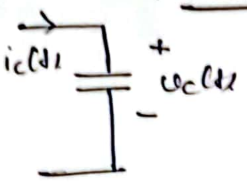
Assignment 1 (Solutions)

1)



$$i_c(t) = C\frac{dv_c}{dt}.$$

$\Rightarrow$ $\cancel{v_c(t)\,d}$

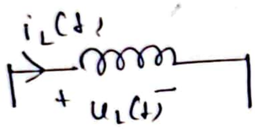
$$\Rightarrow i_c(t).dt = C.dv_c.$$

$$\Rightarrow \int_{v_c(t)}^{v_c(t+T)} dv_c = \int_{t}^{t+T} i_c(\tau).d\tau.$$

$$\Rightarrow v_c(t+T) - v_c(t) = \left(\frac{1}{T}\int_{t}^{t+T} i_c(\tau)d\tau\right).T$$

$$\Rightarrow \boxed{\langle I_c(t)\rangle = 0.} \quad \boxed{QED}$$

2)

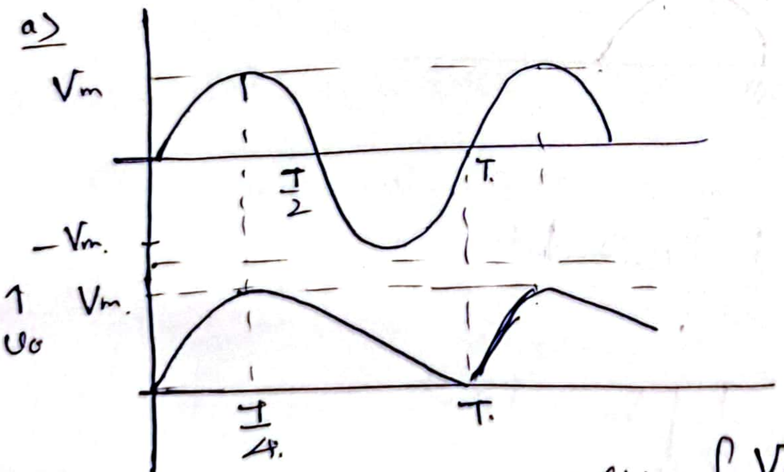


$$v_L(t) = L\frac{di_L(t)}{dt}$$

$$\Rightarrow \int_{i_L(t)}^{i_L(t+T)} di_L(t) = \int_{t}^{t+T} v_L(\tau).d\tau.$$

$$\Rightarrow \boxed{\langle v_L(t)\rangle = 0.} \quad \boxed{QED}$$

3) a)

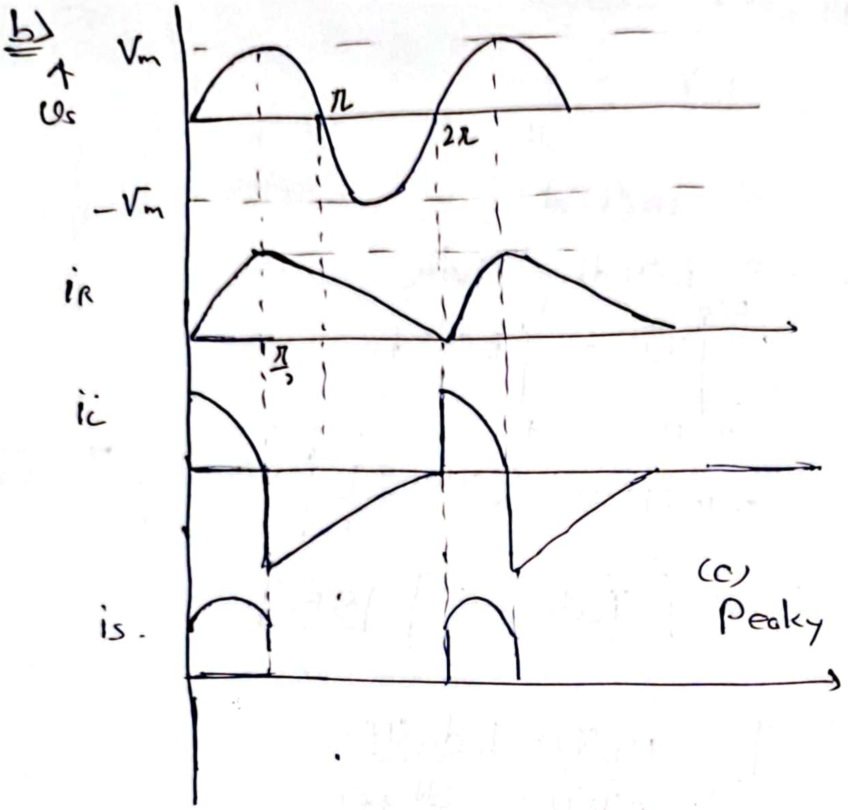


$$v_o(t) = \begin{cases} V_m \sin\omega t. & 0 < t \le \frac{T}{4} \\ 0-(0-V_m)e^{-(t-\frac{T}{4})/\tau}; & \frac{T}{4} \le t < T \end{cases}$$

$$= \begin{cases} V_m \sin\omega t ; & 0 < t \le \frac{T}{4} \\ V_m e^{-(t-\frac{T}{4})/\tau}; & \frac{T}{4} < t < T \end{cases}$$

