یا لطیف

رضا ادیب پور
۹۸۱۴۳۵۰۳
تمرین سری ۲ آنک صفتی

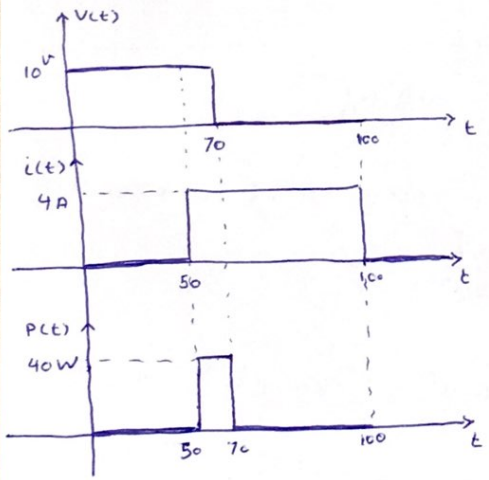
#2-4

$$v(t) = \begin{cases} 10 & ; \ 0 < t < 70^{ms} \\ 0 & ; \ 70^{ms} < t < 100^{ms} \end{cases} \qquad T = 100$$

$$i(t) = \begin{cases} 0 & ; \ 0 < t < 50 \\ 4^{A} & ; \ 50 < t < 100 \end{cases}$$

a): $p = ?$

$$P = v(t)\,i(t) = \begin{cases} 0 & ; \ 0 < t < 50^{ms} \\ 40^{W} & ; \ 50 < t < 70 \\ 0 & ; \ 70 < t < 100 \end{cases}$$



b) $P = ?$

$$P = \frac{1}{T}\int_{0}^{T} v(t)\,i(t)\,dt = \frac{1}{100^{m}}\left[\int_{0}^{5} 0\,dt + \int_{50}^{70} 40\,dt + \int_{70}^{100} 0\,dt\right] =$$

$$= \frac{1}{100}\left(40\,t\Big|_{50}^{70}\right) = \underline{8\,W}$$

c) $W = ?$

$$P = \frac{W}{T} \Rightarrow W = PT = 8^{W} \times 100^{ms} = 800^{mJ} = 0.8\,J$$

#2_9

$$\begin{cases} P = 1500^{W} \\ v(t) = 120\sqrt{2}\sin(2\pi 60t) \\ \text{on period} : 5\ \text{min} \\ \text{off period}: 7\ \text{min} \end{cases} \longrightarrow T = 12^{min}$$

a) $\max\{P(t)\} = ?$ $\qquad P = \frac{V_m I_m}{2} = 1500 \Rightarrow I_m = \frac{2\times 1500}{120\sqrt{2}} = 12.5\sqrt{2}$

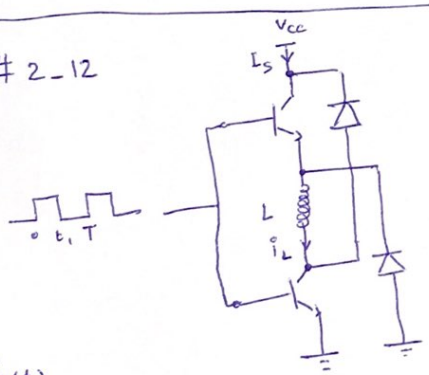
$$P(t) = V_m I_m \sin^2(\omega t) = (12.5\sqrt{2}) \times (120\sqrt{2}) \sin^2(\omega t) = \underbrace{3000}_{max} \sin^2(\omega t)$$

