Swami Keshvanand Institute of Technology, Management &Gramothan, Jaipur

I Mid Term Examination, Dec.-2022

Semester:	I	Branch:	CS, DS, ME, CE
Subject:	BEE	Subject Code:	1FY3-08
Time:	1.5 Hours	Maximum Marks:	20
Session (I/II/III):II			

PART A (short-answer type questions)

(All questions are compulsory) (3*2=6)

Q.1 Write the statement of maximum power transfer theorem. Write down the expression for Maximum Power transferred in load.

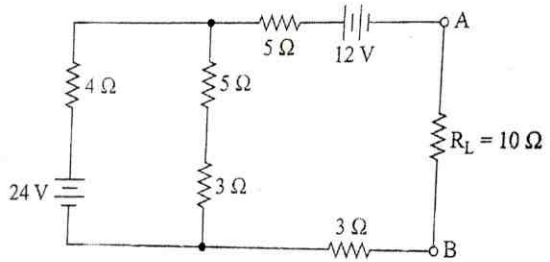
Q.2 Write down the formulas and units for active power, reactive power, apparent power , power factor and form factor.

Q.3 Define the resonance in electric circuit and derive an expression of resonance frequency for series R-L-C circuit.

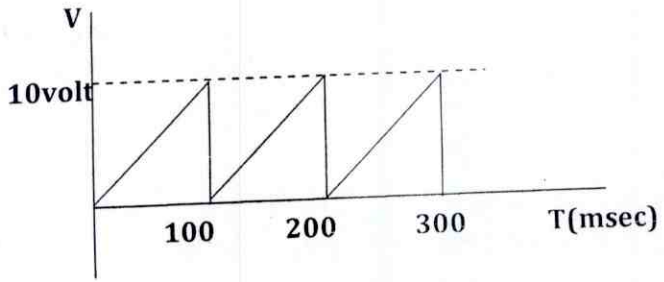
PART B (Analytical/Problem solving questions)

(Attempt any 2 Questions) (2*4=8)

Q.4 Calculate the current through the load resistance R_L connected across the terminal A and B using Thevenin's Theorem.



Q.5 Calculate the Average and RMS value of the wave shown in fig.

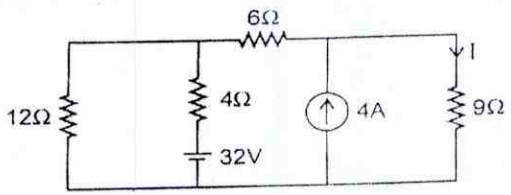


Q.6 Derive the expression for active power consumed in RC series circuit.

PART C (Descriptive/Analytical/Problem solving/Design questions)
(Attempt any 1 Question)(1*6=6)

Q.7 A coil of resistance 5 Ω and inductance of 30 mH in seriesare connectedacross 230V, 50Hz ac supply. Determine inductive reactance, impedance, current, power factor and active power consumed in the circuit and draw the phasor diagram.

Q.8 Compute the current and power dissipated in 9Ω resistance by applying superposition theorem for the circuit shown.



Swami Keshvanand Institute of Technology, Management & Gramothan, Ramnagaria, Jagatpura, Jaipur-302017

Solution of Question Paper

I Mid-Term Examination, Dec.. -2022

Branch/Semester: I	Subject: Basic Electrical Engineering	Subject Code: 1FY3-08
Duration: 1.5 hours	Date: 23/12/2022 Session (I/II/III): I	Max Marks: 20
Submitted By: Vivek Sharma/Dr. Jyoti Shukla		

PART A (short-answer type questions)

Q.1 Write the statement of maximum power transfer theorem. Write down the expression for Maximum Power transferred in load.

Ans. Maximum Power Transfer Theorem explains that to generate maximum external power through a finite internal resistance (DC network), the resistance of the given load must be equal to the resistance of the available source.

The fundamental Maximum Power Transfer Formula is

$$P_{max} = \frac{V_{Th}^2}{4R_{Th}}$$

Q.2 Write down the formulas and units for active power, reactive power, apparent power , power factor and form factor.

