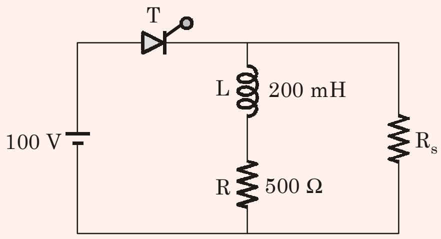
Q.1 Latching current of SCR = 40 mA.

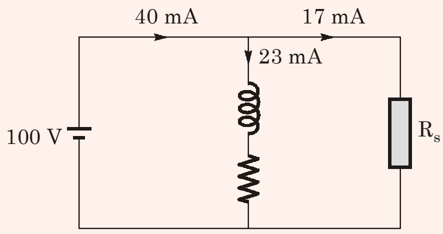


Find R_s so that gate pulse required for ON state is 50 μs.

Solution: (5.882 kΩ)

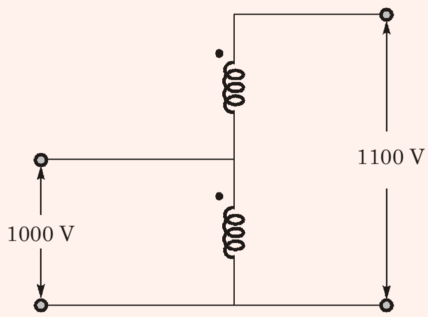
Let us assume thyristor is conducting

Thus,
$$i(t) = \frac{V_s}{R}\left[1 - e^{-\frac{R}{L}t}\right]$$
$$= 0.2\left[1 - e^{-\frac{500}{200\times10^{-3}}\times 50\times10^{-6}}\right]$$
$$i(t) = 0.023 = 23 \text{ mA}$$

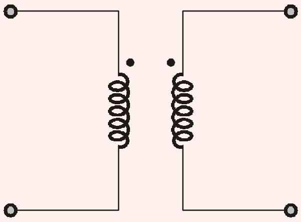


$$\therefore \quad R_s = \frac{100}{17\times10^{-3}} = 5.882 \text{ k}\Omega$$

Q.2



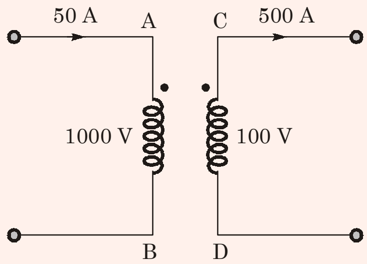
A two winding transformer has 50 kVA rating, it is connected as autotransformer, find the kVA rating of autotransformer.



50 kVA
2 Winding transformer

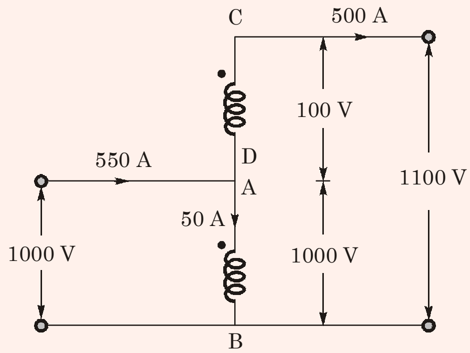
Solution: (550 kVA)

Given,



50 kVA

So,



So, kVA rating of autotransformer

$= 1100 \times 500 \text{ or } 1000 \times 550$

$= 550 \text{ kVA}$

Q.3 $A = \begin{bmatrix} 0 & -3 \\ 1 & 1 \end{bmatrix}, B = \begin{bmatrix} 1 \\ 0 \end{bmatrix}$ and $C = \begin{bmatrix} 1 & 0 \end{bmatrix}$. Check observability and controllability of the system.

(a) Controllable and unobservable
(b) Uncontrollable and observable
(c) Uncontrollable and unobservable
(d) Controllable and observable

Solution: (d)

For controllable, the condition is

$$M_c = [B \quad AB] \neq 0$$

$$AB = \begin{bmatrix} 0+0 \\ 1+0 \end{bmatrix} = \begin{bmatrix} 0 \\ 1 \end{bmatrix}$$

$$M_c = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$$

$$= 1 \neq 0 \quad \text{Controllable.}$$

For observable, $$M_o = \begin{bmatrix} C^T & A^T C^T \end{bmatrix} \neq 0$$

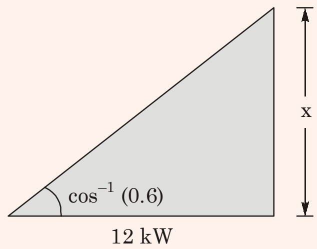
$$C^T = \begin{bmatrix} 1 \\ 0 \end{bmatrix}$$

$$A^T C^T = \begin{bmatrix} 0 & 1 \\ -3 & 1 \end{bmatrix}\begin{bmatrix} 1 \\ 0 \end{bmatrix} = \begin{bmatrix} 0 \\ -3 \end{bmatrix}$$

$$M_o = \begin{bmatrix} 1 & 0 \\ 0 & -3 \end{bmatrix} = -3 \neq 0 \quad \text{Observable.}$$

