EE114 POWER ENGINEERING 1

ASSIGNMENT - 1

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Question 1)

$$v = 100\cos(240\pi t + 45^\circ)\ mV$$

1) $f = \frac{\omega}{2\pi} \Rightarrow \frac{240\pi}{2\pi} \Rightarrow \boxed{120\ Hz}$ $(\because \omega = 240\pi)$

2) Time period $= \frac{1}{f} = \frac{1}{120} = \boxed{8.3\ ms}$

3) $V_{max} = \boxed{100\ mV}$

4) $V(0) = 100\cos(45^\circ) = \boxed{70.71\ mV}$

5) $\phi = 45^\circ$ / $\frac{\pi}{4}$ radians

6) v = zero when $(240\pi t + 45^\circ) = \frac{\pi}{2}$

$$\therefore \quad 240t + \frac{1}{4} = \frac{1}{2} \Rightarrow t = \frac{1}{960} = \boxed{1.041\ ms}$$

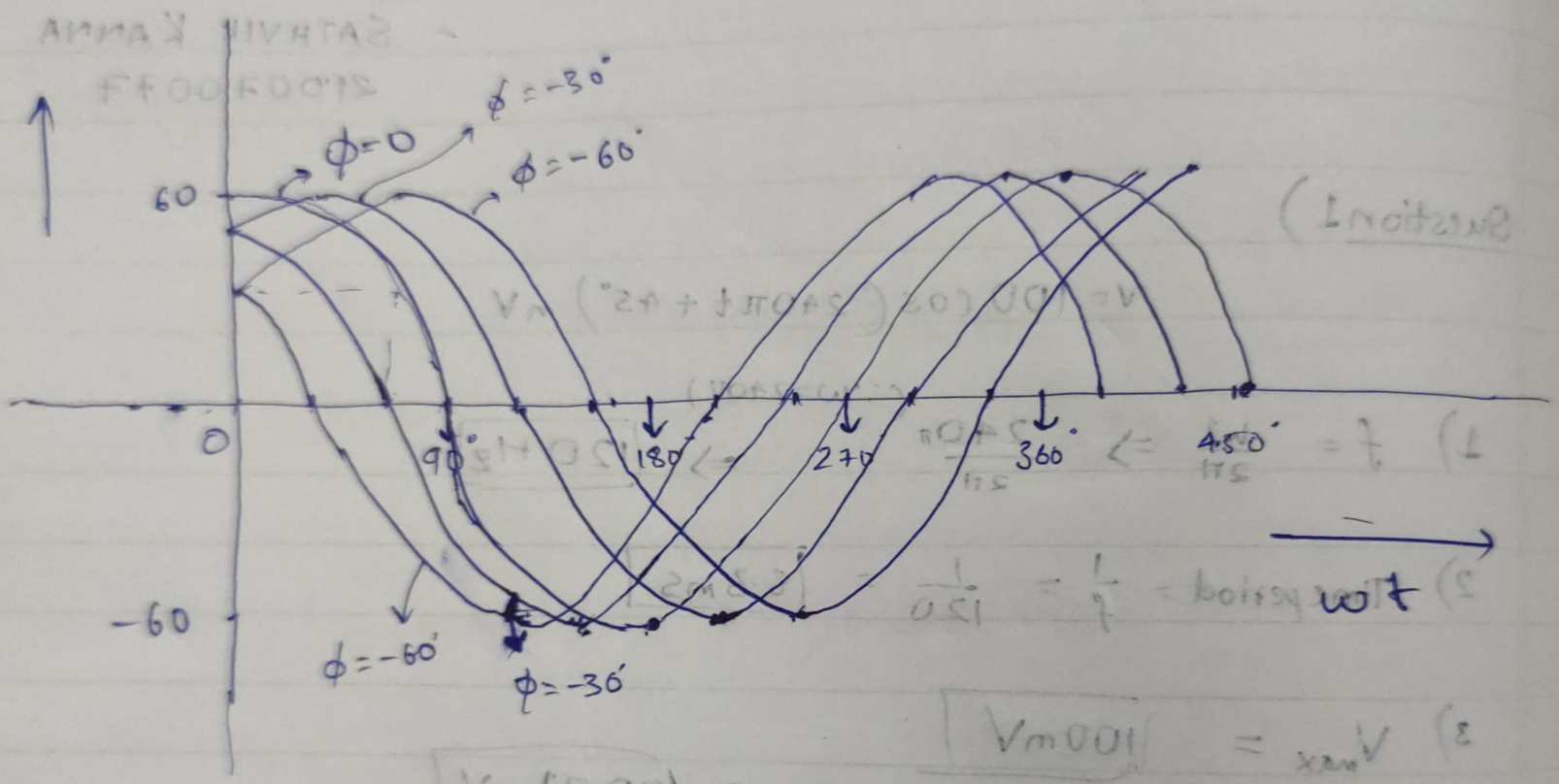
7) $\frac{dv}{dt} = -100 \cdot 240\pi \sin(240\pi t + \pi/4)\ mV$

