Total No. of Questions: 6 *Total No. of Printed Pages:3*

Enrollment No.....

Faculty of Engineering / Science
End Sem Examination May-2024
EN3ES17 / BC3ES01 Basic Electrical Engineering
Programme: B.Tech./ B.Sc. Branch/Specialisation: All

Duration: 3 Hrs. **Maximum Marks: 60**

Note: All questions are compulsory. Internal choices, if any, are indicated. Answers of Q.1 (MCQs) should be written in full instead of only a, b, c or d. Assume suitable data if necessary. Notations and symbols have their usual meaning.

Q.1 i. The internal resistance of an ideal current source is- **1**
(a) Infinite (b) Zero (c) 10 Ω (d) 100 Ω

ii. Which of the following is not a passive element? **1**
(a) Inductor (b) Voltage source (c) Capacitor (d) Resistance

iii. The power factor at resonance condition in a RLC series circuit is- **1**
(a) Zero (b) 0.8 lagging (c) 0.8 leading (d) Unity

iv. The active power consumed in a pure capacitive AC circuit is- **1**
(a) Zero (b) Infinity (c) 100 Watts (d) 1000 Watts

v. The working principle of a transformer is based on- **1**
(a) Self induction (b) Mutual induction
(c) Ampere law (d) Coulomb law

vi. Which part will surely tell that given motor is DC motor and not an AC type? **1**
(a) Winding (b) Shaft (c) Commutator (d) Stator

vii. Fuse wire should possess- **1**
(a) High resistance high melting point
(b) High resistance low melting point
(c) Low resistance low melting point
(d) Low resistance high melting point

viii. Which of the following is a common electric hazard that can result from faulty wiring or electrical equipment? **1**
(a) Electromagnetic radiation
(b) Electric shock
(c) Radioactive contamination
(d) Thermal resistance

P.T.O.

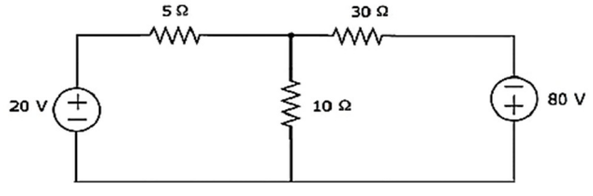
ix. Penstock is a part of which type of power generating plant- **1**
(a) Hydroelectric power plant (b) Thermal power plants
(c) Nuclear power plant (d) All of these

x. Which currents are used for inducing heat in the high frequency induction furnace? **1**
(a) Alternating primary currents (b) Direct primary currents
(c) Alternating secondary currents (d) Direct secondary currents

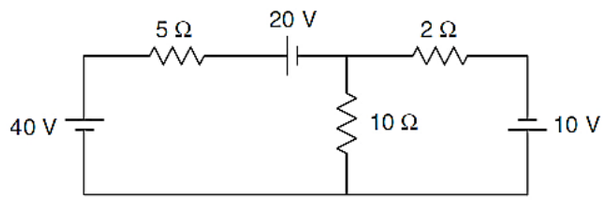
Q.2 i. Explain in brief about active and passive elements. **2**

ii. Explain Norton's theorem with the help of an example. Draw the Norton's equivalent circuit. **3**

iii. Define Ohms law. Calculate the current through 10 Ω resistor using mesh analysis- **5**



OR iv. Give the statement of Thevenin's theorem. Find the current through the 2 Ω resistor using Thevenin's theorem. **5**



Q.3 i. Draw the power triangle and define its each branch with units and formula. **3**

ii. Define for AC circuits with suitable diagram and formulas: **7**
(a) Frequency (b) Time period
(c) RMS value of voltage (d) Average value of voltage
(e) Q factor (f) Active power
(g) Power factor.

OR iii. A resistance of 20Ω, inductance of 0.2 H and capacitance of 100μF are connected in series across 220 V, 50 Hz supply. Determine the following: **7**
(a) Impedance (b) Current

(c) Power factor angle (d) Power factor
(e) Voltage across R, L & C.

