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A2+TA2

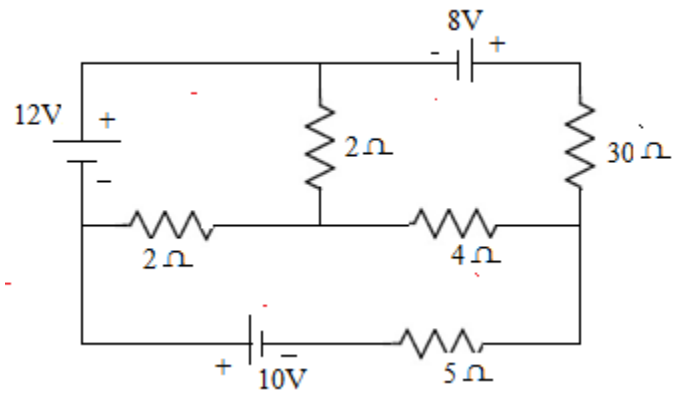
SCHOOL OF ELECTRICAL ENGINEERING

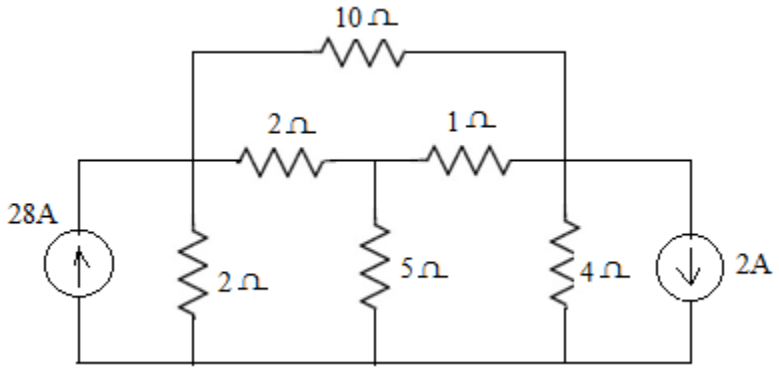
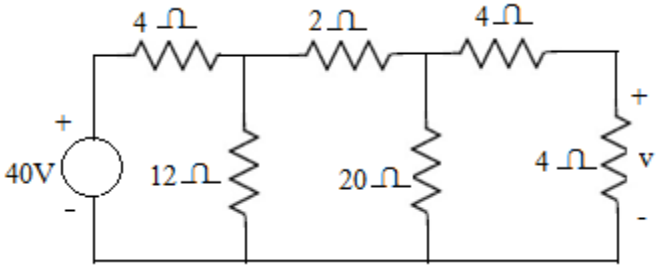
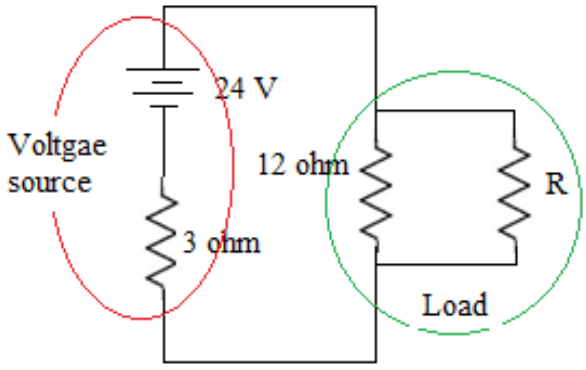
CAT – I

Fall Semester 2021-2022

Class Nbrs: VL2021220106061 **Course Code**: EEE 101L **Date of Exam: 24.10.2021**
Course Title : Basic Electrical and Electronics Engineering **Max. Marks : 30**
Faculty : **Dr. K. SUBRAMANIAN** **Duration:** 1 ½ hours