$dv/dt = 0$ when $240\pi t + \frac{\pi}{4} = \pi$

$$t = \frac{3}{960} = \boxed{3.125\ ms}$$

Question 2)

$$v = 60\cos(\omega t + \phi)$$



1) As ϕ becomes more positive the function shifts towards left.

2) as ϕ changes from 0 to -30° the graph shifts rightwards

Question 3

$$v(t) = 170\cos(120\pi t - 60^\circ)$$

1.) maximum value of voltage is 170V

2) frequency $= \frac{\omega}{2\pi} \Rightarrow \frac{120\pi}{2\pi} = 60\text{hz}$

3) $\omega = 120\pi$ rads per second.

4) phase angle in radian $= -\pi/3$

5) phase angle in degrees $= -60^\circ$

6) period $= \frac{1}{f} = 16.66\text{ ms}$

7) $V = 170$ when $120\pi t - \frac{\pi}{3} = 0 \Rightarrow t = \frac{1}{360} = 2.77\text{ms}$

8) expression is $170\cos\left(120\pi\left(t - \frac{125}{18000}\right) - 60^\circ\right)$

$$\Rightarrow 170\cos(120\pi t - 1.16\pi)$$

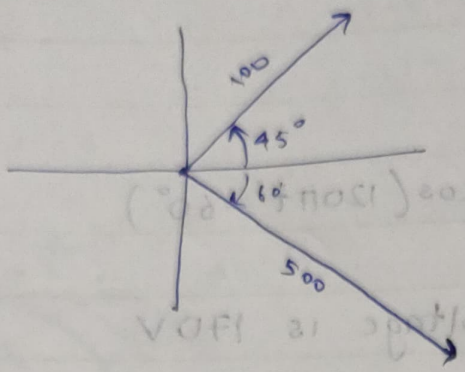
(9) the function should be shifted T - ~~16.66ms~~ 2.77 ms to right

$\Rightarrow$ 13.89ms

10) the function should be shifted 2.77 ms to left.

Question 4)

1.)



x component = $250 + 50\sqrt{2}$

y component = $50\sqrt{2} - 250\sqrt{3}$

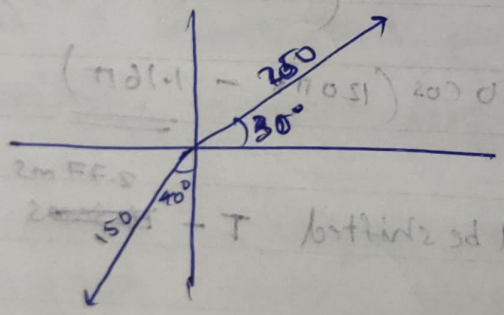
$\omega = 300$

$\Rightarrow \sqrt{(x_{comp})^2 + (y_{comp})^2}$ = Amplitude $\Rightarrow$ ~~587.15~~ 483.85

phase = $\tan^{-1}\left(\frac{y_{comp}}{x_{comp}}\right) \Rightarrow -48.48^\circ$

