(*University of Choice*)
MASINDE MULIRO UNIVERSITY OF SCIENCE AND TECHNOLOGY (MMUST)

MAIN CAMPUS

UNIVERSITY EXAMINATIONS
2021/2022 ACADEMIC YEAR

FIRST YEAR SECOND SEMESTER EXAMINATIONS

FOR THE DEGREE
OF
BACHELOR OF SCIENCE IN MECHANICAL AND INDUSTRIAL ENGINEERING

COURSE CODE: ECE 102

COURSE TITLE: CIRCUIT THEORY

DATE: Monday, April 25th , 2022   TIME: 3.00 - 5.00 PM

INSTRUCTIONS TO CANDIDATES

Answer Question ONE and any other TWO (2) questions

Marks will be awarded for correct working even if the answer is wrong

MMUST observes ZERO tolerance to examination cheating

(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]
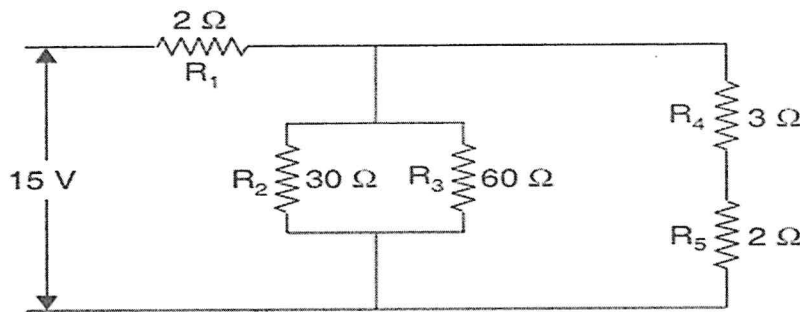

Figure Q1(d)

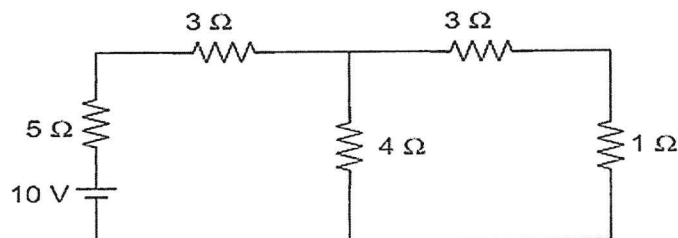(e) Solve the circuit of Figure Q1(e) using Mesh Current Analysis method.   [4marks]

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
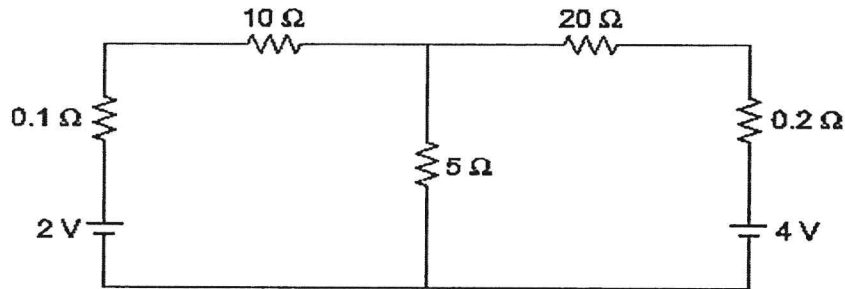
[4marks]

Figure Q2(a)

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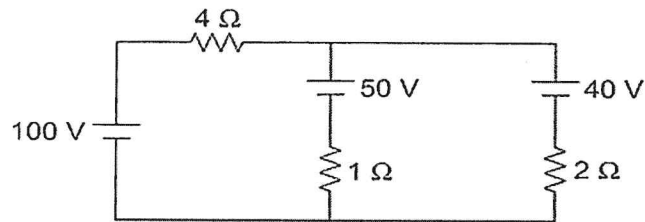
[4marks]

Figure Q2(b)

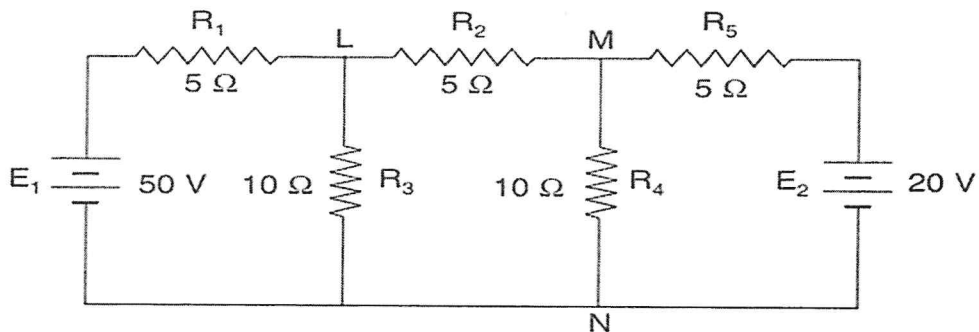(c) Determine the currents through the resistance R_3 and R_4 using Node Voltage Analysis. [6marks]