Note: Answer **ALL t**he Questions. Assume necessary data if required

Question Number		Question	Max. Marks	CO	BL
Q.1	a)	(i) State ohm's law and its limitation (ii) Define conductor, circuit, bi lateral circuit, node, and junction and distinguish node and junction of a circuit.	[4+6]	1	L1
	b)	State Kirchhoff's voltage and current laws and prove any one law's numerically with illustration	[10]	1	L1
	c)	Write short note on (i) Resistor (ii) Inductor (iii) capacitor	[10]	1	L1
	d)	Explain how inductor to hold back the energy after disconnected form the source with relevant diagram	[10]	1	L1
Q.2	a)	Determine the current flow through the 5 ohm resistor is shown in Fig.2 (a). using mesh analysis  **Fig.2(a)**	[10]	2	L3

	b)	Determine the current flow through the 5 ohm resistor is shown in Fig.2 (b). Using nodal analysis  **Fig. 2(b)**	[10]	2	L3
	c)	By using repeated source transformations, find the value of voltage v in Fig. 2(c).  **Fig. 2(c)**	[10]	2	L3
	d)	In Fig. 2(d) what value of R will allow maximum power transfer to the load? Also calculate the maximum total load power. All resistances are in ohms.  **Fig. 2(d)**	[8+2]	2	L3
Q.3	a)	The coil having a resistance of 10 Ω and an inductance of 0.2 H is connected to a 100-V, 50-Hz supply. Calculate (a) the impedance of the coil (b) the reactance of the coil (c) the current taken and (d) the phase difference between the current and the applied voltage	[10]	2	L3

	b)	Two inductive impedance A and B are connected in series. A has R = 5 Ω, L = 0.01 H; B has R = 3 Ω, L = 0.02 H. If a sinusoidal voltage of 230 V at 50 Hz is applied to the whole circuits calculate (a) the current (b) the power factor (c) the voltage drops. Draw a complete vector diagram for the circuit	[10]	2	L3
	c)	Two coils are connected in series. With 2 A d.c through the circuit, the p.ds. across the coils are 20 and 30 V respectively. With 2 A a.c. at 40 Hz, the p.ds. across the coils are 140 and 100 V respectively. If the two coils in series are connected to a 230-V, 50-Hz supply, calculate (a) the current (b) the power (c) the power factor	[10]	2	L3
	d)	A voltage of 125 V at 50 Hz is applied to a series combination of non-inductive resistor and a lossless capacitor of 50 μF. The current is 1.25 A. Find (i) the value of the resistor (ii) power drawn by the network (iii) the power factor of the network. Draw the phasor diagram for the network.	[10]	2	L3

Signature of the question paper setter

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Note: Answer **ALL t**he Questions. Assume necessary data if required

Q.1 a) (iii) State ohm's law and its limitation [4+6]
(iv) Define conductor, circuit, bi lateral circuit, node, and junction and distinguish node and junction of a circuit.

b) State Kirchhoff's voltage and current laws and prove any one law's numerically with illustration [10]

c) Write short note on [10]
(iv) Resistor
(v) Inductor
(vi) capacitor

d) Explain how inductor to hold back the energy after disconnected form the source with relevant diagram [10]

Q.2 a) Determine the current flow through the 5 ohm resistor is shown in Fig.2 (a). using mesh analysis [10]

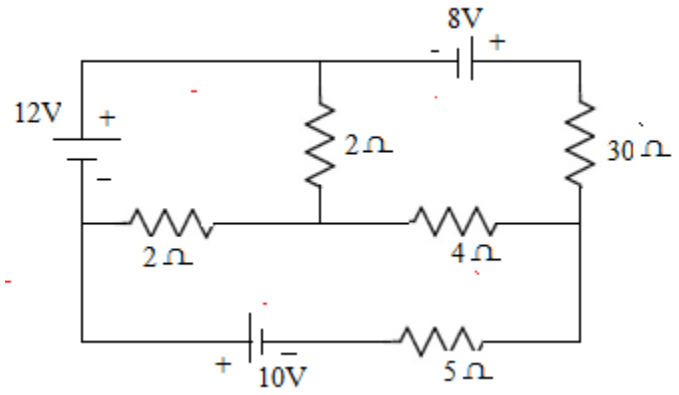
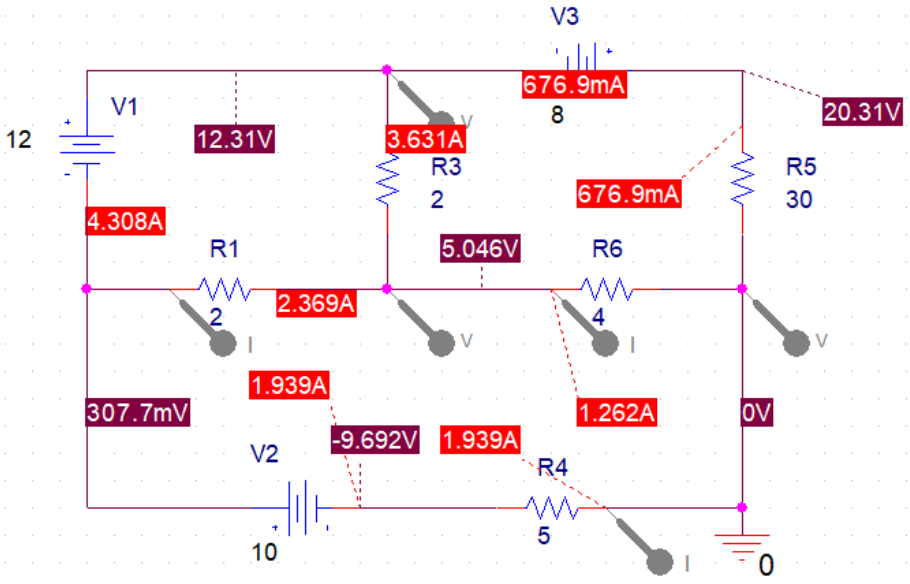