$\Rightarrow$ ~~587.15~~ 483.85 $\cos\left(300t - 48.48^\circ\right)$

2)



x component = 120.08

y component = 10.09

$-150 \sin(377t + 140) \Rightarrow -150 \cos(377t + 50^\circ)$

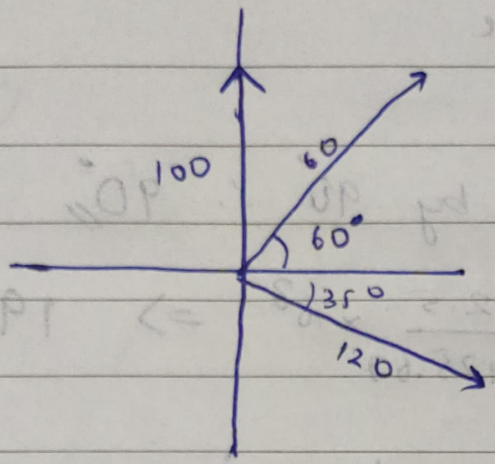
$\Rightarrow 150 \cos(377t - 130^\circ)$

Amplitude = $\sqrt{(x^2) + (y^2)}$ = 120.42

phase = $\tan^{-1}\frac{y}{x}$ = 4.80°

$\Rightarrow$ $120.42 \cos(377t + 4.80^\circ)$

3)



x comp = 128.29

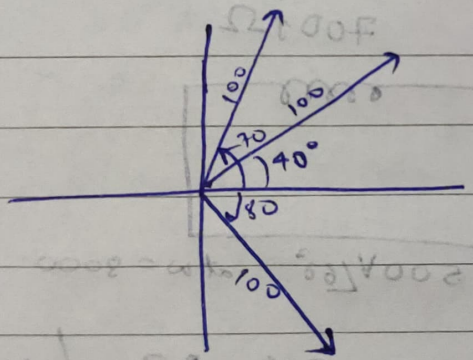
y comp = ~~-16.86~~ 83.14

Amp = ~~120.14~~ 152.88

Phase = 32.94°

$\Rightarrow \underline{152.88 \cos(100t + 32.94^\circ)}$

4)



$x = 100\cos 70 + 100\cos 40 + 100\cos 80$

$y = 100\sin 70 + 100\sin 40 - 100\sin 80$

$\therefore 141.42\cos(\omega t + 25^\circ)$

Question 5 $V = 2.5\cos(\omega t)\ mV$

$\omega = 2\pi \cdot 40 \times 10^3$

1. $\omega \Rightarrow 80\pi \times 10^3$ rad/sec

2. current leads voltage by 90° $\therefore 90^\circ$

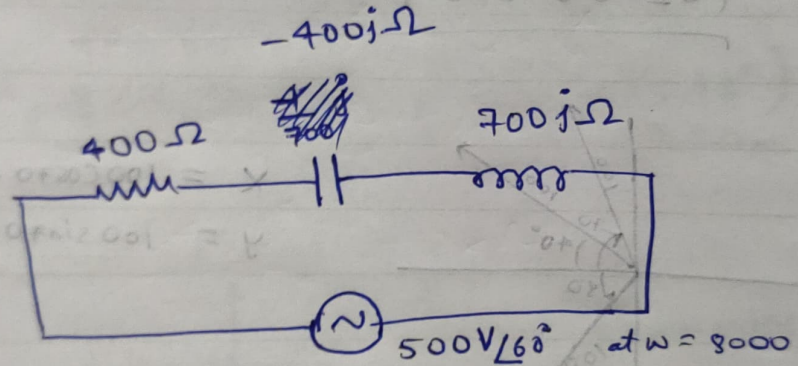
3. $\frac{V}{I} = X_c \Rightarrow \frac{2.5}{125.67} \times 10^3 \Rightarrow 19.89$