Ans.

P=VICosø KWatt
Q=VISin ø KVAR
S=VI KVA
Cosø=P/S
Kf= RMS Value/Average Value

Q.3 Define the resonance in electric circuit and derive an expression of resonance frequency for series R-L-C circuit.

Ans. Electrical resonance occurs in an electric circuit at a particular resonant frequency when the impedances or admittances of circuit elements cancel each other. Resonance is the phenomenon in the electrical circuit, where the output of the electrical circuit is maximum at one particular frequency. That particular frequency is known as the resonant frequency. At the resonant frequency, the capacitive reactance and inductive reactance are equal. In an alternating current, if the phase of the applied potential voltage difference and the current flowing in the circuit are the same, then the circuit is called a resonance circuit. The phenomenon shown by these circuits is called resonance.

In the condition of resonance

$$\omega L = \frac{1}{\omega C}$$

It means

$$\omega^2 = \frac{1}{LC}$$

$$\omega = \frac{1}{\sqrt{LC}}$$

We know

$$\omega = 2\pi f$$

Therefore

$$f = \frac{1}{2\pi\sqrt{LC}}$$

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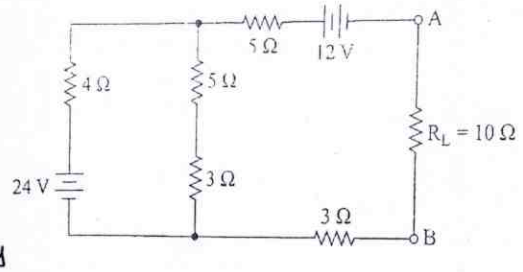
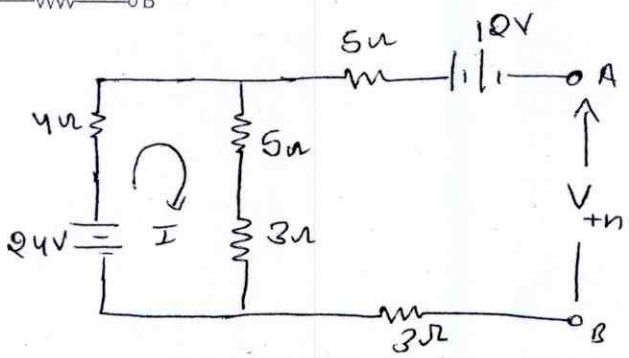
PART B (Analytical/Problem solving questions)

Q.4 Calculate the current through the load resistance R_L connected across the terminal A and B using Thevenin's Theorem.



Ans

To find V_{th}

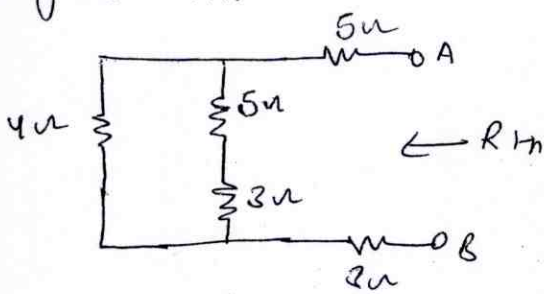


$$24 - 4I - 5I - 3I = 0$$

$$I = 2A$$

$$V_{th} = 5\times2 + 3\times2 - 12 = 16 - 12 = 4\,V$$

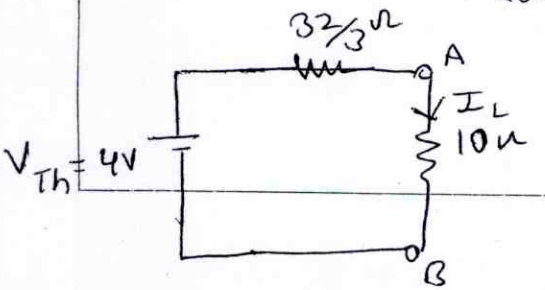
To find R_{th}



$\leftarrow R_{th}$

$$R_{th} = (4\Omega \,||\, 8\Omega) + 5 + 3$$

$$= \frac{4\times8}{12} + 8 = 8\left(\frac{1}{6}+1\right) = \frac{32}{6}\,\Omega$$