Fig.2(a)



b) Determine the current flow through the 5 ohm resistor is shown in Fig.2 (b). Using nodal analysis [10]

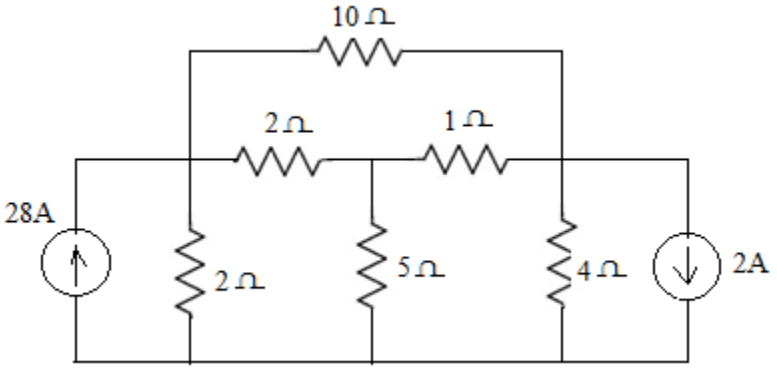
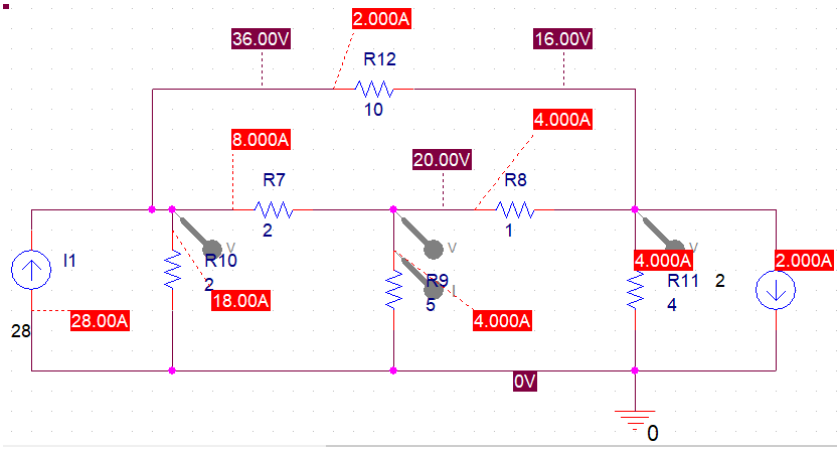


Fig. 2(b)



c) By using repeated source transformations, find the value of voltage v in Fig. 2(c). [10]