4. $\frac{1}{C\omega} = 19.89 \quad C = \frac{1}{19.89 \times} = 2 \times 10^{-7} = 0.2\mu F$

5. $-19.89j$

Question 6

1)

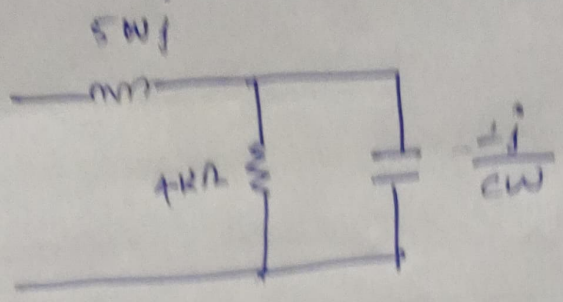


2) $\tan^{-1}\frac{3}{4} = 36.87 \quad \therefore 60 - 36.87 = \underline{\underline{23.13^\circ}}$

3) $I = 1\angle 23.13^\circ$

4) $i(t) = 1 \cdot \cos(8000t + 23.13)$

Question 7



$$LWj + \frac{\frac{-Rj}{CW}}{R - \frac{j}{CW}}$$

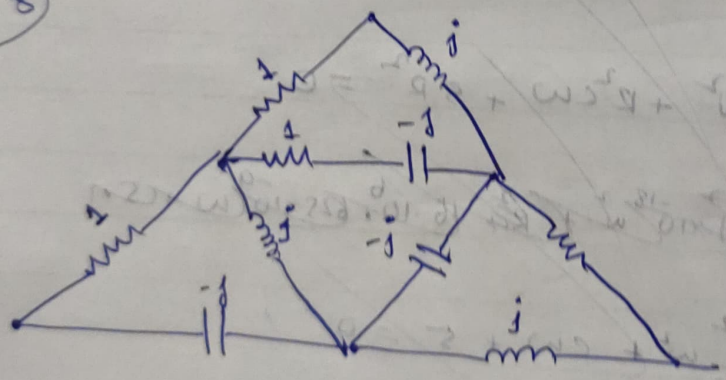
$$\Rightarrow \quad 5w = \frac{16 \times 10^5}{w^2 + 16 \cdot 10^4}$$

$$w^2 + 16 \cdot 10^4 = 32 \times 10^4$$

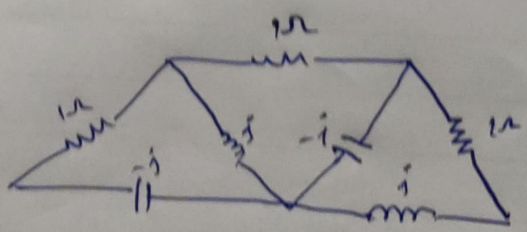
1) $w = 400$ rad/sec

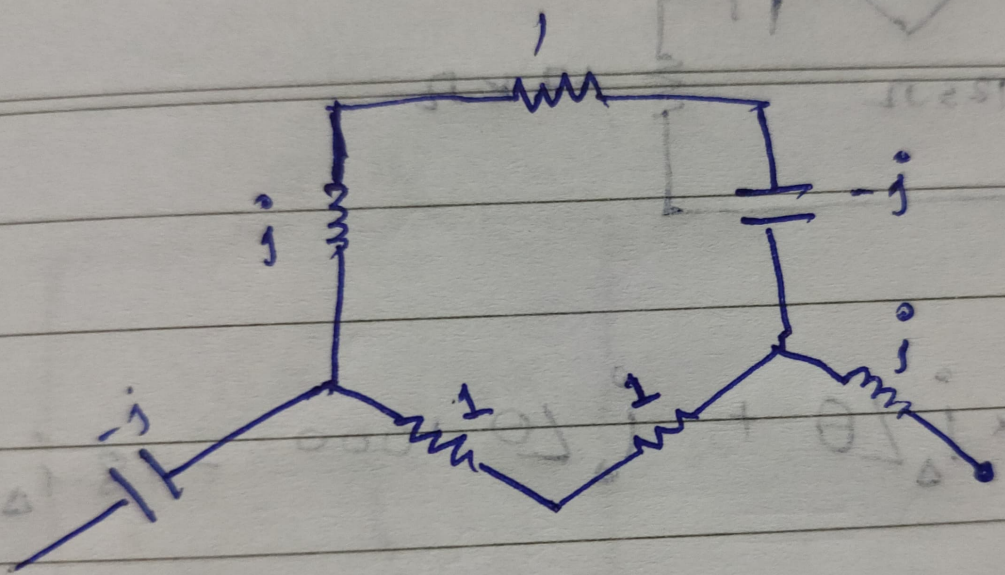
2) $\frac{64 \times 10^7}{32 \times 10^4} = 2k\Omega$

