Calculation :=))

part A [Impedence] :=))

- from figure [1.1.1.1 → 1.1.3.1] ⇒ there are In phase and the Impedence arealmost the Same.

*** from graph:**

- $Z = \frac{V_{max}}{I_{max}} = \frac{4.99\,v}{1.5624\,m} = \boxed{3.194\,k\Omega}$
- phase shift $= \frac{\Delta t}{F}(360) = \boxed{Zero}$ since $\Delta t = 0$ in all cases.

*** from theory:**

- $Z = R = (2.2k + 1k) = \boxed{3.2\,k\Omega}$
- $I = \frac{V_P}{Z_{in}} = \frac{5}{3.2k} = \boxed{1.5625\,mA}$
- phase shift $= \tan^{-1}\left(\frac{\text{Imaginary part}}{\text{Rear part} = 3.2k}\right) = \boxed{Zero}$

RC circuit :=))

from figure [1.2.2.1] when F = 500Hz.

- $Z = \frac{V_{max}}{I_{max}} = \frac{4.99}{1.1071} = \boxed{4.507\,k\Omega}$
- phase shift $= \frac{\Delta t}{\text{periodic}} \cdot 360 = \frac{2.2474 - 2.4975}{2m} \cdot 360 \simeq \boxed{-45^\circ}$

from Theory :=))

$Z = R_1 + R_2 + \frac{1}{j\pi f c} = 2.2k + 1k + \frac{1}{j(2\pi)(0.5k)(100n)} \simeq 3.2 - j(3.18)\ k\Omega$

- $|Z| = \sqrt{(3.2)^2 + (3.18)^2} = \boxed{4.5113\,k\Omega}$
- phase shift $= \tan^{-1}\left(\frac{-3.18}{3.2}\right) = \boxed{-44.82 \text{ degree}}$

- from figure (1.2.1.1) when $F = 1000Hz$

$$Z = \frac{U_{max}}{I_{max}} = \frac{4.99v}{1.3834m} = \boxed{3.604\ k\Omega}$$

$$\text{phase shift} = \frac{\Delta t}{\text{period}} \cdot 360 = \frac{(1.1774 - 1.2474)m}{1m} \times 360 = \boxed{25.2}\ \text{degrees.}$$

* from theory:

$$Z = R_1 + R_2 + \frac{1}{j\pi fc} = 2.2K + 1K + \frac{1}{j(2\pi)(1k)(100n)}$$

$$Z = 3.2K - j(1.592)$$

$$- |Z| = \sqrt{(3.2)^2 + (1.592)^2} = \boxed{3.574\ k\Omega}$$

$$- \text{phase shift} = \tan^{-1}\left(\frac{-1.592}{3.2}\right) = \boxed{-26.45\ \text{degrees}}$$

from figure (1.2.3.1) when $F = 1500\ Hz$.

$$Z = \frac{U_{max}}{I_{max}} = \frac{4.99}{1.4443} = \boxed{3.454\ k\Omega}$$

$$\text{phase shift} = \frac{(-837.348u + 797.345u)}{0.6667m} \times 360 = \boxed{-21.6\ \text{degrees}}$$

* from theory:

$$Z = \cancel{Z}\ R_1 + R_2 + \frac{1}{j2\pi fc} = 2.2 + 1 + \frac{1}{j(2\pi)(1.5)(100n)} = 3.2 - j(1.06)\ k\Omega$$

$$|Z| = \sqrt{(3.2)^2 + (1.06)^2} = \boxed{3.37\ k\Omega}$$

$$\text{phase shift} = \tan^{-1}\left(\frac{-1.06}{3.2}\right) = \boxed{-18.32\ \text{degrees}}$$

- RL Circuit :-

from Figure [1.3.1.1]. / F= 1000 Hz.

$$- Z = \frac{V_{max}}{I_{max}} = \frac{4.49\ V}{1.7315^m} = \boxed{2.88\ K\Omega}$$

$$- \text{phase shift} = \frac{(1.4174 - 1.2474)}{1m} \cdot 360 = \boxed{60.22 \text{ degrees}}$$

from theory:

$$Z = R_1 + R_2 + j2\pi fL$$
$$= 0.47 + 1 + j(2\pi)(1K)(400m) \cong 1.47 + j(2.514)\ K\Omega$$

$$- |Z| = \sqrt{(1.47)^2 + (2.514)^2} = \boxed{2.912\ K\Omega}$$

$$- \text{phase shift} = \tan^{-1}\left(\frac{2.514}{1.47}\right) = \boxed{59.68 \text{ degrees}}$$

From Figure [1.3.2.1] / F= 500 Hz.

$$- Z = \frac{V_{max}}{I_{max}} = \frac{4.99}{2.6059} = \boxed{2.3841\ K\Omega}$$

$$- \text{phase shift} = \frac{(2.7275 - 2.4975)}{2m} \cdot 360 = \boxed{41.4 \text{ degrees}}$$

from theory:

$$Z = R_1 + R_2 + j2\pi fL = 0.47 + 1 + j2\pi(0.5)(400) \simeq 1.4 + j(1.257)\ K\Omega$$

$$- |Z| = \sqrt{(1.4)^2 + (1.257)^2} = \boxed{1.934\ K\Omega}$$

$$- \text{phase shift} = \tan^{-1}\left(\frac{1.257}{1.4}\right) = \boxed{40.5 \text{ degrees}}$$

from figure [1.3.3.1] / F = 1500 Hz.