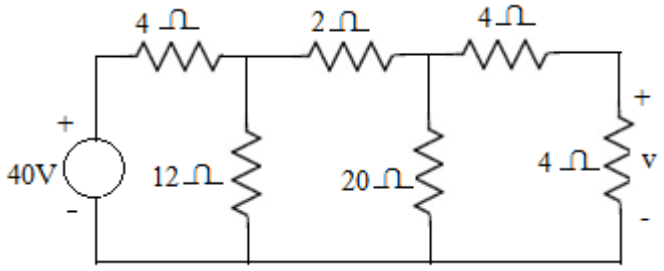
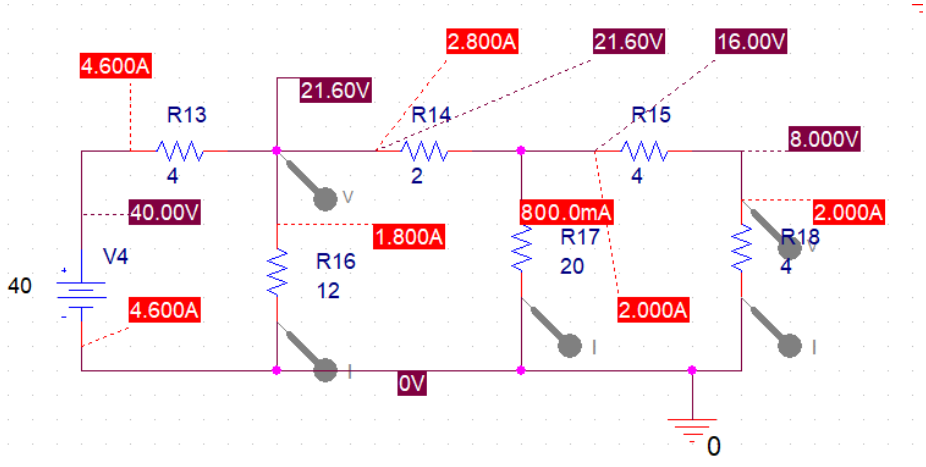


Fig. 2(c)



d) In Fig. 2(d) what value of R will allow maximum power transfer to the load? [8+2]
Also calculate the maximum total load power. All resistances are in ohms.

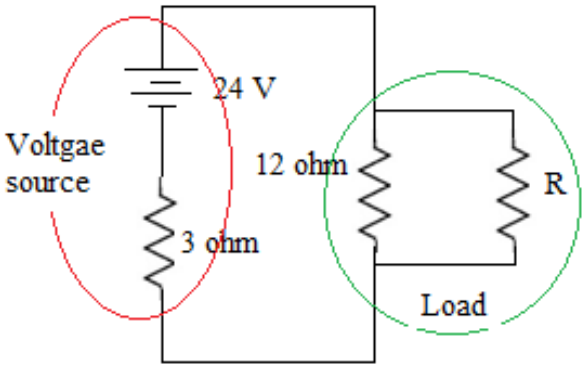
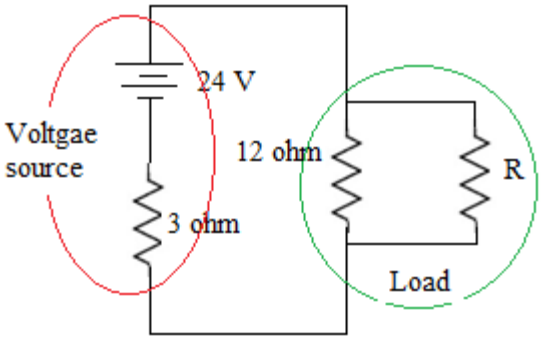


Fig. 2(d)



$$3 = \frac{12R}{12+R}$$

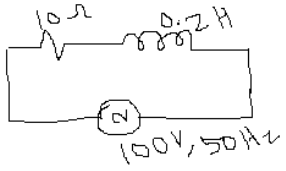
$$36 + 3R = 12R$$

$$9R = 36$$

$$R = 4\,\Omega$$

Q.3 a) [10]

The coil having a resistance of 10 Ω and an inductance of 0.2 H is connected to a 100-V, 50-Hz supply. Calculate (a) the impedance of the coil (b) the reactance of the coil (c) the current taken and (d) the phase difference between the current and the applied voltage



Solution

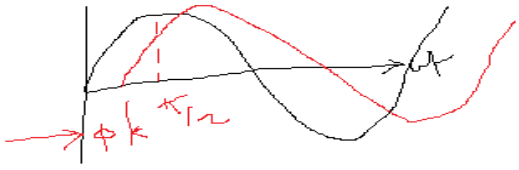
$X_L = 2\pi f L = 2 \times 3.14 \times 50 \times 0.2 = 62.8\ \Omega$

$Z = \sqrt{R^2 + X_L^2} = \sqrt{10^2 + (62.8)^2} = \sqrt{100 + 3943.8} = \sqrt{4043.84} = 63.59\ \Omega$

$I = \frac{V}{Z} = \frac{100}{63.59} = 1.572$ Amps.