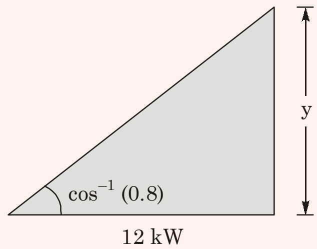
Q.4 3-ϕ delta connected capacitor is used as a boost in power system network to boost voltage and reactive power compensation. A load of 12 kW is connected in the phase where it is operated at 0.6 lagging power factor. What is the value of MVAR required in order to increase the power factor to 0.8 lag.

Solution: (7 kVAR)



$$\tan\phi = \frac{x}{12}$$

$$x = 16 \text{ kVAR}$$



$$\tan(36.869°) = \frac{y}{12}$$

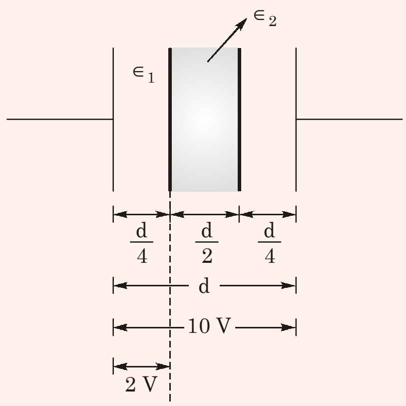
$$(y) = 9\,\text{kVAR}$$

Reactive power supplied by capacitor bank

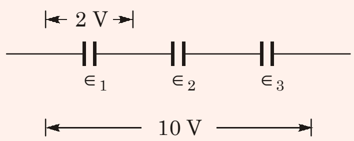
$$= 16\,\text{kVAR} - 9\,\text{kVAR}$$

$$= 7\,\text{kVAR}$$

Q.5 A dielectric of permittivity $\in_2$ of length $\frac{d}{2}$ is inserted between a parallel plate capacitor of dielectric strength $\in_1$. The voltage difference between 2 plates is 10 V and between a plate and dielectric ($\in_1$) is 2 V. Find the ratio of $\frac{\in_1}{\in_2}$.



Solution: (1.5)



$$C_1 = \frac{A\in_1}{d/4} = \frac{4A\in_1}{d}$$

$$C_2 = \frac{A\in_2}{d/2} = \frac{2A\in_2}{d}$$

$$C_3 = \frac{A\in_1}{d/4} = \frac{4A\in_1}{d}$$

$$V_{C_1} = \frac{\frac{1}{j\omega C_1}}{\frac{1}{j\omega C_1} + \frac{1}{j\omega C_2} + \frac{1}{j\omega C_3}} \times V$$

$$V_{C_1} = \frac{\frac{1}{C_1}}{\frac{1}{C_1}+\frac{1}{C_2}+\frac{1}{C_3}} \times 10 = \frac{C_2\,C_3}{C_2\,C_3 + C_1\,C_3 + C_1\,C_2} \times 10$$

$$= \frac{8\,\epsilon_1\epsilon_2 \times 10}{8\,\epsilon_1\epsilon_2 + 8\,\epsilon_1\epsilon_2 + 16\,\epsilon_1^2}$$

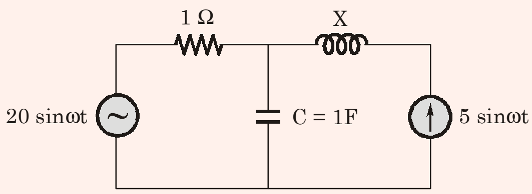
$$\therefore \quad \frac{2}{10} = \frac{8\,\epsilon_1\epsilon_2}{16\,\epsilon_1\epsilon_2 + 16\,\epsilon_1^2} = \frac{\epsilon_2}{2\,\epsilon_2 + 2\,\epsilon_1}$$

$$2\epsilon_2 + 2\epsilon_1 = 5\epsilon_2$$

$$2\epsilon_1 = 3\epsilon_2$$

$$\frac{\epsilon_1}{\epsilon_2} = 1.5$$

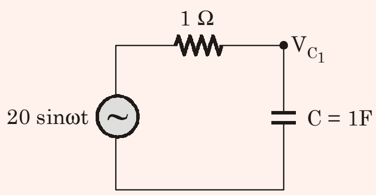
Q.6 Find the value of V_C = _______.



