BINDURA UNIVERSITY OF SCIENCE EDUCATION

FACULTY OF SCIENCE AND ENGINEERING

DEPARTMENT OF ENGINEERING AND PHYSICS

Bachelor of Sciences Honours Degree in Electronic Engineering

EEE1103: ELECTRICAL ENGINEERING CIRCUITS AND ANALYSIS

DURATION: 3 hours TOTAL MARKS: 100

OCT 2024

INSTRUCTIONS

The paper contains SEVEN questions each carrying 20 marks

Answer FIVE questions

QUESTION 1

a) A flashlight battery has a rating of 0.8 ampere-hours (Ah) and a lifetime of 10 hours.

i. How much current can it deliver? [2]

ii. How much power can it give if its terminal voltage is 6 V? [2]

iii. How much energy is stored in the battery in kWh? [2]

b) A coil has an inductance of 40mH and a negligible resistance. If connected to a 240V, 50Hz supply calculate its

i. Inductive reactance. [2]

ii. Resulting current. [2]

c) With the aid of a diagram clearly show how a Thevenin equivalent circuit can be converted to a Norton equivalent circuit and vice versa. [4]

d) Find **I** and V_o in the circuit of Figure 1.1. [6]

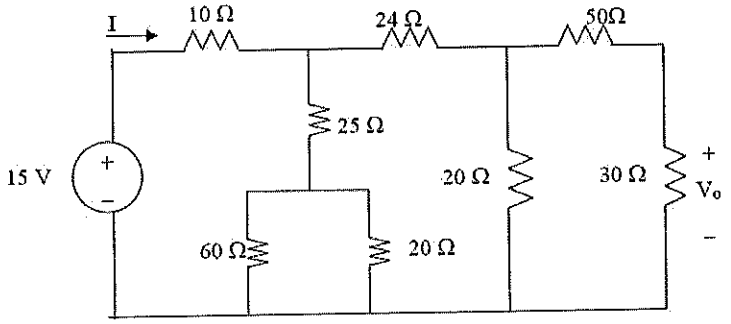

Figure 1.1

QUESTION 2

a) Use superposition to find v in the circuit of Fig. 2.1

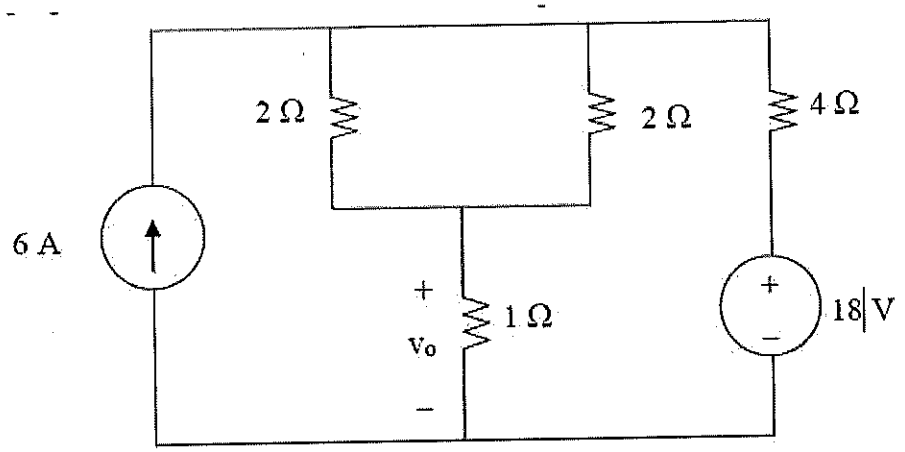

Figure 2.1

[6]

b) If $V_{ab} = 400$ V in a balanced Y-connected three-phase generator, find the phase voltages, assuming the phase sequence is ***abc.*** **[3]**

c) A d.c motor consumes 47.50 MJ when connected to a 250V supply for 1 hour 45 minutes. Determine the power rating of the motor. **[2]**

d)

$$v(t) = 56e{-}200t\text{V}, \; t > 0$$

$$i(t) = 8e{-}200t\text{mA}, \; t > 0$$

i. Find the values of R and C. **[3]**

ii. Calculate the time constant τ. [3]

iii. Determine the time required for the voltage to decay half its initial value at t = 0. [3]

