MACHAKOS UNIVERSITY

University Examinations for 2021/2022

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

SECOND YEAR SECOND SEMESTER EXAMINATION FOR

BACHELOR OF SCIENCE (ELECTRICAL AND ELECTRONICS ENGINEERING)

EEE 203: CIRCUIT THEORY I

DATE: **TIME:**

INSTRUCTIONS TO STUDENTS

1. *This paper contains 5 questions.*
2. *Attempt **Question One** and **Any Other Two questions***

QUESTION ONE [30 MARKS]

a) For the circuit shown in Fig. Q1 a), find

i) Total circuit resistance (3 marks)

ii) Circuit current I (1 mark)

iii) Currents I_1, I_2, I_3 and I_4 (4 marks)

iv) Voltage across R_1 (1 mark)

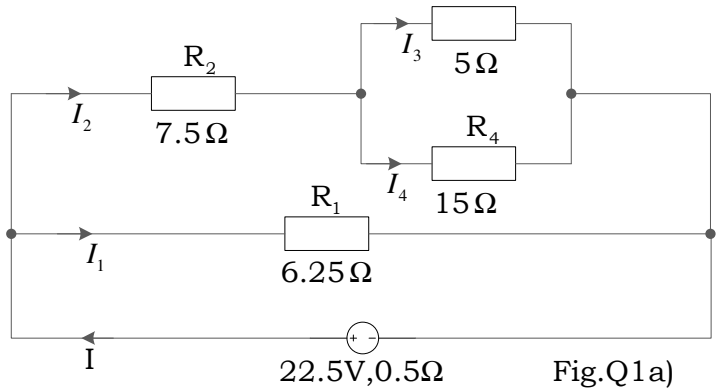

Fig.Q1a)

b) For the circuit shown in Fig. Q1 b), Find
   i) Circuit impedance
   ii) Circuit admittance
   iii) circuit current
   iv) power factor
   v) apparent power
   vi) active power
   vii) reactive power
   viii) voltage across resistance and
   ix) voltage across capacitance. (10 marks)

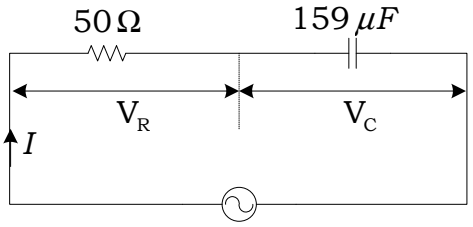

Fig. Q1 b)

c) Define the following terms as used in circuit theory:
   i) Effective value
   ii) Phase
   iii) Node
   iv) Loop
   v) Mesh (5 marks)

d) Apply Kirchhoff's laws to determine the voltage across and power dissipated in the 25 Ω resistor in the circuit of Fig Q1 d). (6 marks)

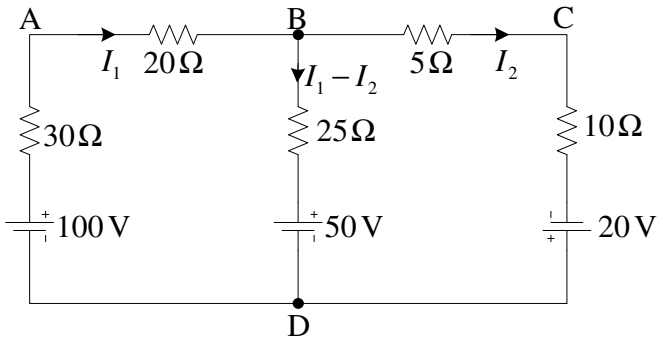

Fig. Q1 d)

QUESTION TWO (20 MARKS)

a) State the Norton's Theorem. (2 marks)

b) Find the Norton's equivalent circuit for Fig. Q2 b) at terminals A-B and hence find the current through the R_L. **[8 marks]**

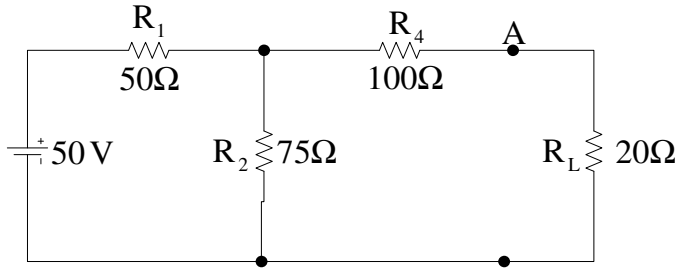

Fig. Q2 b)

c) Three voltages represented by $v_1 = 25\sin\left(\omega t + 15^0\right); e_2 = 15\sin\left(\omega t + 60^0\right)$ and $e_3 = 20\sin\left(\omega t + 45^0\right)$ act together in a circuit. Find an expression for the resultant voltage graphically. (4 marks)

d) In the circuit of Fig. Q2 d), fin the value of Z_L so that it may receive maximum power. Also calculate the value of this power. (6 marks)