Solution: $\left(\frac{25}{\sqrt{1+\omega^2}} \angle -\tan^{-1}\omega\right)$

Applying superposition theorem,

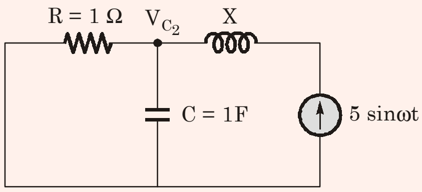
When only voltage source is there,



$$V_{C_1} = \frac{\frac{1}{j\omega C}}{1 + \frac{1}{j\omega C}} \times 20\angle 0°$$

$$= \frac{1}{1 + j\omega} 20\angle 0°$$

When only correct source is there,



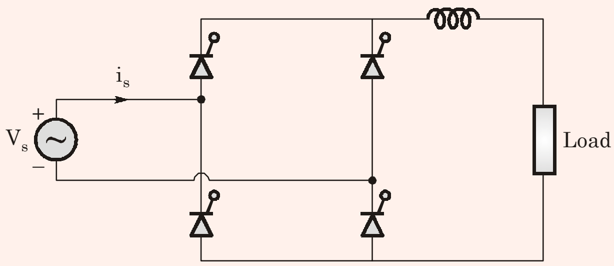
$$I_C = \frac{1}{1+\frac{1}{j\omega}} \times 5\angle 0°$$

$$\therefore \quad V_{C_2} = \frac{\frac{1}{j\omega}}{1+\frac{1}{j\omega}} \times 5\angle 0°$$

$$= \frac{1}{1+j\omega} 5\angle 0°$$

$$\therefore \quad V_C = V_{C_1} + V_{C_2} = \frac{25}{1+j\omega} = \frac{25}{\sqrt{1+\omega^2}} \angle -\tan^{-1}\omega$$

Q.7 A fully controlled converter bridge feeds a highly inductive load with ripple free load current. The input supply (V_s) to the bridge is a sinusoidal source. Triggering angle of the bridge converter is $\alpha = 30°$. The input power factor of the bridge is



Solution: (0.779 lagging)

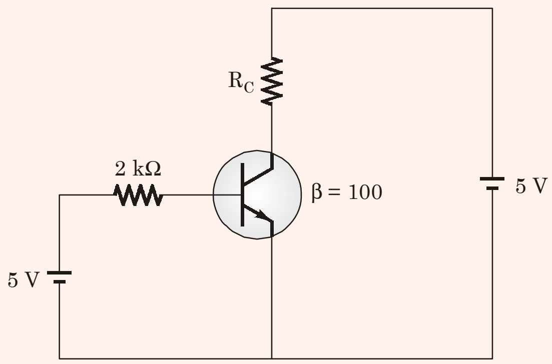
$$P_{in} = V_{sr} I_{sr} \cos\phi = V_o I_o$$

$$\cos\phi = \frac{V_o I_o}{V_{sr} I_{sr}} \qquad \left[\because I_0^2 = I_{sr}^2\right]$$

$$= \frac{V_o}{V_{sr}} = \frac{\frac{2\sqrt{2} V_s}{\pi} \cos 30°}{V_s}$$

$$\text{p.f.} = 0.779 \text{ lagging}$$

Q.8 $V_{CE\,(sat)} = 0.2$ V and $V_{BE} = 0.7$ V. Find the value of R_C for the transistor to be in active region.



Solution: (22.32 Ω)

In input loop:

$$I_b = \frac{5-0.7}{2\text{ k}\Omega} = \frac{4.3}{2\text{ k}\Omega} = 2.15 \text{ mA}$$

So, $$I_c = \beta \cdot I_b = 100 \times 2.15 \text{ mA}$$

Now KVL in output loop:

$$V_{CE} = 5 - 0.215\, R_C$$

For active region $$V_{CE} > 0.2 \text{ V}$$

$\Rightarrow$ $$0.215\, R_C < 5 - 0.2$$

$\Rightarrow$ $$R_{C\,min} = \frac{4.8}{0.215} \simeq 22.32\ \Omega$$

Q.9 $\dfrac{5(s+4)}{(s+0.25)\,(s^2+4s+25)}$, find the value of K and highest corner frequency.