Q.4 i. Write the working principle of a single-phase transformer with suitable diagram. **3**

ii. Explain the working principle of three phase induction motor with suitable diagram. What are various types of three phase induction motor? **7**

OR iii. Explain why single-phase induction motor is not self-starting. List two starting method of single-phase induction motor in detail. **7**

Q.5 i. Explain different electric hazards. Describe different ways to prevent them. **4**

ii. Explain the working of switch mode power supply (SMPS) with the help of block diagram. **6**

OR iii. Explain the roles of Fuse and Miniature Circuit Breaker (MCB) in electrical protection with suitable diagrams. **6**

Q.6 Attempt any two:

i. Explain electric power generation to distribution through overhead lines with single line diagram in detail. **5**

ii. Explain the principle of dielectric heating and write down its two applications. **5**

iii. Draw a neat schematic diagram of welding transformer and explain its working. **5**

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Marking Scheme

BC3ES01/EN3ES17 (T) Basic Electrical Engineering

Q.1	i)	A	**1**
	ii)	B	**1**
	iii)	D	**1**
	iv)	A	**1**
	v)	B	**1**
	vi)	C	**1**
	vii)	B	**1**
	viii)	B	**1**
	ix)	A	**1**
	x)	C	**1**

Q.2	i.	Active, passive elements.	**1, 1**
	ii.	Give the statement of Norton's theorem,	**1**
		Circuit diagram, An example.	**1, 1**
	iii.	Define Ohms Law.	**1,**
		Two Equations, solution, current through 10 Ω resistor	**2,1,1**
OR	iv.	Give the statement of Thevenin's theorem.	**2**
		Rth, Vth, current through the 2 Ω resistor	**1,1,1**

Q.3	i.	Power triangle diagram, define its each branch with, formula.	**1,1,1**
	ii.	Define for AC circuits with suitable diagram and formulas: (a) Frequency, (b) Time period, (c) RMS value of voltage, (d) Average value of voltage, (e) Q factor, (f) Active power, (g) Power factor.	**1 each (1x7)**
OR	iii.	A resistance of 20Ω, inductance of 0.2H and capacitance of 100μF are connected in series across 220V, 50Hz supply. Determine the following: (a) Impedance, (b) Current, (c) Power factor angle, (d) Power factor, (e) Voltage across R, L & C.	**1 each (1x7)**

Q.4	i.	Working principle of a single phase transformer, diagram.	**2,1**
	ii.	Working principle of three phase induction motor, diagram.	**2,2**
		Also, write three phase induction motor types.	**3**
OR	iii.	Explain why single phase induction motor is not self-starting. List two starting method of single phase induction motor in detail.	**2 2.5x2**

Q.5	i.	Different electric hazards, different ways to prevent them.	**2,2**
	ii.	Working of switch mode power supply (SMPS), block diagram.	**3,3**
OR	iii.	Fuse with diagram and Miniature Circuit Breaker with diagram	**3x2**

Q.6		Attempt any two:	
	i.	Explanation of power generation & distribution, single line diagram.	**3, 2**
	ii.	Principle of dielectric heating, diagram, its two applications.	**2,1, 2**
	iii.	Explanation of welding transformer, diagram.	**3,2**

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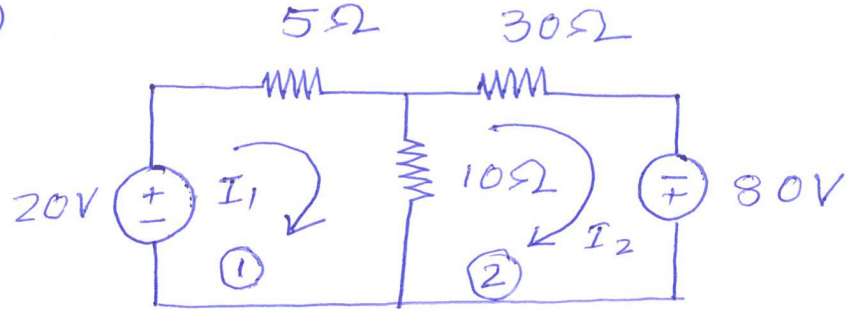
B.E.E