QUESTION 3

a) Transform the following sinusoids to phasors:

i. $-10 \cos(4t + 75°)$. [2]

ii. $5 \sin(20t - 10°)$. [2]

iii. $4 \cos 2t + 3 \sin 2t$. [2]

b) A current source in a linear circuit has $I_s = 8 \cos(500\pi t - 25°)$ A

i. What is the amplitude of the current? [1]

ii. What is the angular frequency? [1]

iii. Find the frequency of the current. [1]

iv. Calculate I_s at t = 2ms. [2]

c) Series-connected 20-pF and 60-pF capacitors are placed in parallel with series-connected 30-pF and 70-pF capacitors. Determine the equivalent capacitance. [3]

d) Use the mesh analysis to determine the current through the 9V battery show in the Fig 3.1 below. [6]

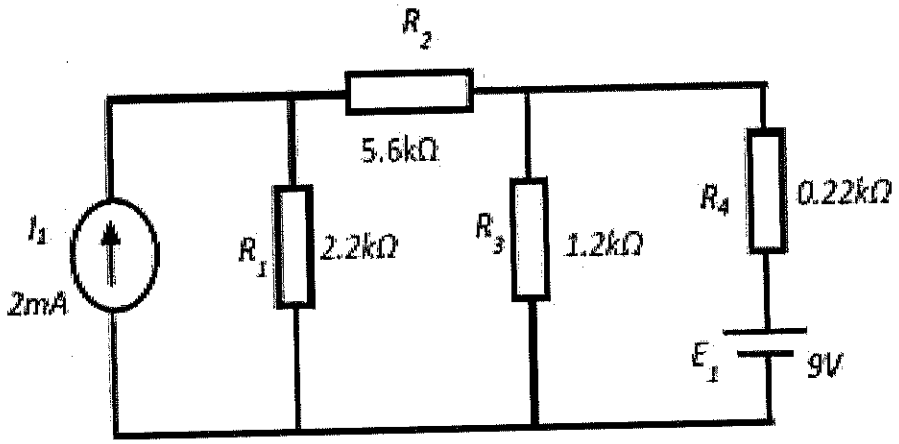

Figure 3.1

QUESTION 4

a) Consider the circuit shown below in Fig 4.1 and calculate V_o. [5]

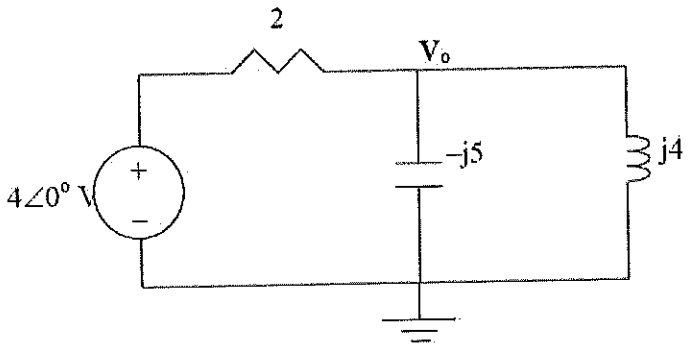

Figure 4:1

b) An energy-storage network consists of series-connected 16-mH and 14-mH inductors in parallel with a series connected 24-mH and 36-mH inductors. Calculate the equivalent inductance. [5]

c) With the help of diagrams, show the difference between an open circuit and short circuit. [5]

d) Calculate the root mean square value for the voltage given by $v_c = 550\text{Sin}\ (377t - 50)$. [3]

e) What is stray capacitance. [2]

QUESTION 5

a) Give statements of the following laws.