(a) 16, 4
(b) 3.2, 4
(c) 3.2, 5
(d) 16, 5

Solution: (b)

$$\frac{5\times 4}{0.25\times 25}\;\frac{\left(1+\frac{s}{4}\right)}{\left(1+\frac{s}{0.25}\right)\left(1+\frac{4s}{25}+\frac{s^2}{25}\right)}$$

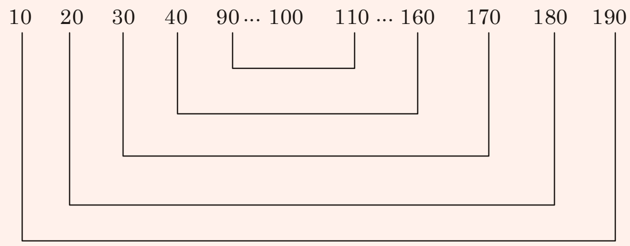
$$K = \frac{5\times 4}{0.25\times 25} = \frac{20\times 100}{25\times 25} = 3.2$$

High corner frequency = 4

Q.10 Average value of multiple of 10 from 2 to 198 is

Solution: (100)

Series of multiple of 10 is



So, average value will be $= \dfrac{200 \times 9 + 100}{19} = 100$

Q.11 A synchronous generator is connected to an infinite bus with excitation voltage $E_f = 1.3$ p.u. The generator has a synchronous reactance of 1.1 p.u. and is delivering real power (P) of 0.6 p.u. to the bus. Assume the infinite bus voltage to be 1.0 p.u. Neglect stator resistance. The reactive power (Q) in p.u. supplied by the generator to the bus under this condition is

Solution: (0.1091 p.u.)

$$\frac{E_f V}{X_s} \sin\delta = P$$

$$\frac{1.3 \times 1}{1.1} \sin\delta = 0.6$$

$$\sin\delta = 0.5077$$

$$\delta = 30.504°$$

$$\frac{E_f V}{X_s} \cos\delta - \frac{V^2}{X_s} = Q$$

$$\frac{1.3 \times 1}{1.1} \times 0.8616 - \frac{1}{1.1} = Q$$

$$Q = 0.1091 \text{ p.u.}$$

Q.12 To evaluate the double integral $\int_0^8 \left(\int_{y/2}^{(y/2)+1} \left(\frac{2x-y}{2} \right) dx \right) dy$. We make the substitution

$u = \left(\frac{2x-y}{2} \right)$ and $v = \frac{y}{2}$ the integral will reduce to

(a) $\int_0^4 \left(\int_0^2 (2udu) dv \right)$

(b) $\int_0^4 \left(\int_0^1 (2udu) \right) dv$

(c) $\int_0^4 \left(\int_0^1 udu \right) dv$

(d) $\int_0^4 \left(\int_0^2 udu \right) dv$

Solution: (b)

$$\int_0^8 \left(\int_{y/2}^{(y/2)+1} \left(\frac{2x-y}{2} \right) dx \right) dy$$

$$\frac{2x-y}{2} = u$$

$$x - \frac{y}{2} = u$$

$$dx = du$$

$$\text{at} \quad x = \frac{y}{2}$$

$$u = \frac{\frac{2y}{2} - y}{2} = 0$$

$$\text{at} \quad x = \frac{y}{2} + 1$$

$$u = \frac{2\left(\frac{y}{2}+1\right) - y}{2} = \frac{y+2-y}{2} = 1$$

Thus, itegral becomes $\int_0^8 \left[\int_0^1 udu \right] dy$

$$v = \frac{y}{2}$$

$$dv = \frac{dy}{2} \quad \Rightarrow \quad dy = 2\,dv$$

$$y = 0 \quad \Rightarrow \quad v = 0$$

$$y = 8 \quad \Rightarrow \quad v = 4$$

$$= \int_0^4 \left[\int_0^1 u du\right] \times 2dv$$

$$= \int_0^4 \left[\int_0^1 2u\, du\right] dv$$

Q.13 Find the value of $\sqrt{12+\sqrt{12+\sqrt{12+}}} \cdots \infty$

(a) 4.0
(b) 4.68
(c) 4.32
(d) 4.23

Solution: (a)

$$y = \sqrt{12+\sqrt{12+\sqrt{12+}}} \cdots \infty$$

$$y = \sqrt{12+y}$$

$$y^2 = 12 + y$$

$$y^2 - y - 12 = 0$$

$$y^2 - 4y + 3y - 12 = 0$$

$$y(y-4) + 3(y-4) = 0$$

$$y = -3, 4$$

Q.14 $A = \begin{bmatrix} 1 & 0 \\ -1 & 1 \end{bmatrix}, B = \begin{bmatrix} 1 \\ 0 \end{bmatrix}$ and $C = \begin{bmatrix} 1 & 0 \end{bmatrix}$. Find state transition matrix.

