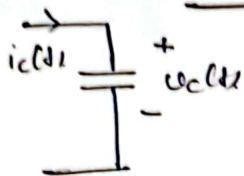# Assignment 1 (Solutions)

1)

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

$$\Rightarrow u_c(t) \cdot d$$
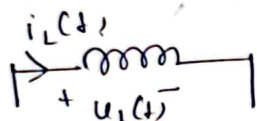
$$\Rightarrow i_c(t) \cdot dt = C \cdot du_c$$

$$\Rightarrow \int_{u_c(t+T)}^{u_c(t)} du_c = \int_{t}^{t+T} i_c(\tau) \cdot d\tau$$

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

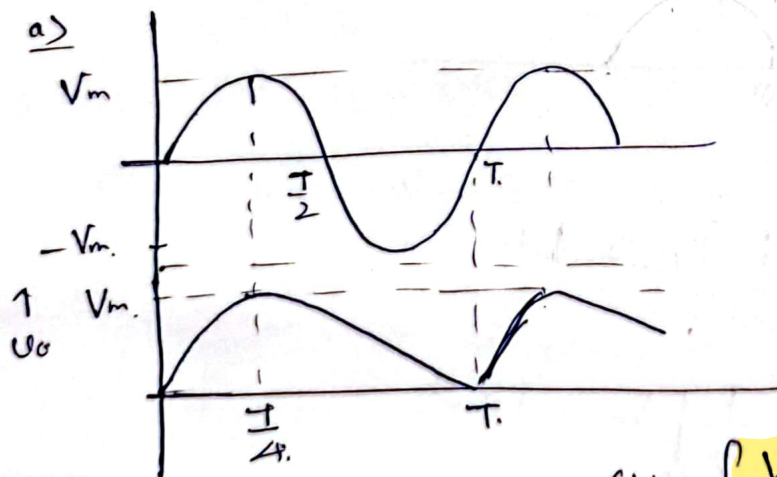$$\Rightarrow \boxed{\langle I_c(t)\rangle = 0.} \quad \boxed{\text{QED}}$$

2)

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

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

$$\Rightarrow \boxed{\langle u_L(t)\rangle = 0.} \quad \boxed{\text{QED}}$$
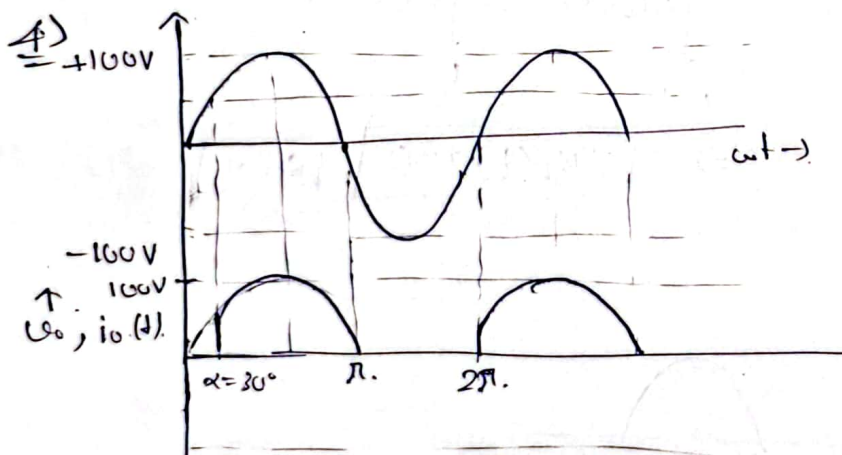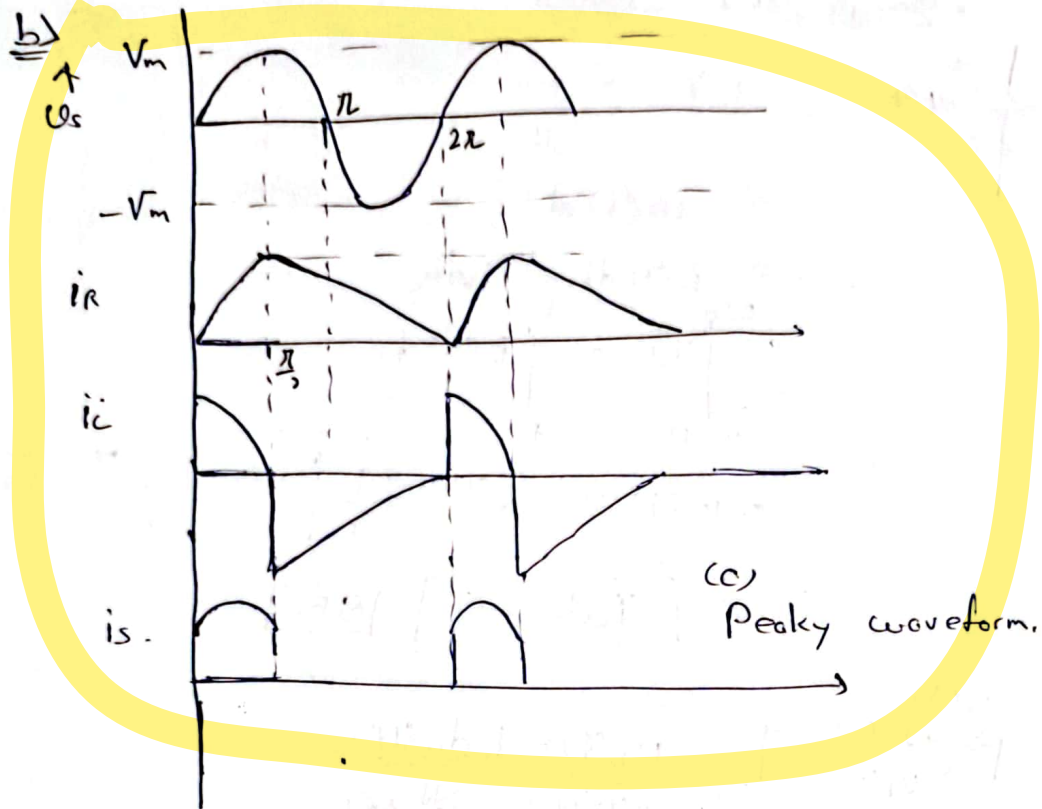
3) a)

