(University of Choice)

MASINDE MULIRO UNIVERSITY OF SCIENCE AND TECHNOLOGY (MMUST)

MAIN CAMPUS

UNIVERSITY EXAMINATIONS
2022/2023 ACADEMIC YEAR

SECOND YEAR FIRST SEMESTER EXAMINATIONS

FOR THE DEGREE
OF
BACHELOR OF SCIENCE IN ELECTRICAL
AND
COMMUNICATION ENGINEERING

COURSE CODE: ECE 212

COURSE TITLE: ELECTRIC CIRCUIT THEORY AND ANALYSIS I

DATE: 5ᵀᴴ DECEMBER, 2022 **TIME: 3: 00 PM – 5:00 PM**

INSTRUCTIONS TO CANDIDATES

ANSWER QUESTION ONE AND ANY OTHER TWO QUESTIONS.
QUESTION ONE CARRIES 30 MARKS AND ALL OTHERS 20 MARKS EACH.

TIME: 2 Hours

MMUST observes ZERO tolerance to examination cheating

This Paper Consists of 4 Printed Pages. Please Turn Over.

QUESTION 1   [30marks]

(a) Explain briefly the difference between linear and nonlinear resistors [4marks]

(b) Differentiate the following types of elements, giving examples in each case [6marks]

   i.   Nonlinear and linear elements
   ii. Unilateral and bilateral elements
   iii. Distributed and lumped elements

(c) State any **THREE** reasons why a sinusoidal waveform is the preferred in electrical engineering.   [3marks]

(d) In the series-parallel circuit given in Figure Q1(d), determine;

(i) the total resistance of the circuit.   [3marks]

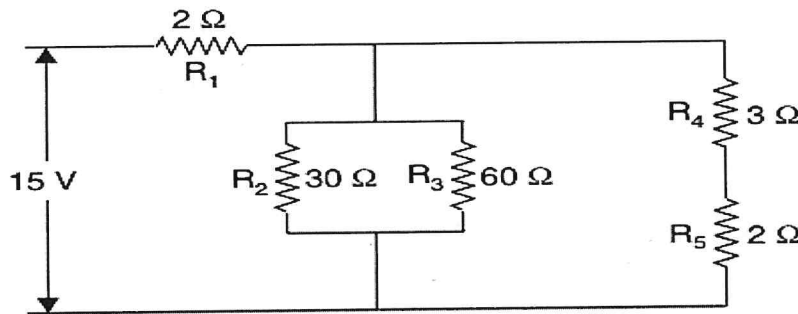(ii) the total current flowing through the circuit.   [1mark]

Figure Q1(d)

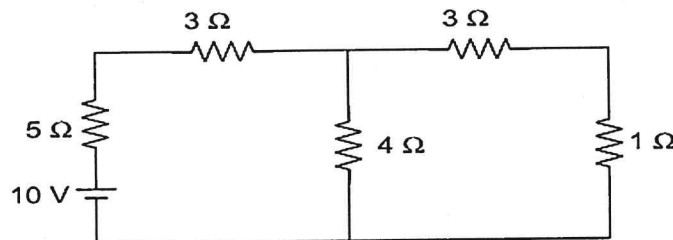(e) Solve the circuit of Figure Q1(e) using Mesh Current Analysis method.   [4marks]

Figure Q1(e)

(f) An alternating current i is given by; $i = 141.4\ Sin\ 314t$. Determine;

   (i)   the maximum value   [1mark]
   (ii)   frequency   [1mark]
   (iii) time period and   [1mark]
   (iv)   the instantaneous value when t is 3 ms.   [2marks]

(g) State any FOUR limitations of Ohms law   [4marks]

(a)(i) State Kirchhoff's laws [2mark]

(ii) Determine the current in each branch of the circuit using Kirchhoff's law
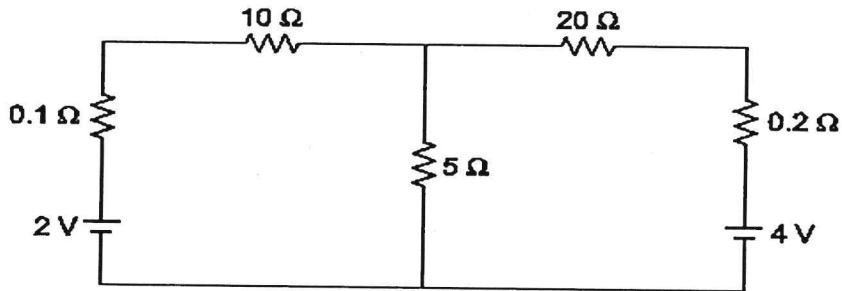
[4marks]