(a) $\begin{bmatrix} e^t & 0 \\ te^t & e^t \end{bmatrix}$
(b) $\begin{bmatrix} 0 & e^t \\ te^t & e^t \end{bmatrix}$
(c) $\begin{bmatrix} te^t & e^t \\ 0 & e^t \end{bmatrix}$
(d) $\begin{bmatrix} e^t & te^t \\ 0 & e^t \end{bmatrix}$

Solution: (a)

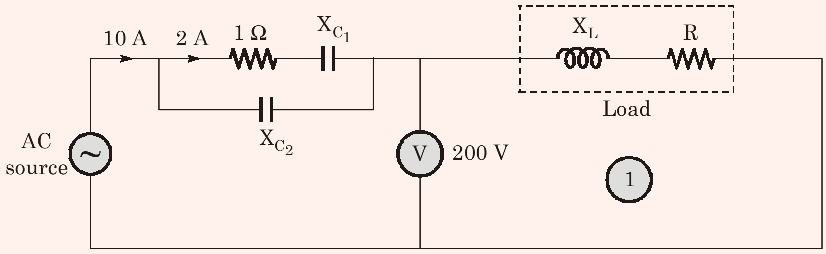
$$\mathcal{L}^{-1}[sI - A]^{-1} = \begin{bmatrix} s & 0 \\ 0 & s \end{bmatrix} - \begin{bmatrix} 1 & 0 \\ -1 & 1 \end{bmatrix}$$

$$[sI - A] = \begin{bmatrix} s-1 & 0 \\ 1 & s-1 \end{bmatrix}$$

$$[sI - A]^{-1} = \frac{1}{(s-1)^2}\begin{bmatrix} s-1 & 0 \\ -1 & s-1 \end{bmatrix} = \begin{bmatrix} \frac{1}{(s-1)} & 0 \\ \frac{-1}{(s-1)^2} & \frac{1}{(s-1)} \end{bmatrix}$$

$$\mathcal{L}^{-1}[sI - A]^{-1} = \begin{bmatrix} e^t & 0 \\ te^t & e^t \end{bmatrix}$$

Q.15 If total power consumption in the following circuit is 1 kW and voltage across load is 200 V. Then find the value of X_L.



Solution: (0.89 Ω)

Total power consumed in circuit = 1 kW

$$1000 = 2^2 \times 1 + (10)^2 \times R$$

$$\Rightarrow \quad 100 - 4 = 100 \times R$$

$$\Rightarrow \quad R = 9.96\ \Omega$$

and
$$\frac{V}{I} = |Z|$$

$$\frac{200}{10} = 10 = |R + jX_L|$$

$$10 = \sqrt{R^2 + X_L^2}$$

$$10 = \sqrt{(9.96)^2 + X_L^2}$$

$$X_L = 0.89\ \Omega$$

Q.16 The value of 1^i is ________ . $\left[\text{here } i = \sqrt{-1}\right]$

Solution: (1)

$$y = 1^i$$

$$\Rightarrow \quad \ln y = i \ln 1$$

$$\Rightarrow \quad \ln y = 0$$

$$\therefore \quad y = e^0 = 1$$

Q.17 A DC shunt motor with armature resistance of 0.6 Ω and field resistance of 125 Ω is connected to main supply 250 V. If same motor is used as generator, in both cases load current is 50 A then find the value of ratio of generator and motor speed.

Solution: (1.27)

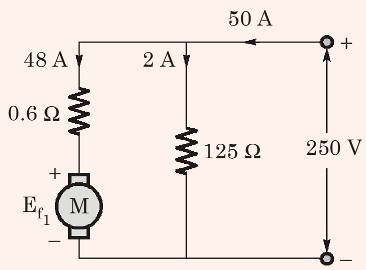


Fig. DC shunt motor

$$250 = 48 \times 0.6 + E_f$$

$$E_{f_1} = 250 - 28.8$$

$$E_{f_1} = 221.2$$

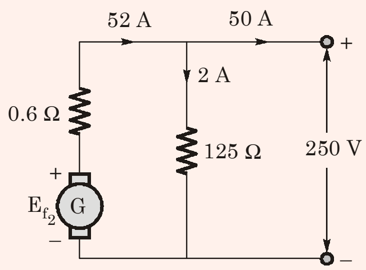


Fig. DC shunt generator

$$E_{f_2} = 52 \times 0.6 + 250 = 281.2$$

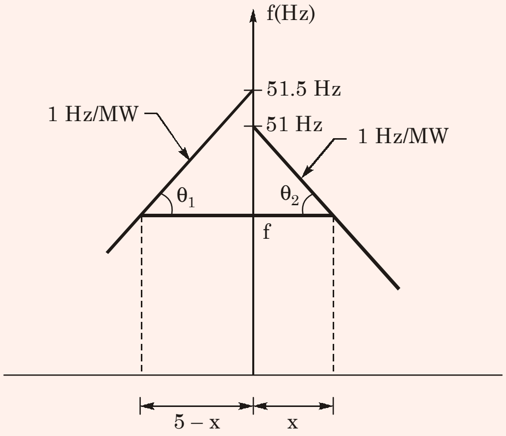
$$E_f \propto \phi\,\omega$$

$$\frac{E_{f_1}}{E_{f_2}} = \frac{\omega_1}{\omega_2} = \frac{221.2}{281.2} = 0.7866$$

$$\therefore \quad \frac{\omega_2}{\omega_1} = 1.27$$

Q.18 There are two generators in a power station. No load frequency of generators are 51.5 Hz and 51 Hz respectively and both are having drop constant of 1 Hz/MW. Assuming that the generators are operating under their respective characteristics, the frequency of the power system in Hz in the steady state is _____.

