



SCHOOL OF COMPUTING AND ENGINEERING SCIENCES (SCES)
BACHELORS OF ELECTRICAL AND ELECTRONICS ENGINEERING
END OF SEMESTER EXAMINATION
UNIT CODE: BEE 1201 UNIT NAME: CIRCUIT THEORY I

DATE: Thursday, 12th March 2026.

Time: 16.00 - 18.00 Hours

Instructions

1. This examination consists of **FIVE** questions.
2. Answer **Question ONE (COMPULSORY)** and any other **TWO** questions.

Question 1 (30 Marks)

- a. Define current. 1 Mk
- b. 1440 coulombs of charge pass through a conductor during a time interval of 4 minutes, what is the current that flows? 1 Mk
- c. Name two differences between DC voltage sources and AC voltage sources. 2 Mks
- d. An electrician uses solid copper wire having a diameter of 1.63 mm to provide electrical distribution to outlets and light sockets. Determine the resistance of 75 meters of a solid copper wire having the above diameter (resistivity of copper is $1.723 \times 10^{-8} \Omega\text{m}$). 3 Mks
- e. State Kirchoff's current law 1 Mk
- f. Use Current division rule to find current flowing through the 8Ω Resistor in figure 1 below. 3 Mks

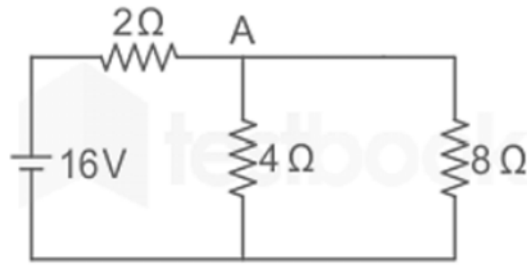


Figure 1

- g. Determine the Value of Current I in figure 2 2 Mks

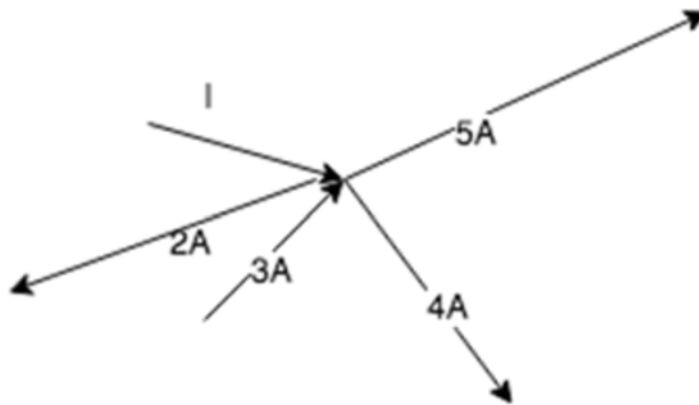


Figure 2

- h. Define RMS in an AC voltage 1 Mk
- i. Determine RMS value of: $i = 50 \sin(\omega t + 20^\circ)$ mA and write the current equation in phasor form 2 Mks
- j. An AC circuit is dissipating 1200 Watts of true power and has 2100 VAr of reactive power. Determine:
- i. The apparent power of the circuit. 1 Mk
 - ii. The power factor of the circuit. 1 Mk
 - iii. The power triangle of the circuit. 1 Mk

- k. A current of 18mA flows when a voltage of 20 V Peak to peak at a frequency of 1 kHz is applied across a circuit that has a resistor of $330\ \Omega$ in series with an inductor of unknown value. Determine the value of the inductor. 4 Mks
- l. A load draws 1000 kW at a power factor of 0.8. what is the reactive power required to improve the power factor to 0.95? 3 Mks
- m. In a balanced Y-connected power system, calculate the phase voltage if the line voltage is 480 volts. 2 Mks
- n. In an ABC phase sequence generator, the value of voltage at phase A is $e_{AN} = 270 \angle 0^\circ$, determine the phase voltage:
- e_{BN} 1 Mk
 - e_{CN} 1 Mk

Question 2 (15 Marks)

- a. A supply voltage $v(t) = 339 \sin 314.16t$ is applied across coil of resistance $4\ \Omega$ and inductance of 9.55 mH. Determine:
- RMS Voltage 1 Mk
 - The inductive reactance 1 Mk
 - The impedance 3 Mks
 - Current 1 Mk
 - Power Dissipated 1Mk
- b. Use Superposition theorem to determine the voltage drop across the resistor R_2 of the circuit in figure 3 below. 8 Mks