Subject code - EN3ES17

solution

Q. 2 (iii)



Applying KVL in Loop - I

$$20 - 5I_1 - (I_1 - I_2)10 = 0$$

$$\Rightarrow 20 - 5I_1 - 10I_1 + 10I_2 = 0$$

$$\Rightarrow 20 - 15I_1 + 10I_2 = 0$$

$$\Rightarrow \boxed{-15I_1 + 10I_2 = -20} \quad \ldots\ldots (1)$$

Applying KVL in Loop - II

$$80 - (I_2 - I_1)10 - 30I_2 = 0$$

$$\Rightarrow 80 - 10I_2 + 10I_1 - 30I_2 = 0$$

$$\Rightarrow \boxed{10I_1 - 40I_2 = -80} \quad \ldots\ldots (2)$$

from equn (1) & (2)

$$-3I_1 + 2I_2 = -4$$

$$(-3) \times I_1 - 4I_2 = -8$$

$$-3I_1 + 2I_2 = -4$$

$$+ \quad -3I_1 + 12I_2 = 24$$

$$-10I_2 = -28$$

$$\Rightarrow I_2 = \boxed{2.8\ A}$$

so $-3I_1 + 2 \times 2.8 = -4 \Rightarrow -3I_1 = -9.6$

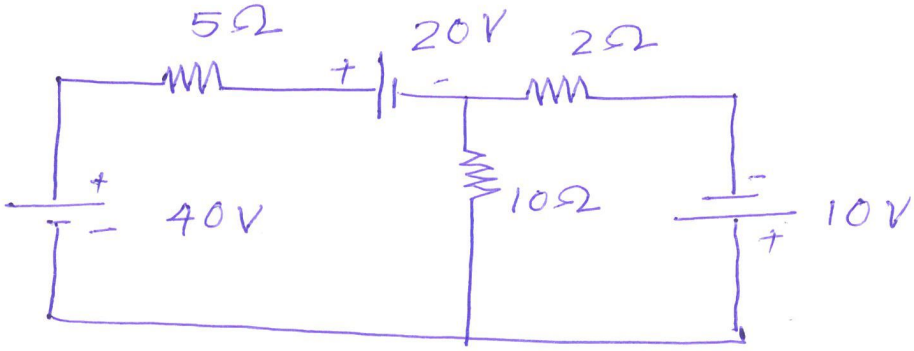
$$\Rightarrow I_1 = 9.6/3 = \boxed{3.2\ A}$$

Hence current through 10Ω resistor is

$I_1 - I_2 = 3.2 - 2.8 = \boxed{0.4\ A}$ 1

OR

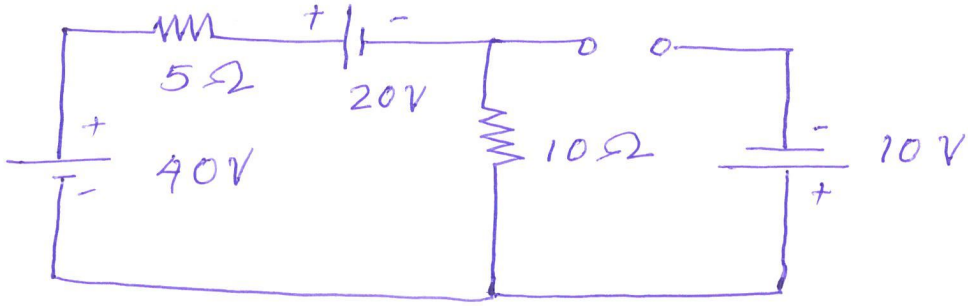
(iv)