Solution: (48.75 Hz)



$$\tan\theta_1 = \frac{51.5 - f}{5 - x} = 1 \text{ Hz/MW} \quad \text{...(i)}$$

$$\tan\theta_2 = \frac{51 - f}{x} = 1 \text{ Hz/MW} \quad \text{...(ii)}$$

From equation (i)

$$51.5 - f = 5 - x$$

$$f - x = 51.5 - 5 = 46.5 \quad \text{...(iii)}$$

From equation (ii)

$$51 - f = x$$

$$f + x = 51 \quad \text{...(iv)}$$

Adding equations (iii) and (iv)

$$2f = 97.5$$

$$f = \frac{97.5}{2} = 48.75 \text{ Hz}$$

$$f = 48.75 \text{ Hz}$$

Q.19 For a 1-ϕ, 2 winding transformer the supply frequency and voltage are increased by 10%. The percentage change in Hysteresis and eddy current losses respectively will be respectively

(a) 10 and 21
(b) –10, 21
(c) 21, 10
(d) –2, 10

Solution: (a)

$$P_h \propto f\,B_m^x \propto f\left(\frac{V}{f}\right)^x \propto f^{1-x}\,V^x$$

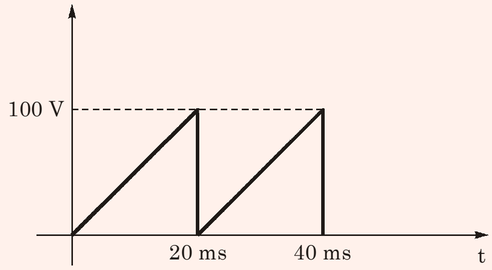
$$\%\,\Delta P_h = \frac{P_{h_2} - P_{h_1}}{P_{h_1}} \times 100 = \frac{(1.1f)^{1-x} \times (1.1\,V)^x - (f)^{1-x}(V)^x}{(f)^{1-x}\,(V)^x} \times 100$$

$$= \left[(1.1)^{1-n}(1.1)^x - 1\right] \times 100 = 10\%$$

$$\%\,\Delta P_e = \frac{(1.1\,V)^2 - (V)^2}{V^2} \times 100 = (1.21 - 1) \times 100$$

$$= 21\%$$

Q.20 A sawtooth waveform is given for a circuit for which a moving iron type meter is connected for measurement of voltage then what is the reading of the meter?



Solution: (57.74 A)

$$I_{rms} = \sqrt{\frac{1}{T}\int_6^T x^2(t)dt}$$

where, $$x(t) = \frac{100t}{20 \times 10^{-3}}$$

$\therefore$ $$I_{rms} = \sqrt{\frac{1}{20 \times 10^{-3}} \int_0^{20\times10^{-3}} \left(\frac{100t}{20 \times 10^{-3}}\right)^2 dt}$$

$$= \sqrt{\frac{1}{20 \times 10^{-3}} \times 25 \times 10^6 \times \frac{(20 \times 10^{-3})^3}{3}}$$

$$= \frac{5 \times 20}{\sqrt{3}} = \frac{100}{\sqrt{3}} = 57.74\text{ A}$$

Q.21 If $\left|x^2 - 2x + 3\right| = 11$ then what is the probable value of $\left|-x^3 + x^2 - x\right|$

(a) 2, 4 (b) 4, 14
(c) 14, 52 (d) 2, 14

Solution: (c)

$$\left|x^2 - 2x + 3\right| = 11$$

As $D = b^2 - 4ac$

$= 4 - 12 = -8 < 0$

$\therefore \quad x^2 - 2x + 3 > 0$

$x^2 - 2x + 3 = 11$

$\therefore \quad x = -2$ and $x = 4$

For $x = -2$

$$\left|-x^3 + x^2 - x\right| = \left|+8 + 4 + 2\right| = 14$$

For $x = 4$

$$\left|-64 + 16 - 4\right| = 52$$

Q.22 Which one of the following is true for real symmetry

(a) all eigen values are real (b) all eigen values are positive
(c) all eigen values are distinct (d) sum of all eigen are zero

Solution: (a)