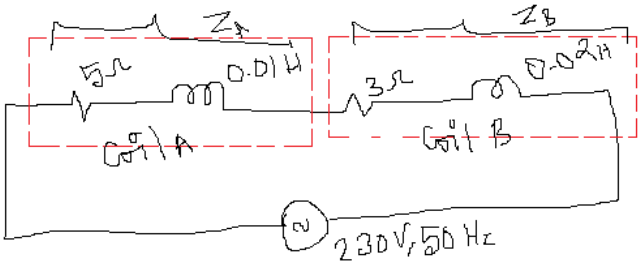
$\phi = \tan^{-1}\left(\frac{X}{R}\right) = \tan^{-1}\left(\frac{62.8}{10}\right)$

$\phi = 80.9^\circ$



b) [10]

Two inductive impedance A and B are connected in series. A has R = 5 Ω, L = 0.01 H; B has R = 3 Ω, L= 0.02 H. If a sinusoidal voltage of 230 V at 50 Hz is applied to the whole circuits calculate (a) the current (b) the power factor (c) the voltage drops. Draw a complete vector diagram for the circuit



Solution

$X_A = 2\pi f L_A = 2 \times 3.14 \times 50 \times 0.01 = 3.14\ \Omega$

$X_B = 2\pi f L_B = 2 \times 3.14 \times 50 \times 0.02 = 6.28\ \Omega$

Since series connection the circuit redrawn as

$$Z = \sqrt{8^2 + (9.42)^2} = \sqrt{64 + 88.74} = 12.35\ \Omega$$

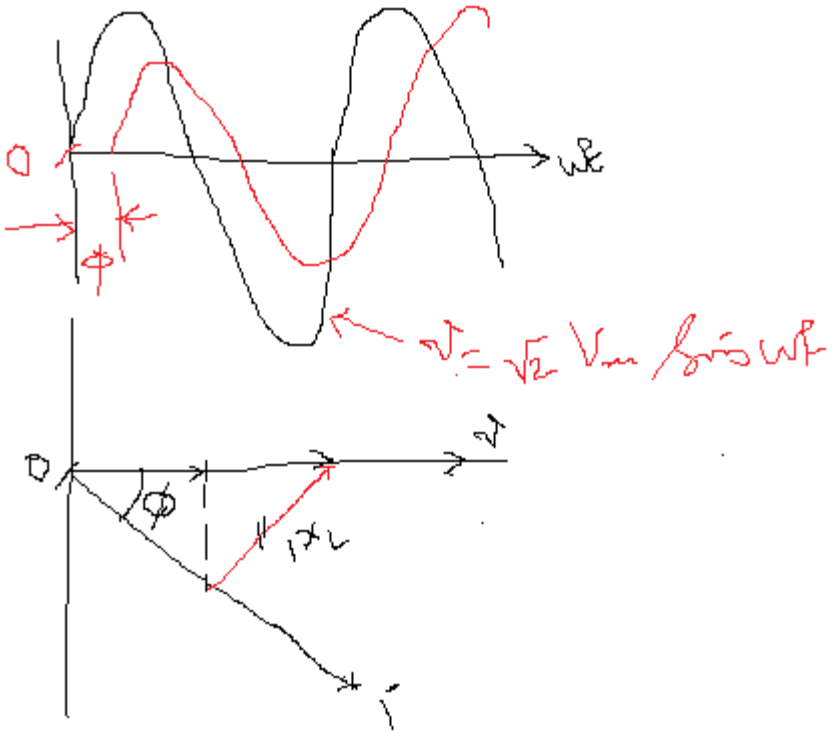
$$i = \frac{V}{Z} = \frac{230}{12.35} = 18.62 \text{ Amps}$$

$$\phi = \tan^{-1}\left(\frac{X}{R}\right) = \tan^{-1}\left(\frac{9.42}{8}\right) = 49.66^\circ$$