Figure Q2(a)

(b) Determine the value of current flowing through the 1Ω resistor using Superposition theorem.
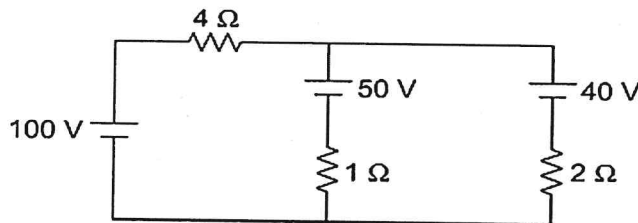
[4marks]

Figure Q2(b)

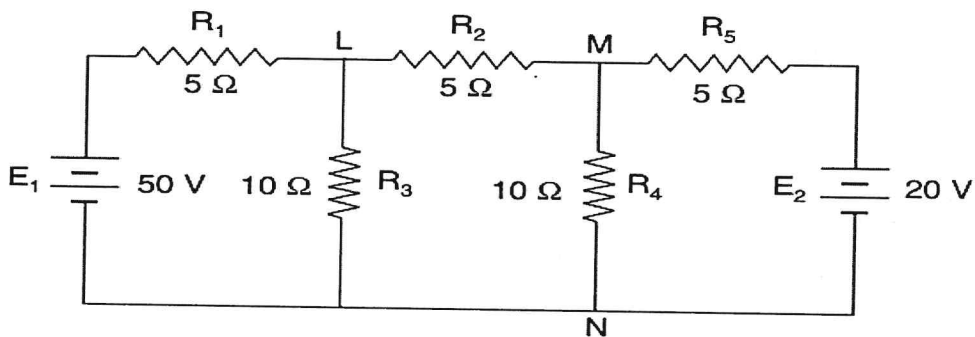(c) Determine the currents through the resistance R_3 and R_4 using Node Voltage Analysis. [6marks]

Figure Q2(c)

(d) Using Thevenin's theorem, find the current in the 6Ω resistor; [4marks]
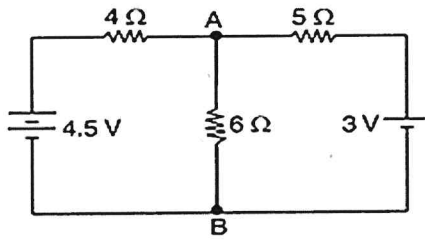
Figure Q2(d)

QUESTION 3   (20marks)

(a) For the circuit shown in FigQ3(a), two impedances consist of resistance of 15Ω and series connected inductance of 0.04 H and resistance of 10Ω, inductance of 0.01 H and a capacitance of 100 μF, all in series are connected in series and are connected to a 230 V, 50 Hz a.c. source. Determine;

(i) current drawn   [3marks]

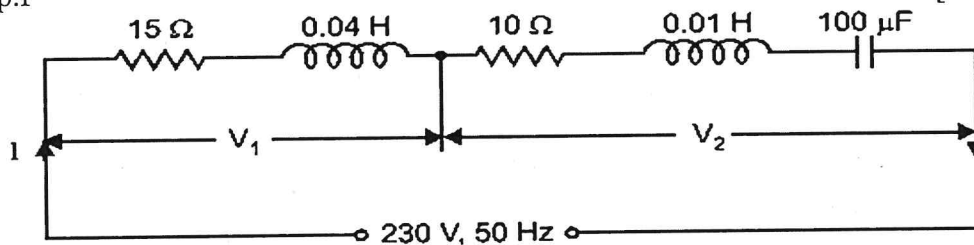(ii) voltage across each impedance   [2marks]

(iii) total p.f   [1mark]

Figure Q3(a)

(b) A 230V, 50 Hz a.c. supply is applied to a coil of 0.06H inductance and 2.5Ω resistance connected in series with a 6·8 μF capacitor. Determine;

(i) impedance   [3marks]

(ii) current   [1mark]

(iii) phase angle between current and voltage   [1mark]

(c) State the THREE advantages of a.c. compared to a d.c system   [3marks]

(d) A coil consists of 2000 turns of copper wire having a cross-sectional area of 0.8 mm^2. The mean length per turn is 80 cm and the resistivity of copper is 0.02μΩ-m. Find the resistance of the coil and power absorbed by the coil when connected across 110 V d.c. supply.