i. Faraday's law of electromagnetic induction [2]

ii. Lenz's law. [2]

b) Draw a sketch of power against time with supporting equations of the following:

i. Inductive load. [3]

ii. Resistive load. [3]

iii. Capacitive load. [3]

c) Define the following

i. average power. [1]

ii. reactive power. [2]

iii. apparent power. [2]

iv. power factor. [2]

QUESTION 6

a) Find the overall power dissipated in the circuit below in Fig 5.1. [5]

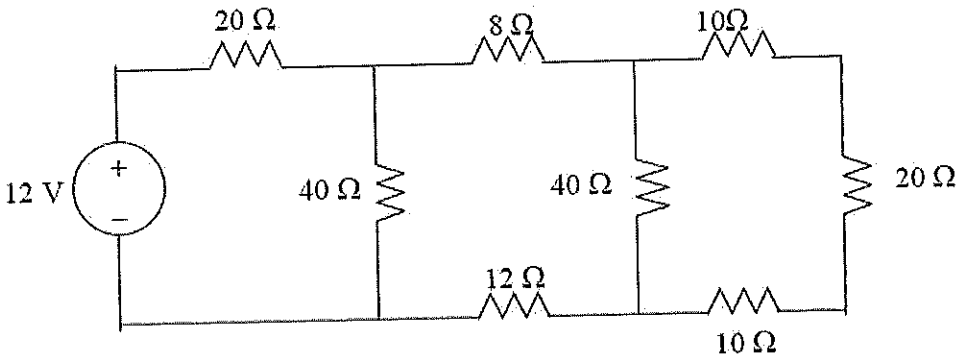

Figure 5:1

b) An aluminum wire *7,5m* long is connected in parallel with a copper wire *6m* long. When a current of *5A* is passed through the combination, it is found that the current in the aluminum wire is *3A*. The diameter of the aluminum wire is *1.0mm*. Determine the diameter of the copper wire (Resistivity of copper is *0,017μΩm*, that of aluminum is *0,028μΩm)*. [6]

c) Draw the V-I relationship of an ideal voltage source. [5]

d) Briefly describe what is hysteresis. [4]

QUESTION 7

a) Find the Norton equivalent as viewed from the terminals of the circuit in Fig.6.1.

i. **a-b.**

ii. **c-d.** [10]

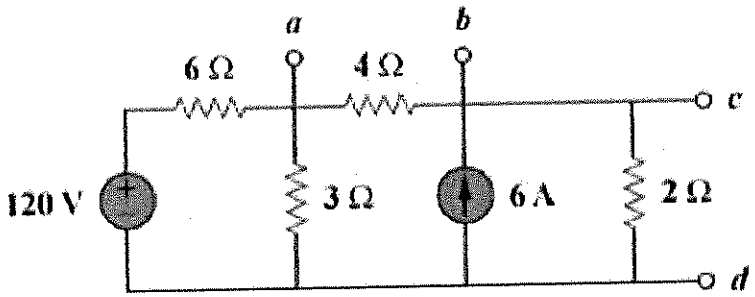

Figure 6:1

b) Find the frequency domain impedance Z as shown in the Fig 7.1 below. [7]

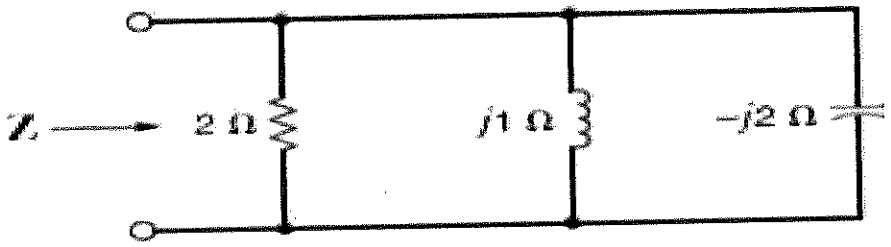

Figure 7:1

c) What is rms value. [3]

THE END