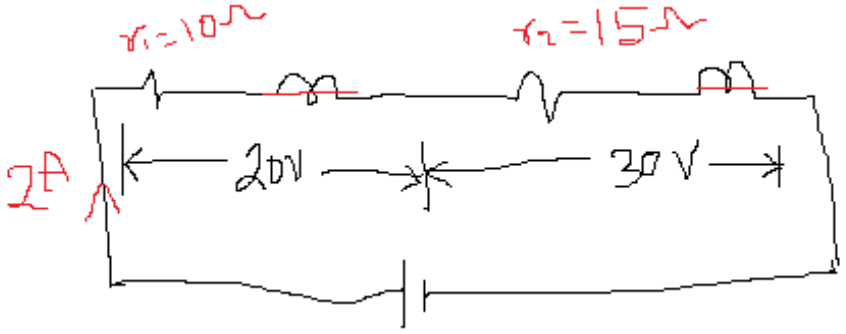
Voltage drop

$$V_R = iR = 18.62 \times 8 = 148.96\ \Omega$$

$$V_X = iX = 18.62 \times 9.42 = 175.4\ \Omega$$

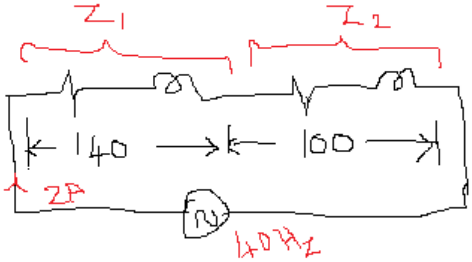


c) Two coils are connected in series. With 2 A d.c through the circuit, the p.ds. across the coils are 20 and 30 V respectively. With 2 A a.c. at 40 Hz, the p.ds. across the coils are 140 and 100 V respectively. If the two coils in series are connected to a 230-V, 50-Hz supply, calculate (a) the current (b) the power (c) the power factor [10]



$$r_1 = \frac{20}{2} = 10\Omega$$

$$r_2 = \frac{30}{2} = 15\Omega$$



$$Z_1 = \frac{140}{2} = 70\Omega$$

$$Z_2 = \frac{100}{2} = 50\Omega$$

$$Z_1 = \sqrt{r_1^2 + X_1^2}$$

$$X_1 = \sqrt{Z_1^2 - r_1^2} = \sqrt{70^2 - 10^2}$$

$$= \sqrt{4900 - 100} = \sqrt{4800} = 69.2\Omega$$

$$\therefore L_1 = \frac{1}{2\pi f X_1} = \frac{1}{2 \times 3.14 \times 40 \times 69.2} = 57.46mH$$

$$X_{R_1} = 2\pi f L_1 = 2 \times 3.14 \times 50 \times 57.46 \times 10^{-6}$$

$$= 55.42\ \Omega$$

$$X_{L_2} = 2\pi f L_2 = 2 \times 3.14 \times 50 \times 83.47 \times 10^{-6}$$

$$= 38.15\ \Omega$$

$$Z_{eff} = \sqrt{(R_1 + R_2)^2 + (X_{L1} + X_{R2})^2}$$

$$= \sqrt{(10+15)^2 + (55.42 + 38.15)^2}$$

$$= \sqrt{25^2 + 93.57^2}$$

$$= \sqrt{625 + 8755.35}$$

$$= 96.85$$

$$I = \frac{V}{Z} = \frac{230}{96.85} = 2.375 \text{ Amps}$$

$$\cos\phi = \frac{R}{Z} = \frac{25}{96.85} = 0.258 \text{ lag}$$

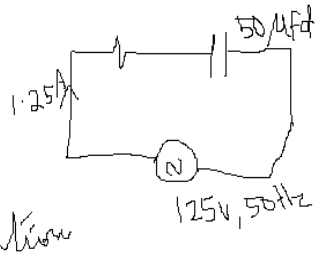
$$P = VI\cos\phi$$

$$= 230 \times 2.375 \times 0.258$$

$$P = 140.98 \text{ watts}$$

d) [10]

A voltage of 125 V at 50 Hz is applied to a series combination of non-inductive resistor and a lossless capacitor of 50 μF. The current is 1.25 A. Find (i) the value of the resistor (ii) power drawn by the network (iii) the power factor of the network. Draw the phasor diagram for the network.



$$X_c = \frac{1}{2\pi fC} = \frac{10^6}{2\times 3.14\times 50\times 50}$$

$$= 63.69\ \Omega$$

solution

$$Z = \frac{V}{I} = \frac{125}{1.25} = 100\ \Omega$$

$$R = \sqrt{Z^2 - X_c^2}$$

$$R = \sqrt{100^2 - 63.69^2}$$

$$= \sqrt{10000 - 4083.2}$$

$$R = 76.92\ \Omega$$

$$\cos\theta = \frac{R}{Z} = \frac{76.92}{100} = 0.769\ \text{lag}$$

$$P = VI\cos\theta = 125\times 1.25\times 0.769$$

$$P = 120.16\ \text{WATTS}$$