$$I_L = \frac{V_{th}}{R_{th}+R_L} = \frac{4}{\frac{32}{6}+10} = \frac{4\times3}{62}$$

$$= 0.1935\,A$$

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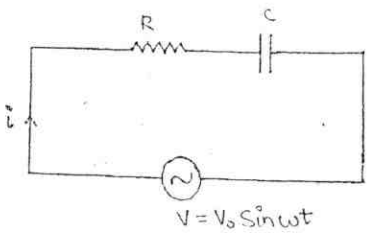
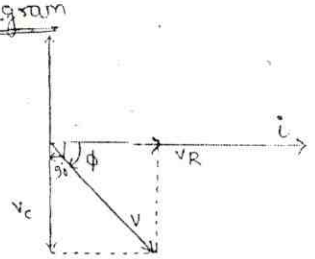
Q.6 Derive the expression for active power consumed in RC series circuit.

Ans

Series RC Circuit



Phasor diagram



In such a circuit the instantaneous values of current and voltage are given by –

$$V = V_0 \sin\omega t \quad , \quad i = i_0 \sin(\omega t + \phi)$$

Instaneous power is given by –

$$P = Vi$$

$$P = V_0 \sin\omega t \cdot i_0 \sin(\omega t + \phi)$$

$$= V_0 i_0 \sin\omega t [\sin\omega t \cos\phi + \cos\omega t \sin\phi]$$

$$= V_0 i_0 [\sin^2\omega t \cos\phi + \sin\omega t \cos\omega t \sin\phi]$$

$$P_{inst} = V_0 i_0 [\sin^2\omega t \cos\phi + \tfrac{1}{2}\sin 2\omega t \sin\phi]$$

for one complete cycle, $\sin^2\omega t = \frac{1}{2}$, $\sin 2\omega t = 0$

Hence the average for one complete cycle –

$$P = \tfrac{1}{2} V_0 i_0 \cos\phi = \frac{V_0}{\sqrt{2}} \times \frac{i_0}{\sqrt{2}} \times \cos\phi$$

$$\boxed{P = V_{rms} i_{rms} \times \cos\phi}$$

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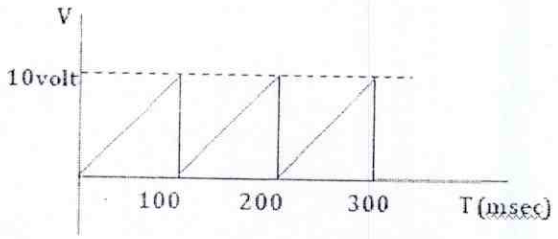
Q.5 Calculate the Average and RMS value of the wave shown in fig.



Ans –

$$T = 100 \times 10^{-3}\ \text{sec} = 0.1\ \text{sec}$$

$$V_{avg} = \frac{1}{T}\int_0^T v(t)\,dt \qquad v(t) = 100t$$

$$= \frac{1}{0.1}\int_0^{0.1} 100t\,dt = 10\times100\left[\frac{t^2}{2}\right]_0^{0.1} = \frac{10\times100}{2}\times0.1\times0.1$$

$$= \frac{10\times100}{2}\times\frac{1}{100} = 5\ V$$

$$V_{rms} = \sqrt{\frac{1}{T}\int_0^T \{v(t)\}^2 dt} = \sqrt{\frac{1}{0.1}\int_0^{0.1}(100t)^2 dt}$$

$$= \sqrt{\frac{1}{0.1}\times100\times100\left(\frac{t^3}{3}\right)_0^{0.1}} = \sqrt{\frac{10\times100^2}{3}\times(0.1)^3}$$

$$= 5.78\ V$$

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PART C (Descriptive/Analytical/Problem solving/Design questions)

Q.7 A coil of resistance 5 Ω and inductance of 30 mH in series are connected across 230V, 50Hz ac supply. Determine inductive reactance, impedance, current, power factor and active power consumed in the circuit and draw the phasor diagram.

