MACHAKOS UNIVERSITY

University Examinations for 2022/2023 Academic Year

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

SECOND YEAR FIRST 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***
3. *Show calculations where applicable*

QUESTION ONE (COMPULSORY) (30 MARKS)

a) Find the Thevenin's equivalent of the circuit shown in Fig. Q1(a) at terminals A-B. Hence, calculate
   (i) the value of the current flowing through 15Ω impedance and
   (ii) the power dissipated in this resistor. (8 marks)

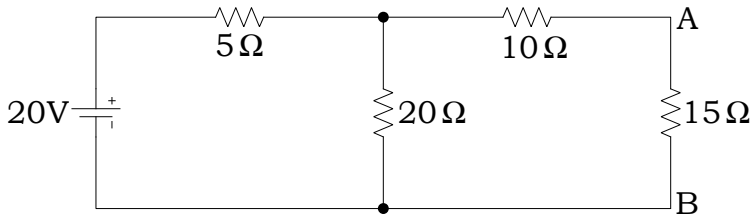

Fig. Q1a)

b) A resistance of 150Ω and an inductance of $0.5H$ are connected in series across a $200V$ 50 Hz supply. Find
   (i) Circuit impedance (2 marks)
   (ii) Circuit Current (1 mark)
   (iii) power factor (1 mark)
   (iv) apparent power (1 mark)

(v) active power (1 mark)
(vi)reactive power (1 mark)
(vii) voltage across resistance and (1 mark)
(viii) voltage across inductance (1 mark)

c) For the circuit shown in Fig. Q1 c), determine
(i) the mesh currents I_1, I_2 and I_3 (6 marks)
(ii) the voltage across $12.5\,\Omega$ (1 mark)
(iii)Power dissipated in the $2.5\,\Omega$ (1 mark)

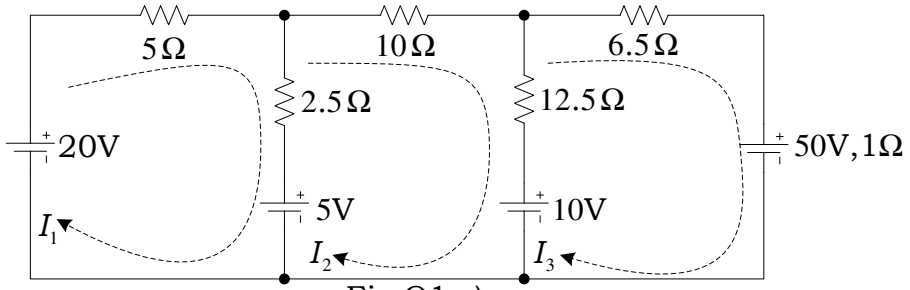

Fig.Q1 c)

d) Three voltages represented by
$v_1 = 25\sin\omega t;\ v_2 = 30\sin(\omega t + \pi/4);\ v_3 = 40\sin(\omega t - \pi/6)$ act together in a circuit.
Graphically, find an expression for the resultant voltage. (5 marks)

QUESTION TWO (20 marks)

a) State the two Kirchhoff's laws. (3 marks)
b) Apply Kirchhoff's laws in the circuit of Fig. Q2 b) to determine

(i) Currents I_1 and I_2
(ii) the voltage across 20 Ω
(iii)power dissipated in the 10 Ω resistor in the (6 marks)

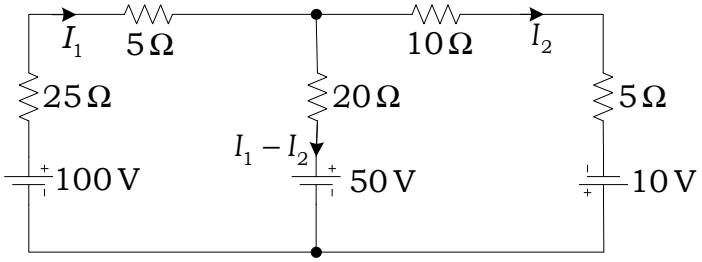

Fig.Q2 b)

c) For the circuit shown in Fig.Q2 c), find
i) Total circuit impedance
ii) The circuit current
iii) Circuit power factor

iv) The current I_1

v) The current I_2

vi) The voltage V_1

vii) The voltage V_2

viii) Apparent power

ix) Active power

x) Reactive power (11 marks)