Figure Q2(c)

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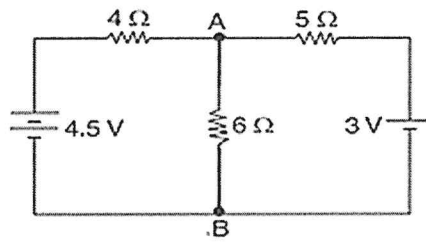
Figure Q2(d)

QUESTION 3 (20marks)

(a) For the circuit shown in FigQ3(a), determine the values of;

(i) Current flowing through the circuit, I. [3marsk]
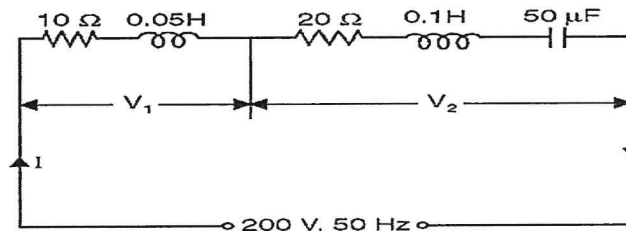(ii) Voltage drops, V_1 and V_2 [2marks]
(iii) power factor, p.f. [1mark]

Figure Q3(a)

(b) A voltage $v(t) = 100 \sin 314t$ is applied to a series circuit consisting of 10Ω resistance, $0·0318H$ inductance and a capacitor of 63.6 µF. Determine;

(i) expression for i(t) [3marks]
(ii) phase angle between voltage and current [1mark]
(iii) power factor [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 mm². 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
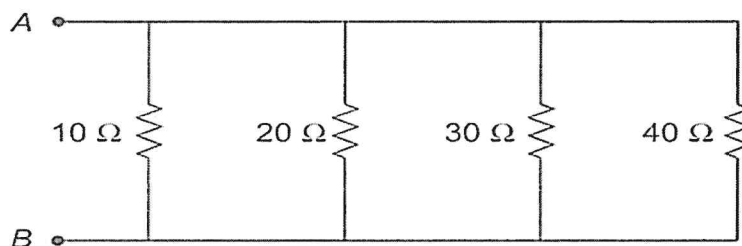[6marks]

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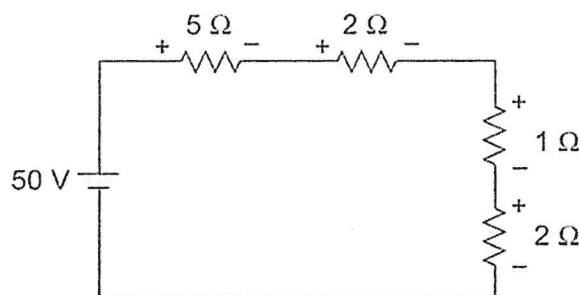
(d) Determine the parallel resistance between points A and B of the circuit shown [4marks]

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) Figure Q5(e) shows a circuit connected to a 230 V, 50 Hz supply. Determine the current drawn from the supply
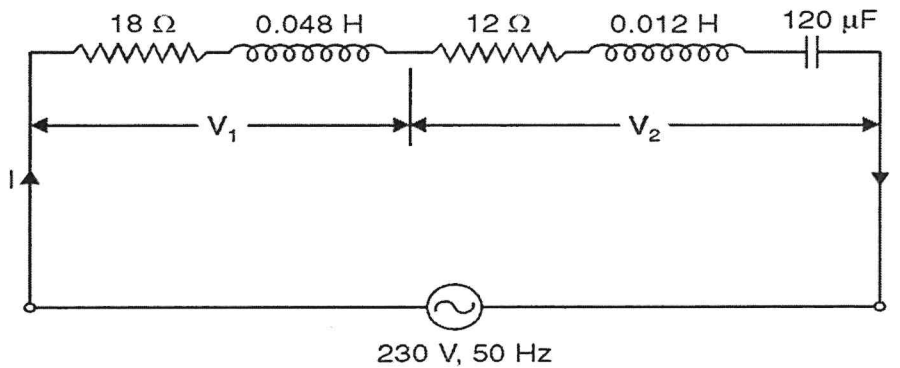   [4marks]

Figure Q5(e)