Question 8



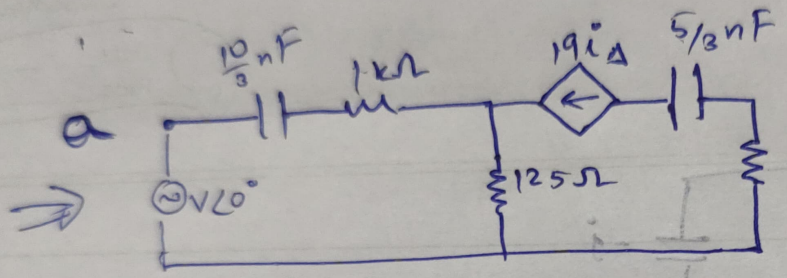
$$\frac{(1+j)(1-j)}{2} = 1\Omega.$$





$\Rightarrow \quad \frac{2}{3}\Omega$

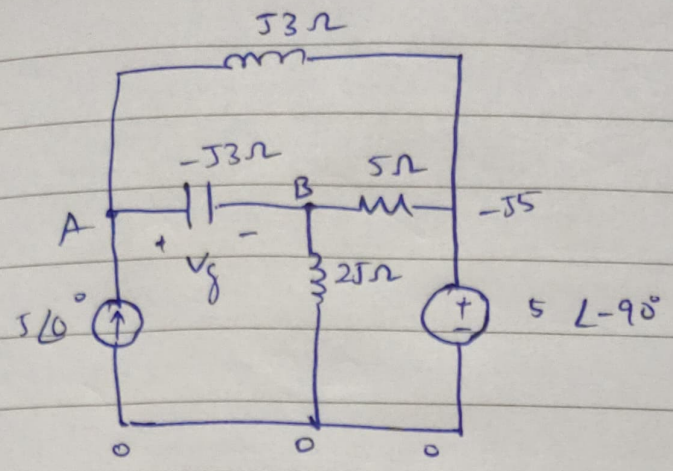
(10)



$$V\angle 0^\circ = -j\,12000 \times \dot{i}_\Delta \angle\theta + \dot{i}_\Delta \angle\theta\, 1000 - 18\, i_\Delta \angle\theta \times 125$$

$$Z_{ab} = \frac{V\angle 0^\circ}{i_\Delta \angle\theta} = -j \times 12000 - 1250$$

(11)



$$5 = \frac{V_A + J5}{J3} + \frac{V_A - V_B}{-J3}$$

$$\frac{V_B}{J2} + \frac{V_B + J5}{5} + \frac{V_D - V_A}{-J3} = 0$$

$$J15 = V_A + J5 + V_B - V_A$$

$$V_B = J10$$

$$\Rightarrow \quad 5 + 3J + \frac{J10 - V_A}{-J3} = 0$$

$$-15J + 9 + J10 - V_A = 0$$

$$V_A = -J5 + 9$$

$$V_A - V_B = -J15 + 9$$