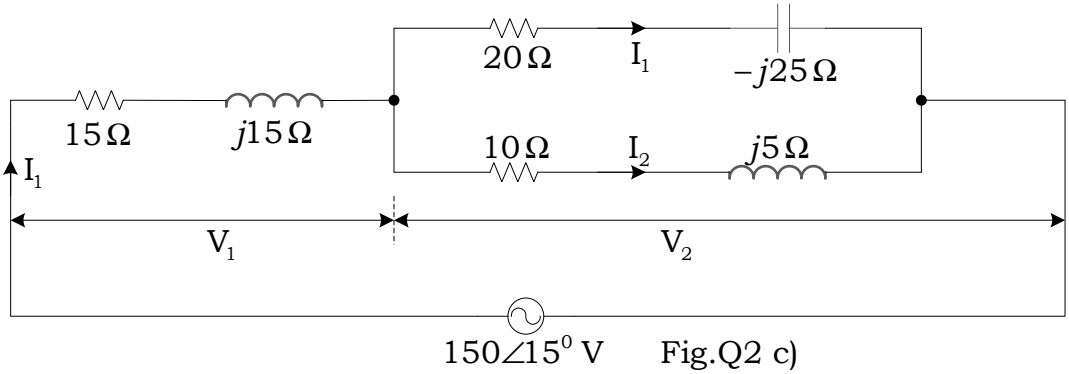

Fig.Q2 c)

QUESTION THREE (20 marks)

a) For the circuit shown in Fig.Q3 a), use Ohms law to find

(i) Total circuit resistance (2 marks)

(ii) Circuit current I (1 mark)

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

(iv) Voltage across $17.5\ \Omega$ (1 mark)

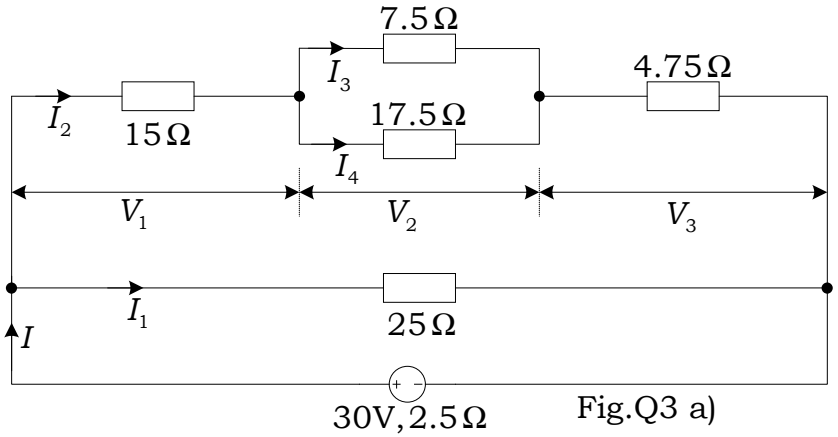

Fig.Q3 a)

b) For the circuit shown in Fig.Q3 b), calculate circuit's

(i) Current I_1 (1 mark)

(ii) Current I_2 (1 mark)

(iii) Total circuit current I_s (1 mark)

(iv) Total apparent power (1 mark)
(v) Total real power (1 mark)
(vi) Total reactive power (1 mark)
(vii) Power factor (1 mark)

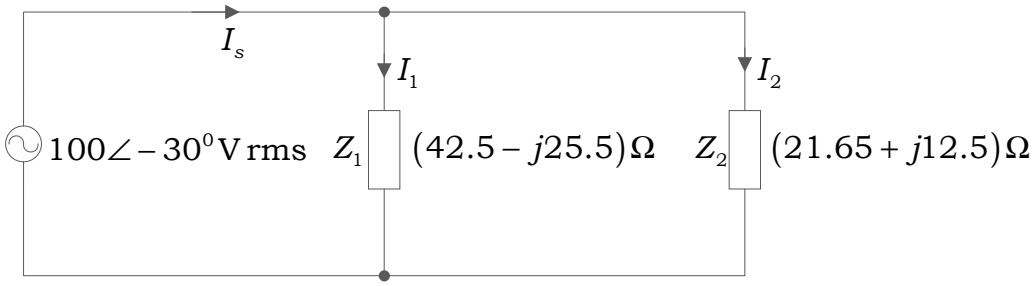

Fig.Q3 b)

c) Briefly explain the following terms as used in circuit analysis:
(i) Circuit (1 mark)
(ii) Branch (1 mark)
(iii) Node (1 mark)
(iv) Loop (1 mark)
(v) Mesh (1 mark)