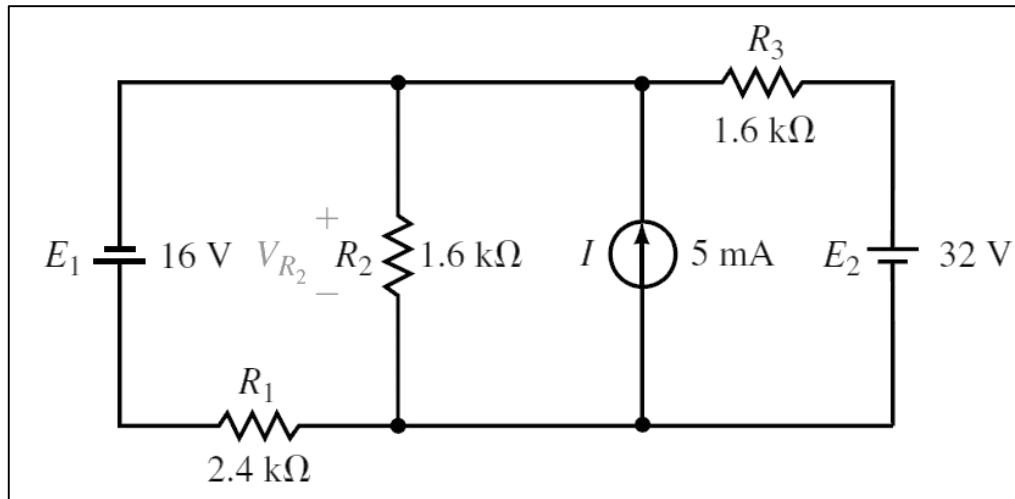


Figure 3

Question 3 (15 Marks)

a. A wound coil that has an inductance of 180mH and a resistance of 35Ω is connected to a 100V 50Hz supply. Determine

- | | |
|---|-------|
| i. Impedance of the coil | 2 Mks |
| ii. Current flowing through the coil | 1 Mk |
| iii. Power factor of the circuit | 1 Mk |
| iv. Real power supplied | 1 Mk |
| v. Reactive power supplied | 1 Mk |
| vi. Apparent power Supplied | 1 Mk |
| vii. The resulting power triangle for the above coil. | 1 Mk |

b. Determine currents I_1 , I_2 , I_3 and I_5 in the figure 4 below using current divider rule

when $I_4 = 4\text{A}$.

4 Mks

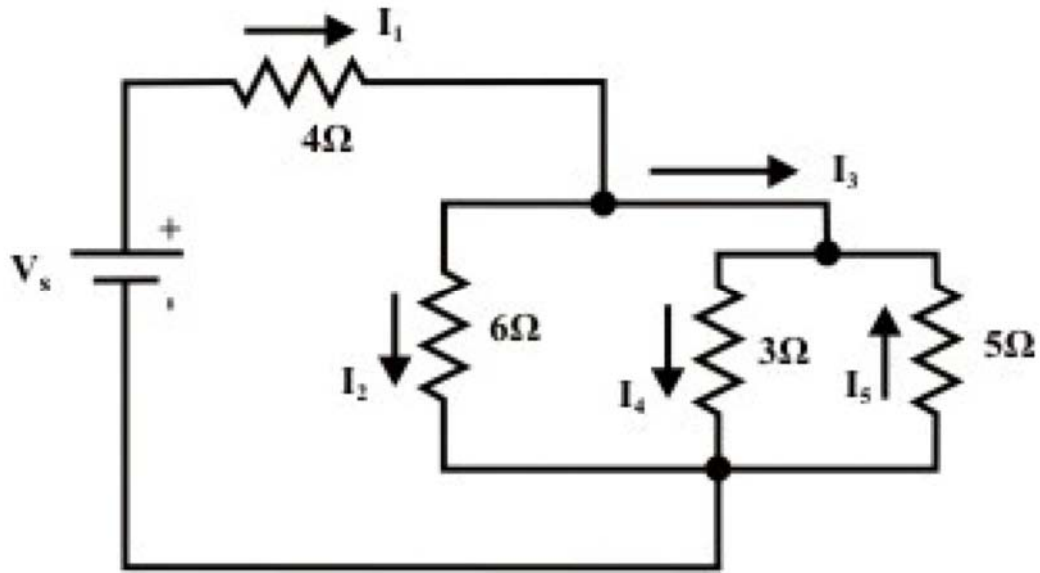


Figure 4

- c. 100 Hz sinusoidal voltage source has an RMS of 106.06 Volts. Write the voltage equation as a function of time. 3 Mks

Question 4 (15 Marks)

- a. Find the Norton equivalent of the circuit external to resistor R_L in figure 5. 4 Mks