          [4marks]

QUESTION 4   (20marks)

(a) (i) The current in a 2H inductor varies at a rate of 2A/s. Find the voltage across the inductor and the energy stored in the magnetic field after 2 s.   [3marks]

(ii) A capacitor having a capacitance 2 μF is charged to a voltage of 1000 V. Calculate the stored energy in joules. [3marks]

(b) A residential flat has the following average electrical consumptions per day:

(i)   4 tube lights of 40 watts working for 5 hours per day;
(ii)   2 filament lamps of 60 watts working for 8 hours per day;
(iii)   1 water heater rated 2 kW working for 1 hour per day;
(iv)   1 water pump of 0.5 kW rating working for 3 hours per day.

Assuming the month has 30 days, determine the cost of energy per month if 1 kWh of energy (i.e., 1 unit of energy) costs Kshs. 3.50 [6marks]

(c) Determine the total amount of power in the series circuit [4marks]
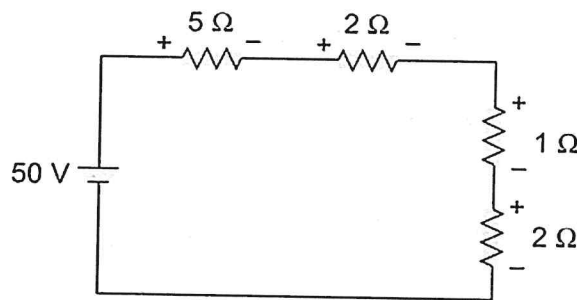
(d) Determine the parallel resistance between points A and B of the circuit shown [4marks]
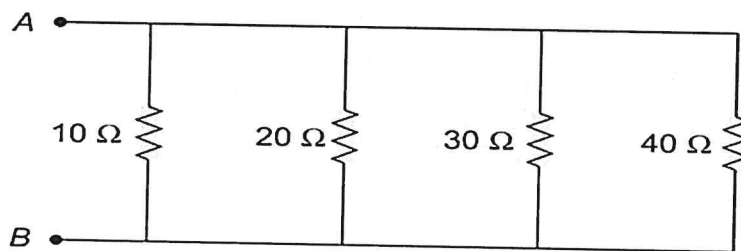
QUESTION 5 [20marks]

(a)Define the following terms as applied in ac circuit theory [3marks]

i.   Period
ii. Amplitude
iii. Frequency

(b) A coil has a resistance of 5Ω and an inductance of 31.8 mH. Determine the current taken by the coil and power factor when connected to 200 V, 50 Hz supply. [4marks]

(c) A capacitance of 20 µF and a resistance of 100 ohms are connected in series across 120 V, 60 Hz mains. Determine the current and power factor.   [4marks]

(d) A resistance 12 Ω, an inductance of 0.15 H and a capacitance of 100 µF are connected in series across a 100 V, 50 Hz supply. Determine the current and power factor of the circuit.

[5marks]

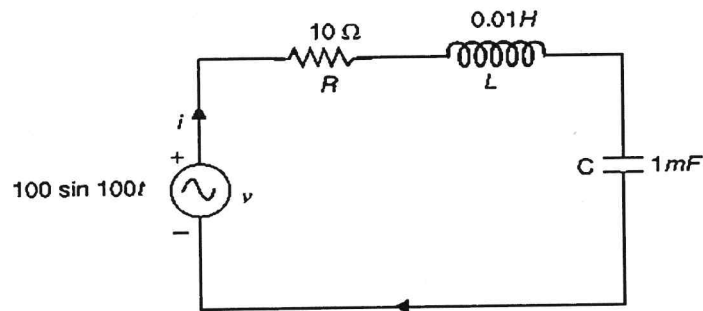(e)Given a circuit in Figure Q5(e), determine the circuit current using Kirchhoff's law

[4marks]

Figure Q5(e)