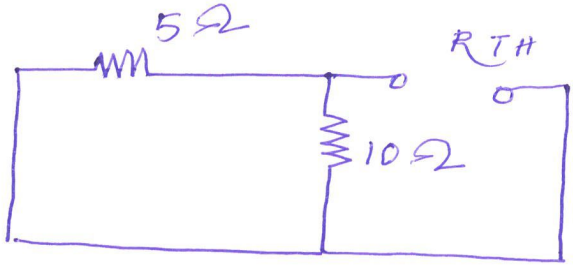
1

* Load Resistance $R_L = 2\Omega$

step-I open Load



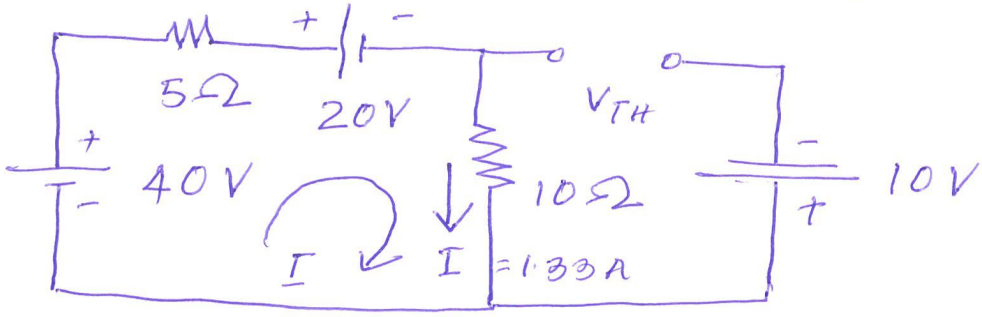
step-2 calculation of R_{TH}



1

$R_{TH} = 10\Omega \,||\, 5\Omega = \frac{10 \times 5}{10+5} = \frac{50}{15} = \boxed{3.33}\Omega$

step-3 calculation of V_{TH}



Applying KVL to the close Loop

$40 - 5I - 20 - 10I = 0$

$\Rightarrow 20 - 15I = 0 \Rightarrow I = \frac{20}{15} = 1.33\ A$

Applying KVL to V_{TH} loop

$V_{TH} - 10 \times 1.33 - 10 = 0$

$\Rightarrow V_{TH} - 13.3 - 10 = 0$

$\Rightarrow V_{TH} = \boxed{23.3\ V}$ 1

step-4 calculation of load current

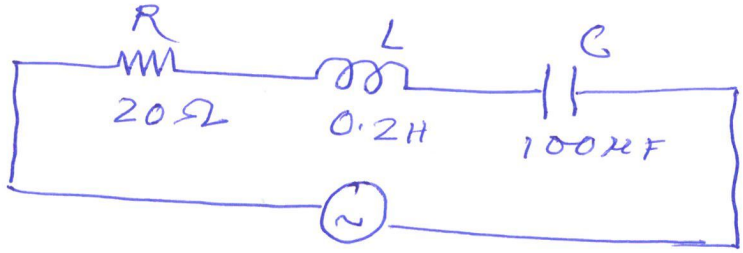
$$I_L = \frac{V_{TH}}{R_{TH} + R_L}$$ 1

$$= \frac{23.3}{3.33 + 2} = \boxed{4.371\ A}$$ 1

Q.3 (iii)

$R = 2\Omega$, $L = 0.2H$, $C = 100\mu F = 100 \times 10^{-6} F$

$V = 220V$, $f = 50Hz$



(a) $X_L = \omega L = 2\pi f L = 2\pi \times 50 \times 0.2\ \Omega$

$= \boxed{62.831\ \Omega}$

$X_C = \frac{1}{\omega C} = \frac{1}{2\pi f C} = \frac{1}{2\pi \times 50 \times 100 \times 10^{-6}}\ \Omega$

$= \boxed{31.83\Omega}$

Impedance $Z = \sqrt{R^2 + (X_L - X_C)^2}$

$= \sqrt{(20)^2 + (62.831 - 31.83)^2}$

$= \sqrt{1361} = \boxed{36.891\ \Omega}$ ✓1

(b) current $I = \frac{V}{Z} = \frac{220}{36.891} = \boxed{5.963\ A}$ ✓1

(c) $\cos\phi = \frac{R}{Z} \Rightarrow \phi = \cos^{-1}(R/Z)$ ✓1

$\Rightarrow$ p.f angle $\phi = \cos^{-1}\left(\frac{20}{36.891}\right) = \boxed{57.17^{\circ}\ (Lag)}$

(d) p.f $\cos\phi = \frac{R}{Z} = \frac{20}{36.891} = \boxed{0.542\ (Lag)}$ ✓1

(e) $V_R = IR = 5.963 \times 20 = \boxed{119.26\ V}$ ✓1

$V_L = I X_L = 5.963 \times 62.831 = \boxed{374.66\ V}$ ✓1

$V_C = I X_C = 5.963 \times 31.83 = \boxed{189.8\ V}$ ✓1

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