c_1 + 6c_4$

62. Banti is 80% more efficient than Anand
Assume, Anand efficiency is 100 percent
Then, Banti is 180 (100+80) percent efficient
$\therefore$ Ratio of time taken by Anand and Banti = 180:100 = 9 : 5
(Reciprocal to efficiencies)
Now, assume Banti takes x days
Given Anand does the job in 14 days
14 : X:: 9:5 $\Rightarrow$ 9x = 70

$$x = \frac{70}{9} = 7\frac{7}{9}$$

63. By the rule of alligation, we have

Strength of first jar   Strength of second jar

60%   22%

Mean strength

42%

20%   18%

Ratio = 20: 18 = 10: 9

$\therefore$ Required quantity replaced = $\frac{9}{19}$

64. $\left(x^n+1\right)$ is divisible by $\left(x+1\right)$, when n is odd

$\left(87^{65}+1\right)$ will be divisible by 88

$\left(87^{65}+1\right)+86$, when divided by 88 will give 86 as remainder

65. Number of males in U.P = $\left[\frac{3}{5} \text{ of } \left(15\% \text{ of } N\right)\right] = \frac{3}{5}\times\frac{15}{100}\times N = \frac{9N}{100}$

Where N = 3276000

Number of males in M.P = $\left[\frac{3}{4} \text{ of } \left(20\% \text{ of } N\right)\right] = \frac{3}{4}\times\frac{20}{100}\times N = \frac{15N}{100}$

Number of males in Goa = $\left[\frac{3}{8} \text{ of } \left(12\% \text{ of } N\right)\right] = \frac{3}{8}\times\frac{12}{100}\times N = \frac{4.5N}{100}$

Total males in these 3 states = $\left(9+5+4.5\right)\frac{N}{100} = \frac{28.5N}{100}$

Required % = $\left(\frac{28.5\times\frac{N}{100}\times 100}{N}\right)\% = 28.5\%$