Assignment No. 2 Solution.

Q# 01

$V_{rms} = 400\ V$

$f = 50\ Hz$.

$R_L = 100\ \Omega$.

$C = 350\ \mu F$

$\alpha = 0.49\ rad$.

a) $\Delta V = ?$

Sol:.

$\Delta V_o = V_m (1 - \sin\alpha)$.

$\Delta V_o = 400 \times \sqrt{2} (1 - \sin(0.49))$

$\Delta V_o = 299.768\ V$

b) $\Delta V_o = \dfrac{V_m}{2fRC}$

$\Rightarrow C = \dfrac{V_m}{2fR\Delta V_o}$

$$C = \frac{400 \times \sqrt{2}}{2 \times 50 \times 100 \times 1.5}$$

$$C = 0.037 \approx 37 \times 10^{-3} F$$

Q#03

$V_{rms} = 230\ V$

$\alpha = 25^{\circ}$

$R_L = 250\ \Omega$.

(a) $\forall\ I_{av} = ?$

$$I_{o\,avg} = \frac{V_{o\,avg}}{R}$$

So for $V_{o\,avg}$.

$$V_{o,avg} = \frac{V_m}{\pi}(1 + \cos\alpha)$$

$$= \frac{230\sqrt{2}}{3.14}(1 + \cos 25^{\circ})$$

$$= 196.78\ V.$$

so.

$$I_{avg} = \frac{196.78}{250} = 0.787A.$$

(b) P_{abs}

$$P_{abs} = I_{o,rms}^2 \times R$$

$$I_{o,rms} = \frac{V_m}{R}\sqrt{\frac{1}{2} - \frac{\alpha}{2\pi} + \frac{\sin 2\alpha}{4\pi}}$$

$$= \frac{230 \times \sqrt{2}}{250}\sqrt{0.5 - \frac{0.436}{2\times 3.14} + \frac{\sin 2(0.436)}{4\times 3.14}}$$

$$= 1.3 \times 0.60$$

$$= 0.78\ A.$$

$$P = (0.78)^2 \times 250 = 152.1\ W.$$

(c) Source VA.

$$S = V_{in,rms} \times I_{in,rms}$$

$$S = 230 \times 0.78 = 179.4\ VA$$

(d) $$PF = P/S = \frac{152.1}{179.4}$$

$$= 0.84$$

Q4.

$V_{rms} = 230\ V$

$R = 150\ \Omega$

(a) I_{peak}, avg & rms ?

$$i_{avg} = \frac{V_{o,avg}}{R} = \frac{2V_m}{\pi R} = \frac{2 \times 230 \times \sqrt{2}}{\pi \times 150}$$

$$= \frac{650.44}{471} = 1.38\ A$$

$$i_{d,avg} = \frac{i_{avg}}{2} = \frac{1.38}{2} = 0.69\ A$$

$$i_{o,peak} = \frac{V_m}{R} = \frac{230 \times \sqrt{2}}{150} = 2.16\ A$$

$$i_{d,peak} = i_{o,peak} = 2.16\ A$$

$$i_{o,rms} = \frac{V_{o,rms}}{R} = \frac{V_m}{\sqrt{2} \times R} = \frac{230 \times \sqrt{2}}{\sqrt{2} \times 150} =$$

$$= 1.53\ A$$

$$i_{d,rms} = \frac{i_{o,rms}}{\sqrt{2}} = 1.084\ A$$

(b) i peak reverse voltage

$$V_d = V_m = 230 \times \sqrt{2} = 325.22\,V.$$

Question 2 solution

From the parameters given,

$$V_m = 120\sqrt{2} = 169.7 \text{ V}$$

$$\omega RC = (2\pi 60)(500)(10)^{-6} = 18.85$$

The angle θ is

$$\theta = -\tan^{-1}(18.85) + \pi = 1.62 \text{ rad} = 93°$$

$$V_m \sin\theta = 169.5 \text{ V}$$

The angle α is

$$\sin(1.62)e^{-(\pi+\alpha-1.62)/18.85} - \sin\alpha = 0$$

$$\alpha = 1.06 \text{ rad} = 60.6°$$

(*a*) Peak-to-peak output voltage

$$\Delta V_o = V_m(1 - \sin\alpha) = 169.7[1 - \sin(1.06)] = 22 \text{ V}$$

(*b*) With the ripple limited to 1 percent, the output voltage will be held close to V_m and the approximation of Eq. (4-13) applies.

$$\frac{\Delta V_o}{V_m} = 0.01 \approx \frac{1}{2fRC}$$

Solving for C,

$$C \approx \frac{1}{2fR(\Delta V_o/V_m)} = \frac{1}{(2)(60)(500)(0.01)} = 1670 \ \mu\text{F}$$