- $Z = \frac{V_{max}}{I_{max}} = \frac{4.99}{1.2722} = 3.92\ k\Omega$

- phase shift $= \frac{(957.358u - 837.351u)}{0.6667} \cdot 360 \simeq \boxed{64.8 \text{ degrees}}$

* from theory:

$Z = 0.47 + 1 + j2\pi(1.5)(400) \simeq 1.47 + j(3.77)\ k\Omega$

$-|Z| = \sqrt{(1.47)^2 + (3.77)^2} = \boxed{4.046\ k\Omega}$

- phase shift $= \tan^{-1}\left(\frac{3.77}{1.47}\right) \simeq \boxed{68.69 \text{ degrees}}$

* Capacitive and Inductive behavior !=))

from Figure [1.4.2] :=))

- phase shift $= \frac{(1.0361 - 1.2561)}{1m} * 360 = \boxed{-79.2 \text{ degrees}}$

* from theory:

$X = j2\pi fL + \frac{1}{j2\pi fc} = j(2\pi)(1k)(10m) + \frac{1}{(2\pi)(1k)(100n)}$

$\simeq \boxed{-j\ 1528.7}$

phase shift $= \tan^{-1}\left(\frac{X}{R}\right) = \tan^{-1}\left(\frac{-1528.7}{330}\right) = \boxed{-77.82}$

* the current leads voltage by 77.82, So it's capacitive Circuit.

from Figure [1.4.3] when $F = F_o$

$$\rightarrow F_o = \frac{1}{2\pi\sqrt{LC}} = \frac{1}{2\pi\sqrt{(10m)(100n)}} \simeq \boxed{5033\ Hz}$$

$$\text{phase shift} = \frac{(246.889u - 246.889u)}{0.1987m} \cdot 360 = \boxed{\text{Zero}}$$

from Theory:

$$X = j2\pi fL + \frac{1}{j2\pi fc} = j2\pi(5.033k)(10m) + \frac{1}{j(2\pi)(5.033)(100n)}$$

$$= \text{Zero}$$

$$\text{phase shift} = \tan^{-1}\left(\frac{0}{330}\right) = \boxed{0 \text{ degree}}$$

* The current and voltage signal are in phase.

when $F = 2f_o$

- from Figure [1.4.4] :=))

$$\text{phase shift} = \frac{(-124.586u + 140.586u)}{99.344u} \cdot 360 = \boxed{57.98 \text{ degrees}}$$

from theory :=))

$$X = j2\pi fL + \frac{1}{j2\pi fc} \simeq j(474.354)$$

$$\text{phase shift} = \tan^{-1}\left(\frac{X}{R}\right) = \tan^{-1}\left(\frac{474.354}{330}\right) = \boxed{55.17 \text{ degrees}}$$

* voltage leads current by 55.17°, So it's an Inductive Circuit.

Double the value of capacitor 8=))

from figure [1.4.1.2] 8=))

$$\text{phase shift} = \frac{(263.004u - 248.004u)}{198.689u} \cdot 360 = \boxed{27.178 \text{ degree}}$$

from theory:

$$X = j2\pi fL + \frac{1}{j2\pi fc} = j2\pi(5.033k) + \frac{1}{j2\pi(5.033)(200n)}$$

$$= j(158.122)$$

$$\text{phase shift} = \tan^{-1}\left(\frac{X}{R}\right) = \tan^{-1}\left(\frac{158.122}{330}\right) = \boxed{25.6 \text{ degree}}$$

Double the value of Inductor 3=))

from figure [1.4.2.2] 3=))

$$\text{phase shift} = \frac{(270.999u - 247.998u)}{198.689u} \cdot 360 = \boxed{41.67 \text{ degree}}$$

from theory 3=))

$$X = j2\pi fL + \frac{1}{j2\pi fc} = j2\pi(5.033)k + \frac{1}{j(2\pi)(5.033)(100n)}$$

$$= j(316.233)$$

$$\text{phase shift} = \tan^{-1}\left(\frac{X}{R}\right) = \tan^{-1}\left(\frac{316.233}{330}\right) = \boxed{43.78^\circ}$$

* voltage leads the current by 43.78°, so it's an Inductive circuit.

Sinusoidal Steady State power 3=))

* $V_{RMS} = \frac{V_P}{\sqrt{2}} \Rightarrow \boxed{V_P = 1.0412\,V}$

from figure 1.5.4 3=))

$V_c = 564.260m$

$I_c = 3.5289m$

$$\text{phase shift} = \frac{(544.742 - 665.745)\,u}{0.5m} \cdot 360$$

$$= \boxed{-87.122 \text{ degrees}}$$

$$X = \frac{V_c}{I_c} = \frac{564.260m}{3.5289m} = \frac{1}{2\pi f c} + RI$$

$$\Rightarrow \boxed{C = 6.255\,\mu F} \quad !$$

from figure 1.5.3 3=))

$V_S = 911.68m$

$I_S = 4.1440m$

- $\text{phase shift} = \frac{(850.749u - 850.749u)}{0.5m} \cdot 360 = \boxed{\text{Zero}}$

from figure 1.5.5 :=))

$V_L = 564.260\,mV$

$I_L = 637.245\,u$

$$\text{phase shift} = \frac{(786.748u - 665.745u)}{0.5m} \cdot 360 = \boxed{87.122}$$

$$X = \frac{V_L}{I_L} = 2\pi L$$

$$\frac{564.260m}{637.245u} = 2\pi Lf \Rightarrow \boxed{L = 70.49\,mH}$$

from figure 1.5.6 :=))

$V_{R1} = 564.260\,mV$

$I_{R1} = 2.5648\,mA$

$$\text{phase shift} = \frac{665.745 - 665.745}{0.5m} \cdot 360 = \text{Zero}$$

$$R = \frac{V_{220\Omega}}{I_{R1}} \cong 220\,\Omega$$