QUESTION FOUR (20 marks)

a) Find the Norton's equivalent circuit for Fig. Q4 a) at terminals A-B and hence find the current through the $30\,\Omega$. **[8 marks]**

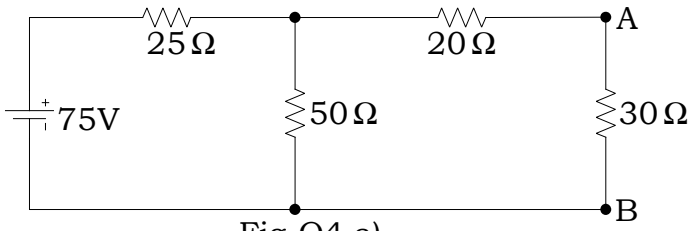

Fig. Q4 a)

b) For the circuit shown in Fig.Q4 b), take node 3 as the reference node and use nodal analysis to find

(i) Currents I_1, I_2, I_3, I_4 and I_5 **[8 marks]**

(ii) The power dissipated in the $15\,\Omega$ resistor **(1 mark)**

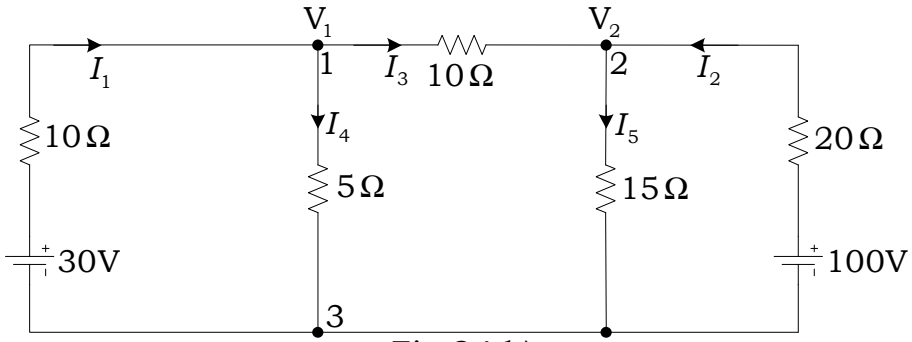

Fig.Q4 b)

c) State the three ways of marking the resistance values on the body of a resistor. **[3 marks]**

QUESTION FIVE (20 marks)

a) For the circuit of Fig. Q5 a), take node 3 as the reference and use superposition theorem to find

(i) The branch currents I_1, I_2, I_3, I_4 and I_5 **(11 marks)**

(ii) voltage across $25\,\Omega$ resistor. **(1 mark)**

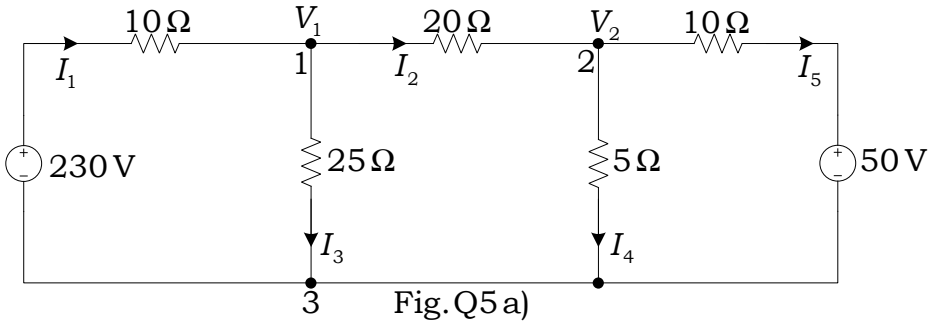

Fig. Q5 a)

b) A resistance of $15\,\Omega$ and a capacitance of $120\mu F$ are connected in parallel and fed from 100 V, 50 Hz supply. Find

(i) The circuit impedance
(ii) Total circuit current
(iii) Power factor
(iv) Apparent power
(v) Active power
(vi) Reactive power
(vii) Parameters of equivalent series circuit **[8 marks]**