MACHAKOS UNIVERSITY

University Examinations for 2023/2024 Academic Year

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

SECOND YEAR FIRST SEMESTER EXAMINATION FOR

BACHELOR OF SCIENCE IN ELECTRICAL AND ELECTRONICS ENGINEERING

EEE 203: CIRCUIT THEORY I

DATE: **TIME:**

INSTRUCTIONS

1. This paper contains 5 questions.
2. Attempt **Question One** and **Any Other Two questions**
3. Show calculations where applicable.

QUESTION ONE [30 MARKS]

a) Define the following terms as used in circuit analysis:

(i) Loop **[1 mark]**

(ii) Branch **[1 mark]**

(iii) Phase **[1 mark]**

(iv) Electrical engineering **[1 mark]**

b) State the two the Kirchhoff's laws **[2 marks]**

c) For the circuit shown in Fig. Q1 c), use Kirchhoff's laws to find

i. The currents I_1, I_2 and I_3 **[6 marks]**

ii. Voltage across the $12.5\,\Omega$ resistor **[1 mark]**

iii. Power dissipated in the $2.5\,\Omega$ resistor **[1 mark]**

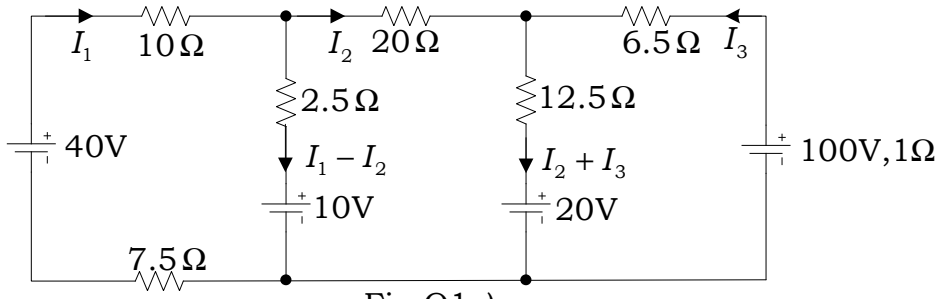

Fig. Q1c)

d) A resistance of $100\,\Omega$ and a capacitance of $100\,\mu$F are connected in series across a $400\,$V ,50 Hz supply. Find

(i) Circuit impedance **[1½ marks]**
(ii) Circuit Current **[1 mark]**
(iii) power factor **[½ 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 capacitance **[1 mark]**

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

(i) the total circuit resistance **[2 marks]**
(ii) the supply current, I **[1 mark]**
(iii) the currents I_1 I_2, I_3 and I_4 **[4 marks]**
(iv) the voltage, V_2 **[1 mark]**

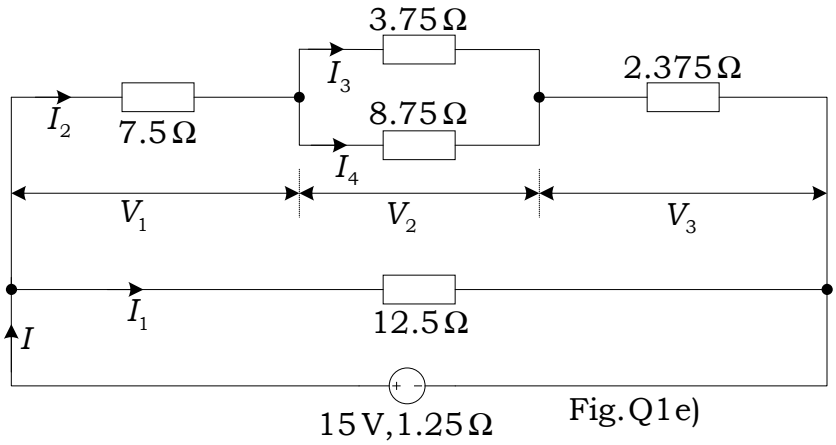

Fig. Q1e)