$$\Rightarrow \boxed{\max\{P(t)\} = 3000^{W}}$$

b) P in 12^{min} cycle : $\qquad P = 1500 \times \frac{5}{12} = 625^{W}$

c) W in 12^{min} cycle: $\qquad W = PT = 625^{W} \times 12^{min} = 7500\,j$

#2_12



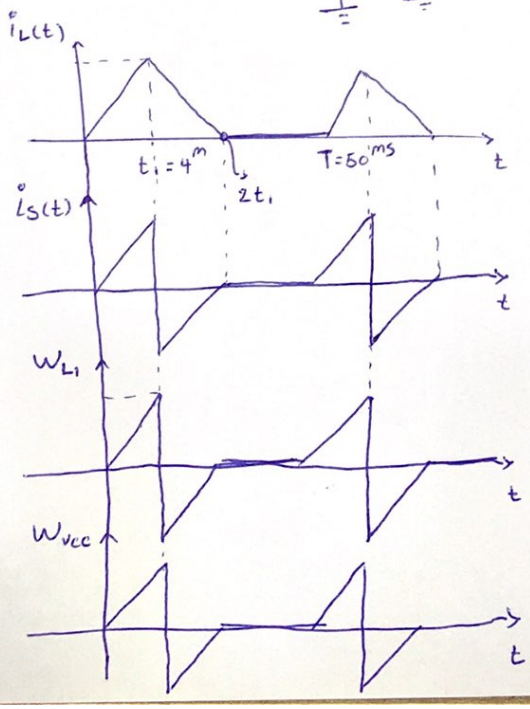
$$\begin{cases} L = 50^{mH} \\ V_{cc} = 90^{V} \\ t_1 = 4^{ms} \\ T = 50^{ms} \end{cases}$$

a) $W_{L,\,Peak} = ?$

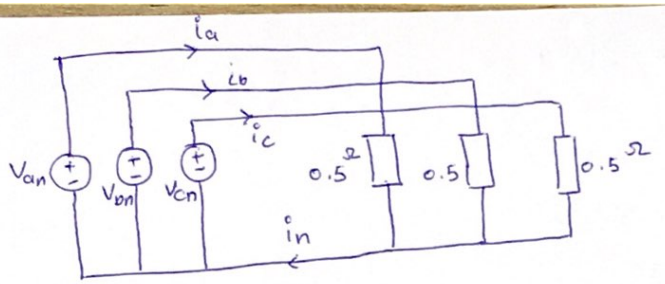
$$\frac{V_{cc}\,t}{L} = \frac{90t}{50^{m}} \leftarrow i_L(t) = 1800t \;;\; 0 < t < 4^{ms}$$

$$\Rightarrow i_L(t = 4^{ms}) = 1800(4^{m}) = 7.2^{A}$$

$$\Rightarrow W_{L,\,Peak} = \frac{(V_{cc}\,t_1)^2}{2L} = \frac{(90 \times 4^{m})^2}{2 \times 50^{mH}} = 1.296\,J$$



2-16



$I_{rms} = 12\ A$

$P_{\varphi} = R I_{rms}^2 = \frac{1}{2}(12)^2 = 72\ W$, $P_{Nutral} = R I^2 = \frac{1}{2}(12\sqrt{3})^2 = 216\ W$

$P_{Total\ 1\varphi} = P_{\varphi} + P_{Nutral} = 72 + 216 = 288\ W$ $P_{Total\ 3\varphi} = 3(72) + 216 = 432\ W$

$R_{Nutral} = \frac{P_{Nutral}}{I_{Nutral}^2} = \frac{72}{(12\sqrt{3})^2} = 0.167\ \Omega$

2-19

$v(t) = 2 + 5\cos(2\pi 60t) - 3\cos(4\pi 60t + 45^\circ)$

$i(t) = 1.5 + 2\cos(2\pi 60t + 20^\circ) + 1.1\cos(4\pi 60t - 20^\circ)$

a) V_{rms} & I_{rms} b) $P = ?$

$V_{rms} = \left[2^2 + \left(\frac{5}{\sqrt{2}}\right)^2 + \left(\frac{3}{\sqrt{2}}\right)^2\right]^{\frac{1}{2}} = 4.58\ V$

$I_{rms} = \left[1.5^2 + \left(\frac{2}{\sqrt{2}}\right)^2 + \left(\frac{1.1}{\sqrt{2}}\right)^2\right]^{\frac{1}{2}} = 2.2\ A$

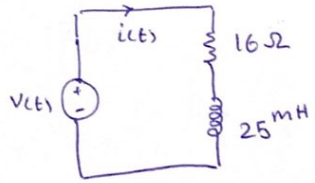
b) $P = V_o I_o + \sum_{n=1}^{\infty} \frac{V_m I_m}{2}\cos(\theta_n - \varphi_n) = 2 \times 1.5 + \left(\frac{5}{\sqrt{2}}\right)\left(\frac{2}{\sqrt{2}}\right)\cos(-20^\circ) + \left(\frac{3}{\sqrt{2}}\right)\left(\frac{1.1}{\sqrt{2}}\right) \cdot \cos(-115^\circ) = 7\ W$

2-22

Fourier series of a ns Periodic Voltage: $v(t) = 6 + 5\cos(2\pi 60t) + 3\cos(6\pi 60t)$