Q.23 Consider LTI system with T.F. $H(s) = \frac{1}{s(s+4)}$ if the input to all system is cos(3t) and steady state output is $A\sin(3t + \alpha)$, then value of A is

(a) $\frac{1}{30}$ (b) $\frac{1}{15}$
(c) $\frac{3}{4}$ (d) $\frac{4}{5}$

Solution: (b)

$$H(s) = \frac{1}{s(s+4)}$$

Input $= \cos(3t)$

Steady state output $= A\sin(3t + \alpha)$

$$|H(s)| = \left|\frac{1}{j\omega(j\omega + 4)}\right| = \frac{1}{3 \times \sqrt{9 + 16}} = \frac{1}{15}$$

$$A = \frac{1}{15}$$

Q.24 Tolerance band of resistors 200 Ω and 300 Ω are 1%. Find the tolerance when they are connected in parallel _____.

Solution: 1%

$$R_{actual} = \frac{200 \times 300}{200 + 300} = 120$$

Taking 1% positive error,

$$R_{net} = \frac{202 \times 303}{202 + 303} = 121.2$$

$$\text{Tolerence} = \frac{121.2 - 120}{120} = 0.01$$

$$= 1\%$$

Taking 1% negative error,

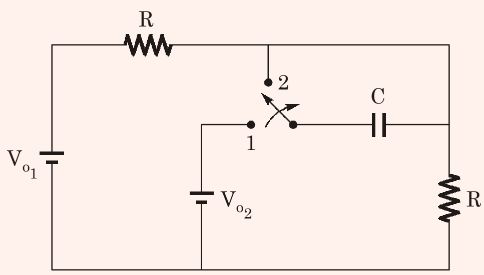
$$R_{net} = \frac{198 \times 297}{198 + 297} = 118.8$$

$$= 118.8$$

$$\text{Tolerence} = \frac{118.8 - 120}{120} = -0.01$$

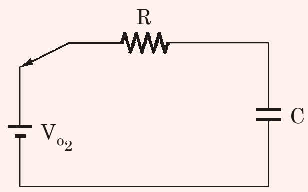
$$= -1\%$$

Q.25 $V_{o_1} > V_{o_2}$ switch is at position 1 for long time and at time $t = 0$ switch is moved to position 2. Find $V_c(t)$.

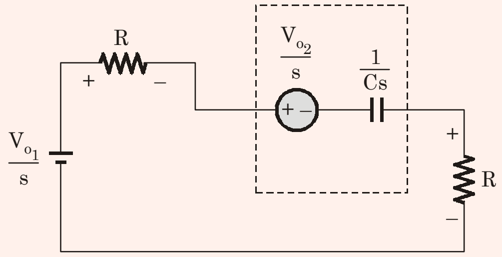


Solution: $\left[V_{o_1} + V_{o_2}\right]\left[1 - e^{-t/2RC}\right] - (V_{o_2})$

Case-I at $t = 0^-$



Case-II



$$\frac{V_{o_1}}{s} - 2(s)R - I(s)\cdot\frac{1}{Cs} + \frac{V_{o_2}}{s} - I(s)R = 0$$

$$I(s) = \frac{\frac{V_{o_1}}{s} + \frac{V_{o_2}}{s}}{R + \frac{1}{Cs} + R}$$

$$I(s) = \frac{(V_{o_1} + V_{o_2})}{s\left(2R + \frac{1}{Cs}\right)} = \frac{(V_{o_1} + V_{o_2}) \times C}{(2RCs + 1)}$$

$$= \frac{(V_{o_1} + V_{o_2})C}{2RC\left(s + \frac{1}{2RC}\right)}$$

$$V_c(s) = I(s) \times \frac{1}{Cs} - \frac{V_{o_2}}{s}$$

$$V_c(s) = \frac{V_{o_1} + V_{o_2}}{2R\left(s + \frac{1}{2RC}\right)} \times \frac{1}{Cs} - \frac{V_{o_2}}{s}$$

$$V_c(s) = \frac{V_{o_1} + V_{o_2}}{2RC\left(s + \frac{1}{2RC}\right) \times s} - \frac{V_{o_2}}{s}$$

$$= \frac{V_{o_1} + V_{o_2}}{2RC} \times 2RC\left[\frac{1}{s} - \frac{1}{s + \frac{1}{2RC}}\right] - \frac{V_{o_2}}{s}$$

$$V_c(t) = \left[V_{o_1} + V_{o_2}\right]\left[1 - e^{-t/2RC}\right] - (V_{o_2})$$

Q.26 Two inductors L_1 and L_2 of equal values are connected in series with all possible combinations and obtained values of L are 380 mH and 240 mH. Find mutual inductance M.