$$u_0(t) = \begin{cases} V_m \sin\omega t, & 0 < t \leq \frac{T}{4} \\ 0 - (0 - V_m)e^{-(t - \frac{T}{4})/\tau}, & \frac{T}{4} \leq t < T \end{cases}$$

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

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

b)

(c) Peaky waveform.

4)

$$V_0 = \frac{1}{2\pi} \int_{\alpha}^{2\pi} v_s(t)\, d\omega t$$

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

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

$$V_0 = \frac{100}{2\pi}\left[1 + \frac{\sqrt{3}}{2}\right] = 29.69\, V.$$

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

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

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

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

$$= 485.58 \text{ W.}$$

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

$$\Rightarrow \boxed{\alpha = 60°}$$

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

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

5)

$\boxed{v_G(t) = v_L(t) + E + iR}$

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

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

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

2). $I_L = I_o = \frac{50}{10} = 5 \text{ A.}$
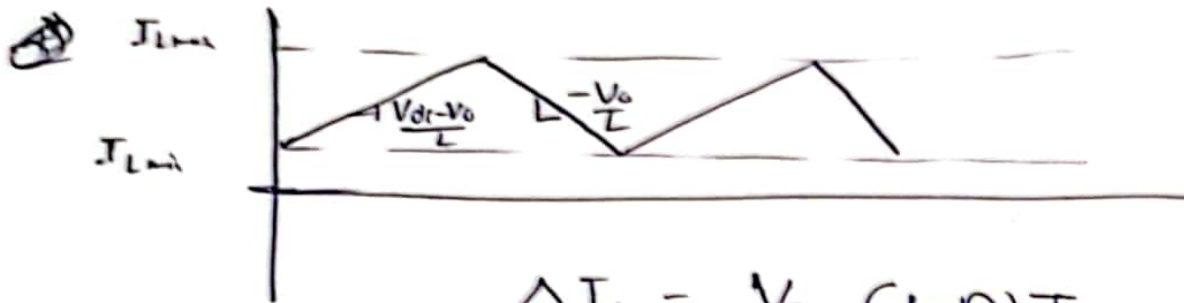
3). $\boxed{P_{in} = P_{out}}$

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

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

$i_{sw} + i_D + = i_L$

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

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

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

$$= \frac{50}{60\mu} \times \frac{1}{2} \times \frac{1}{2K}$$

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

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

$$= 5 - 0.104$$

$$= 4.896 A.$$

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