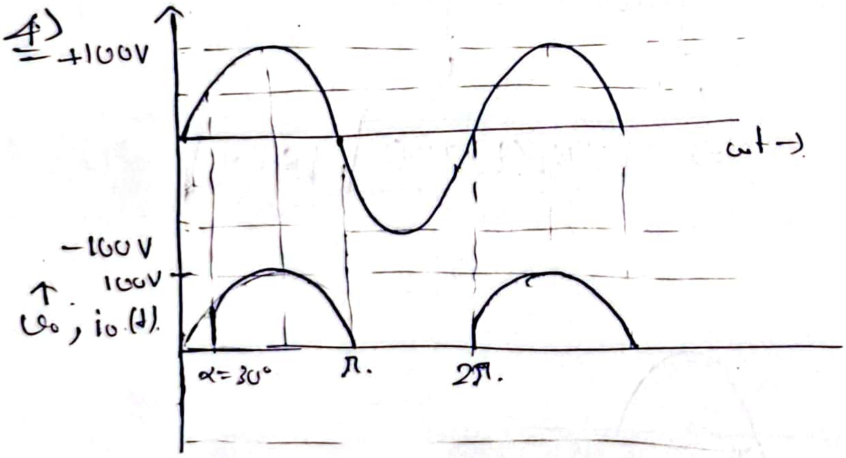
where. $\boxed{\tau = RC.}$

b)



(c) Peaky waveform.

4)



$$V_o = \frac{1}{2\pi}\int_{\alpha}^{2\pi} v_s(t).\,d\omega t$$

$$= \frac{1}{2\pi}\int_{\alpha}^{\pi} V_m \sin\omega t\, d\omega t$$

$\cos 2C = 1 - 2..$

$$= \frac{V_m}{2\pi}.\left[\cos\alpha + 1\right]$$

$$V_o = \frac{100}{2\pi}\left[1 + \frac{\sqrt{3}}{2}\right] = 29.69\text{ V}.$$

$$V_{rms}^2 = \frac{V_m^2}{2\pi}\left[\int_{\alpha}^{\pi}(1 - \cos 2\omega t).\,d\omega t\right] = \frac{V_m^2}{2\pi}\left[(\pi - \alpha) + \frac{1}{2}\left\{\sin 2\alpha\right\}\right]$$

$$V_{orms}^2 = \frac{V_m^2}{2\pi}\left[(\pi-\alpha) + \frac{1}{2}\sin 2\alpha\right]$$

$$V_{orms} = 69.68\ V.$$

c) $P = \frac{V_{orms}^2}{R} = \frac{69.68^2}{R} = \frac{4855.83}{R}\ W.$

$= 485.58\ W.$

d)

$$V_o = 23.87 = \frac{V_m}{2\pi}(1+\cos\alpha) = 23.87$$

$$\Rightarrow \boxed{\alpha = 60^\circ}$$

$\cancel{\omega t} = \quad \omega t = \alpha.$

$$\Rightarrow t = \frac{\alpha}{\omega} = \frac{\pi}{3\times 2\pi f} = \frac{1}{6\times 50} = 3.33\ ms.$$

5)

$$v_o(t) = v_L(t) + E + iR$$

$$\Rightarrow \langle v_o(t)\rangle = \langle v_L(t)\rangle^{0} + \langle E\rangle + \langle i\rangle R.$$

$$\Rightarrow \langle i(t)\rangle = \frac{50-10}{10} = \frac{40}{10} = 4A.$$

6) 1) $V_o = DV_{dc} = 0.5\times 100 = 50V.$

2) $I_L = I_o = \frac{50}{10} = 5A.$

3). $\cdot\ P_{in} = P_{out}$

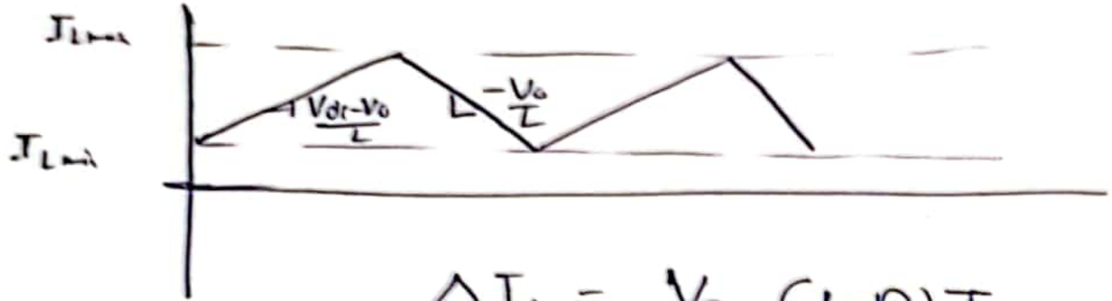
$\Rightarrow 100 \times I_{sw} = 50\times 5.$

$\Rightarrow I_{sw} = \frac{250}{100} = 2.5A.$

$i_{sw} + i_D = i_L$

$\Rightarrow \langle i_{sw}\rangle + \langle i_D\rangle = \langle i_L\rangle$

$\Rightarrow I_D = I_L - I_{sw} = 5 - 2.5 = 2.5A.$



$$\Delta I_L = \frac{V_o}{L}\cdot(1-D)T_s$$

$$= \frac{5\cancel{0}}{6\cancel{0}\cancel{m}} \times \frac{1}{2} \times \frac{1}{2\cancel{k}}$$

$$= \frac{5}{24} = 208.33\,mA = 0.208\,A.$$

$$I_{Lmin} = I_L \cancel{+} - \frac{\Delta I_L}{2}$$

$$= 5 - 0.104$$

$$= 4.896\,A.$$

$$I_{Lmax} = I_L + \frac{\Delta I_L}{2} = 5+0.104 = 5.104\,A.$$