Ans.

$R = 5\Omega$

$L = 30 \times 10^{-3}\ H$

Inductive reactance $X_L = \omega L = 2\pi f L = 2\pi \times 50 \times 30 \times 10^{-3}$

$X_L = 9.42\Omega$

Impedance $Z = 5 + j\,9.42$

$= \sqrt{5^2 + (9.42)^2} \angle \tan^{-1}\left(\frac{9.42}{5}\right)$

$= 10.66 \angle 62^\circ$

current $I = \frac{V}{Z} = \frac{230\angle 0}{10.66\angle 62}$

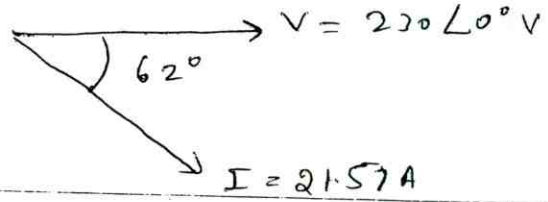
$I = 21.57 \angle -62^\circ$

current I is lagging the voltage, V by 62°

$P.f = \cos\phi = \cos 62^\circ = 0.47$ lagging

Power consumed $= VI\cos\phi$

$= 230 \times 21.57 \times 0.47 = 2331.7\ W$



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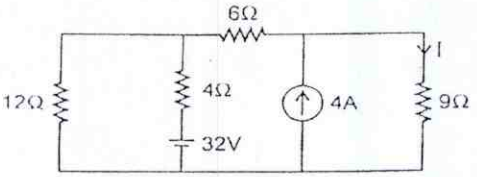
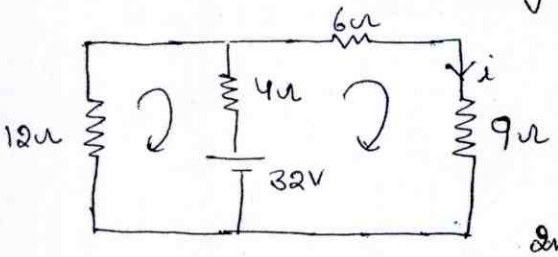
Q.8 Compute the current and power dissipated in 9Ω resistance by applying superposition theorem for the circuit shown.



Ans -

Actuate 32 Voltage source



2n loop 1

$$32 - 4(i_1' - i_2') - 6i_1' - 9i_1' = 0$$

$$-19i_1' + 4i_2' + 32 = 0 \quad \text{—(1)}$$

2n loop 2

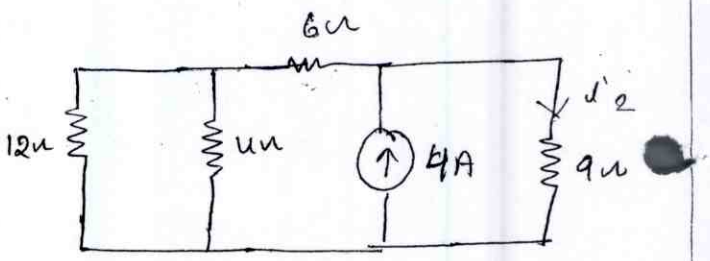
$$-13i_2' - 4(i_2' - i_1') - 32 = 0$$

$$i_1' - 4i_2' = 8 \quad \text{—(2)}$$

$$i_1' = 4/3 \text{ A}$$

Actuate current source

$$R_{Th} = (12 \| 4) + 6$$
$$= 9\Omega$$



Apply CoR

$$i_2' = 4 \times \frac{9}{9+9} = \frac{36}{18} = 2 \text{ A}$$

Total current flow through 9Ω resistance is

$$I_T = i_1' + i_2' = 3.33 \text{ A}$$