$R_L = 16\ \Omega$ & $L_L = 25\ mH \Rightarrow Z_L = R_L + LS$

$P = ?$



$P = R I_{rms}^2$

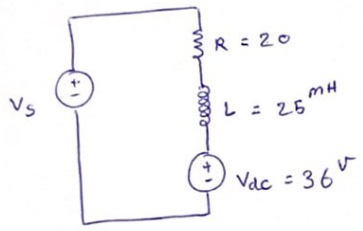
$I_o = \frac{V_o}{R} = \frac{6}{16} = 0.375\ A$

$$I_1 = \frac{5}{16 + j(2\pi 60)(0.025)} = 0.269\,A$$

$$I_2 = \frac{3}{16 + j(6\pi 60)(0.025)} = 0.0923^{A}$$

$$\Rightarrow I_{rms} = 0.375^2 + \left(\frac{0.269}{\sqrt{2}}\right)^2 + \left(\frac{0.0923}{\sqrt{2}}\right)^2 = 0.426^{A} \Rightarrow P = R I_{rms}^2 = (0.426)^2 \times 16 = 2.90^{W}$$

#2_25



$$V_s(t) = 50 + \sum_{n=1}^{\infty} \left(\frac{400}{n\pi}\right) \sin(200n\pi t)$$

$$P = V_o I_o + \sum_{n=1}^{\infty} \frac{V_m I_m}{2} \cdot \cos(\theta_n - \varphi_n)$$

$$I_o = \frac{V_o - V_{dc}}{R} = \frac{50 - 36}{20} = \boxed{0.7\,A}$$

$$P_{o,R} = R I_o^2 = 20(0.7)^2 = 9.8^{W}, \quad P_{Vdc} = I_o V_{dc} = (0.7) \times 36 = 25.2^{W}$$

$$P_L = 0$$

بالتعويض:

if $n = 0 \rightarrow V_s = 50^{V} \rightarrow Z_n = 20^{\Omega} \rightarrow I_n = 0.7^{A} \rightarrow \theta = 0 \rightarrow P_n = 9.8^{W}$

if $n = 1 \rightarrow V_s = 127.32^{V} \rightarrow Z_n = 25.43^{\Omega} \rightarrow I_n = 5.01^{A} \rightarrow \theta = 0.67 \rightarrow P_n = 250.66^{W}$

if $n = 2 \rightarrow V_s = 63.66 \rightarrow Z_n = 37.24^{\Omega} \rightarrow I_n = 1.71^{A} \rightarrow \theta = 1 \rightarrow P_n = 29.22^{W}$

if $n = 3 \rightarrow V_s = 42.44 \rightarrow Z_n = 51.16^{\Omega} \rightarrow I_n = 0.83^{A} \rightarrow \theta = 1.17 \rightarrow P_n = 6.87^{W}$

$$\Rightarrow P_R = \sum_{n=0}^{\infty} P_n \approx 9.8 + 250.66 + 29.22 + \cdots = \boxed{300\,W}$$

#2_29

$$\begin{cases} v(t) = 240\sqrt{2}\sin(2\pi 60t)\ V \\ i(t) = 8\sin(2\pi 60t) + 4\sin(4\pi 60t)\ A \\ \text{a) } P = ? \quad \text{b) } PF = ? \quad \text{c) } THD = ? \quad \text{d) distortion factor} = ? \quad \text{e) crest factor} = ? \end{cases}$$

$$I_{1,rms} = \frac{8}{\sqrt{2}} = 5.66^{A}, \quad I_{2,rms} = \frac{4}{\sqrt{2}} = 2.82^{A} \Rightarrow I_{rms} = \sqrt{5.66^2 + 2.82^2} = 6.32^{A} \ \&\ I_{peak} = 10.38$$

a) $P = V_{1,rms} I_{1,rms} \cos(\theta_1 - \varphi_1) = 240 \times 5.66 \cos(0) = 1358^{W}$

b) $PF = \frac{P}{S} = \frac{P}{V_{rms} I_{rms}} = \frac{1358}{240 \times 6.32} = 0.895 = 89.5\%$

c) $THD_i = I_{2,rms} / I_{rms} = 2.82/6.32 = 0.446 = 44.6\%$

d) $DF = \frac{I_{1,rms}}{I_{rms}} = \frac{5.66}{6.32} \times 100 = 89.6\%$

e) $CF = \frac{I_{peak}}{I_{rms}} = \frac{10.38}{6.32} = 1.64$