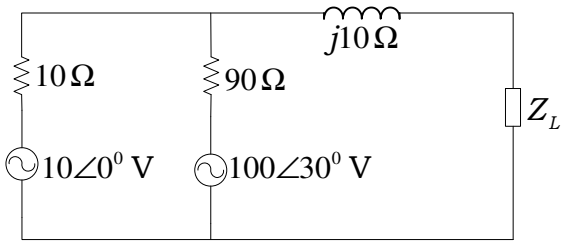

Fig. Q2 c)

QUESTION THREE [20 MARKS]

a) For the circuit shown in Fig.Q3 a), use nodal analysis to find
(i) Currents I_1, I_2, I_3, I_4 and I_5 (8 marks)
(ii) the voltage across the $15\,\Omega$ resistor (1 mark)

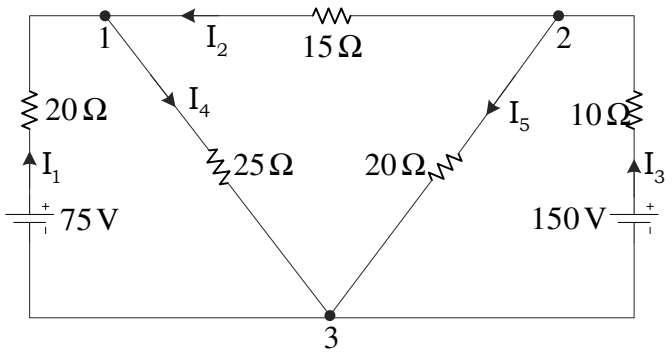

Fig. Q3 a)

b) For the circuit below, use superposition theorem to find voltage across 6Ω resistor.

(4 marks)

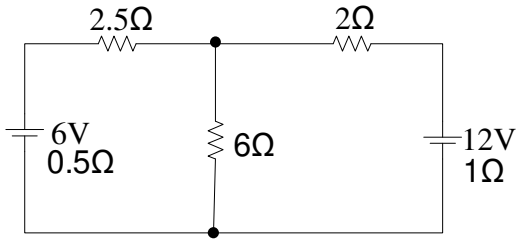

Fig. Q3 b)

QUESTION FOUR (20 MARKS)

a) A circuit consists of a 15Ω resistance in one branch, a 7.5Ω inductive reactance in the second and a capacitive reactance of 12Ω in the third branch. It is fed from a 230 V, 50 Hz supply. Find the

(i) Current in each branch
(ii) Total circuit current
(iii) Circuit impedance
(iv) Power factor
(v) Parameters of equivalent series circuit
(vi) Draw a phasor diagram of the circuit (10 marks)

b) State the three ways of marking the resistance values on the body of a resistor. (3 marks)

c) For the circuit of Fig.Q4 c), determine

(i) Thevenin's equivalent circuit and
(ii) Current through the resistance R_L, if its value is 250Ω (7 marks)

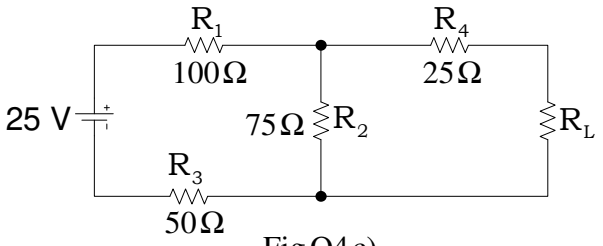

Fig Q4 c)

QUESTION FIVE (20 MARKS)

a) For the circuit shown in Fig. Q5 a), determine
(i) the mesh currents I_1, I_2 and I_3
(ii) the voltage across 20Ω and 40Ω. (8 marks)

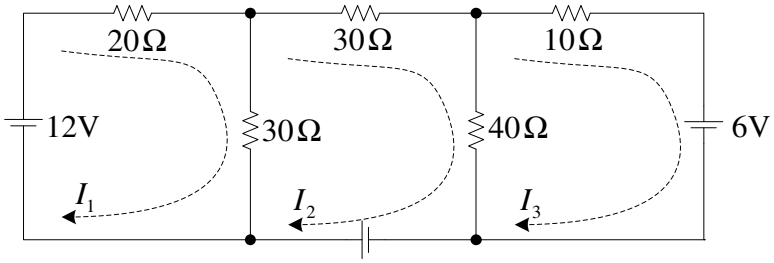

Fig. Q5 a)

b) A 50-Hz voltage of 230 V effective value is impressed on a capacitance of $100\mu F$.
(i) Write the time equations for the voltage and resulting current. Let the zero axis of the voltage wave be at $t = 0$
(ii) Show the voltage and current on a time diagram
(iii) Show the voltage and current on a phasor diagram.
(iv) Find the maximum energy stored in the capacitor. (10 marks)

c) Write down the colour code for the following resistors:
(i) $2.7k\Omega \pm 10\%$
(ii) $56k\Omega \pm 20\%$ (2 marks)