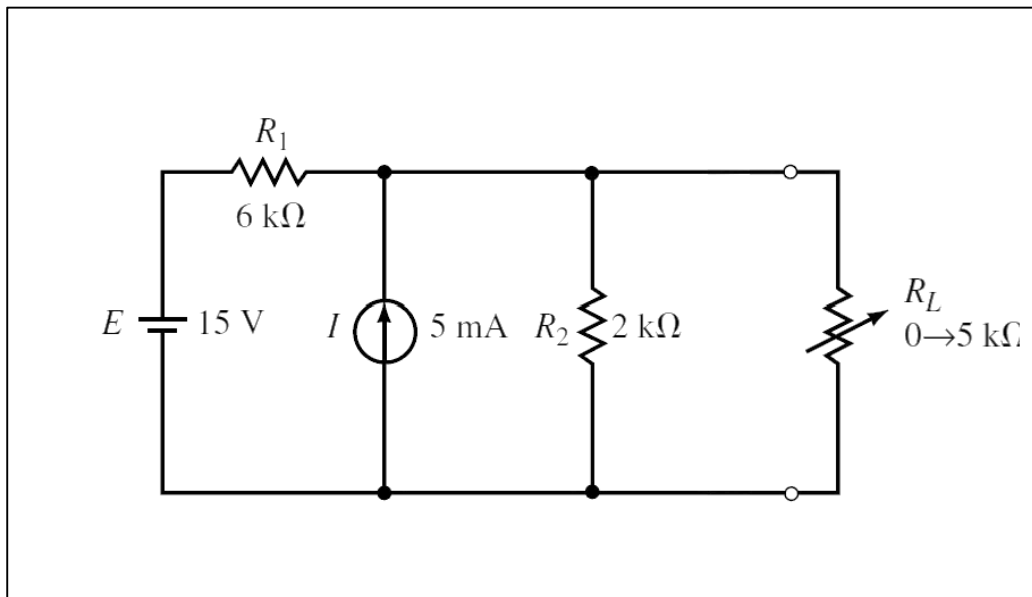


Figure 5

- b. The circuit in figure 6 represents a balanced Y-Y system, determine:

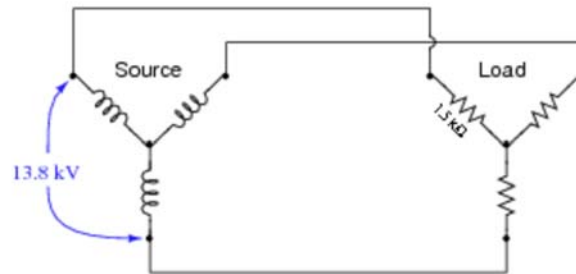


Figure 6

- | | |
|--|-------|
| i. Phase voltage at the source | 1 Mk |
| ii. Phase current at the source | 1 Mk |
| iii. Line current at the source | 1 Mk |
| iv. Phase voltage at the load | 1 Mk |
| v. Total active power load at the load | 3 Mks |
- c. Use voltage and Current divider rule to find I_o and V_o in figure 7. 4 Mks

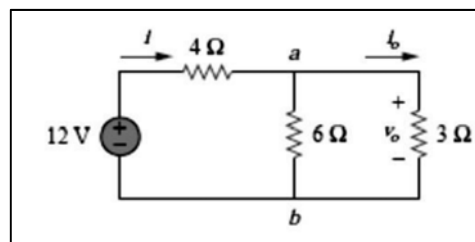


Figure 7

Question 5 (15 Marks)

- | | |
|---|-------|
| a. Explain the following methods used to measure power in three phase circuit. | |
| i. Three Wattmeter Method | 2 Mks |
| ii. Two Wattmeter Method | 2 Mks |
| b. Define phase sequence in three phase voltage generation | 1 Mk |
| c. A 3-phase power generator supplies a balanced Y connected load. What is the current flowing through the neutral conductor. | 1 Mk |

d. Consider a single-phase equivalent circuit of a three phase 4-wire Y-Y system shown in figure 8 where E_{AN} is the generator voltage and V_{an} is the load voltage. Determine:

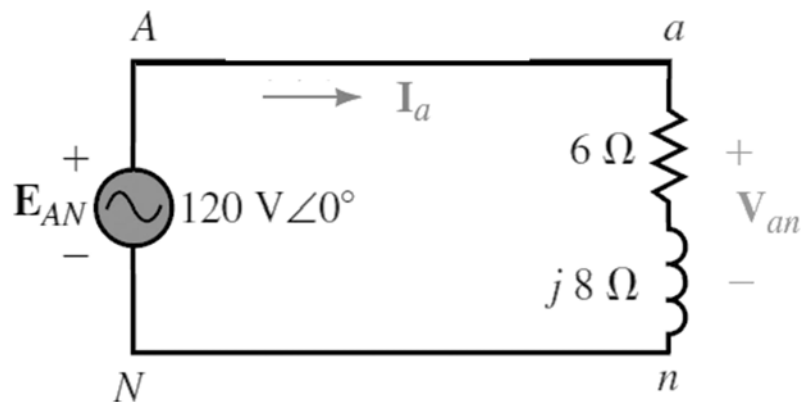


Figure 8

- | | |
|---|-------|
| i. Determine the line Voltages at the load | 3 Mks |
| ii. Determine the phase currents | 3 Mks |
| iii. Determine the apparent power delivered to the load | 2 Mks |
| iv. Active power delivered to the load | 1 Mk |