Solution: (35)

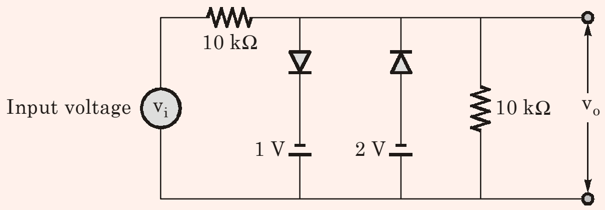
$$2L + 2M = 380$$
$$2L - 2M = 240$$
$$\underline{-\quad +\quad\quad -}$$
$$4M = 140$$
$$M = 35 \text{ mH}$$

Q.27 In the measurement of power of balanced load by two watt meter method, the reading respectively $P_1 = 250$ kW and $P_2 = 100$ kW. Find the power factor of the meter

Solution: (0.8029 lagging)

$$\phi = \tan^{-1}\left[\frac{\sqrt{3}(250-100)}{(250+100)}\right]$$
$$= \tan^{-1}[0.7423]$$
$$= 36.586°$$
$$\cos\phi = 0.8029 \text{ lagging}$$

Q.28 Assuming diodes are ideal for output to be clipped, input voltage v_i must be outside.



(a) –1 to –2
(b) –2 to –4
(c) +1 to –2
(d) 2 to –4

Solution: (a)

To get clipped output,

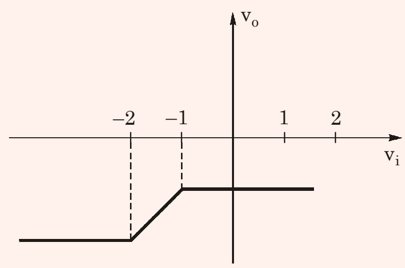
$$v_i > -1 \text{ V}$$

and $$v_i < -2 \text{ V}$$

$\therefore$ If $-2 < v_i < -1$, there would be no clipped output.

For output to be clipped off the input voltage v_i must be outside from –1 to –2 where

$$v_o = v_i$$



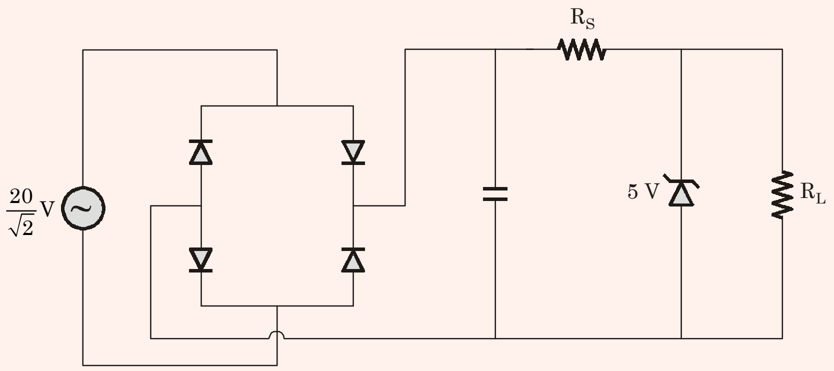
Q.29 Invalid 8-4-2-1 binary coded decimal is

(a) 1001 (b) 1000
(c) 1100 (d) 0011

Solution: (c)

∵ value can't be greater than 9.

Q.30 The sinusoidal AC source in the figure has an rms value of $\frac{20}{\sqrt{2}}$ V. Considering all possible values of R_L, the minimum value of R_s in Ω to avoid burn-out of the Zener diode is



Solution: (300 Ω)

$$I_s \geq I_z + I_L$$

$$\frac{1}{20} \geq \frac{20-5}{R_s} \qquad \text{(Putting } I_L = 0\text{)}$$

$$\Rightarrow \quad R_s \geq 300\ \Omega$$

Hence, $R_{s_{min}} = 300\ \Omega$

Q.31 At what time between 6 am to 7 am the minute and hour hand of a clock make an angle closest to 60°.

(a) 6 : 22 am (b) 6 : 27 am
(c) 6 : 38 am (d) 6 : 45

Solution: (a)

Q.32 India is a colonial country because

(a) India was former British colony.
(b) Indian information technology professional colonize the world.
(c) India does not follow colonial practices.
(d) India has helped other country gain freedom.

Solution: (a)

Q.33 Match the **List-I** with **List-II**:

	List-I		List-II
A.	Eradicate	**1.**	Use
B.	Utilise	**2.**	Misrespect
C.	Saturate	**3.**	Completely soak
D.	Distort	**4.**	Destroy

	A	B	C	D
(a)	4	3	1	2
(b)	1	4	2	3
(c)	4	1	3	2
(d)	1	2	3	4

Solution: (c)

■■■■