QUESTION TWO [20 MARKS]

a) For the circuit shown in Fig. Q2 a), take node 3 as the reference node and use nodal analysis method to find

(i) Currents I_1, I_2, I_3, I_4 and I_5 **[11 marks]**

(ii) the voltage across the $12.5\,\Omega$ resistor **[1 mark]**

(iii) the power consumed by the $7.5\,\Omega$ resistor. **[1 mark]**

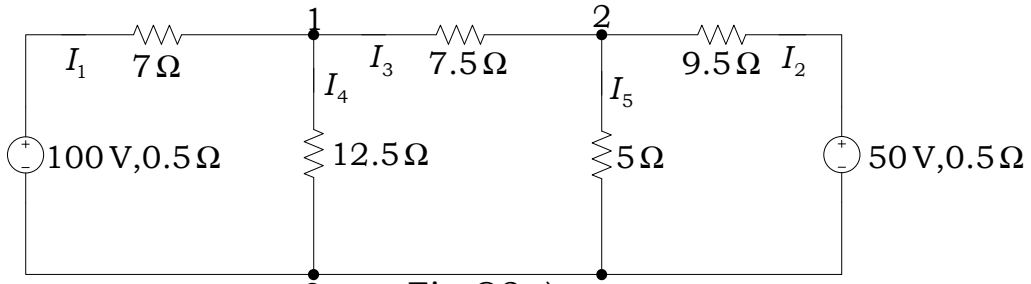

Fig. Q2 a)

b) For the circuit of Fig.Q2 b), determine

(i) Thevenin's equivalent circuit at terminal A-B and

(ii) Current through the $5\,\Omega$ resistance. **[7 marks]**

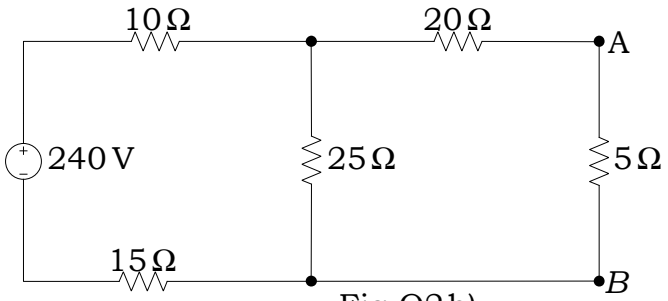

Fig. Q2 b)

QUESTION THREE [20 MARKS]

a) For the circuit shown in Fig. Q3 a), find

(i) Mesh currents I_1, I_2 and I_3 **[7½ marks]**

(ii) The voltage across the $10.5\,\Omega$ resistor **[1 mark]**

(iii) Power dissipated in the $20\,\Omega$ resistor **[1 mark]**

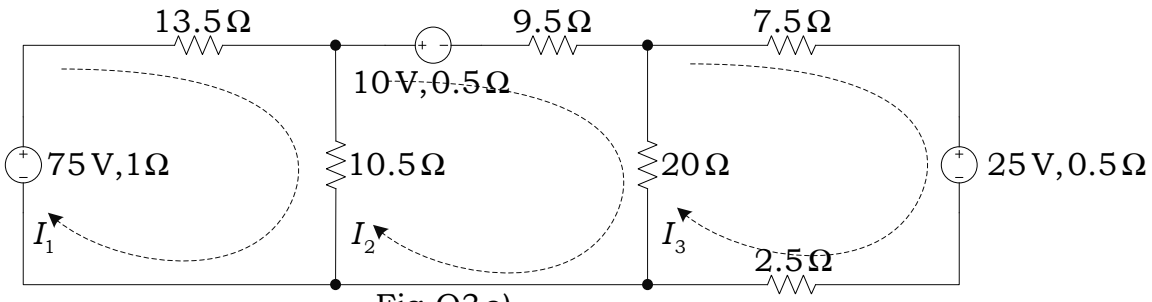

Fig. Q3 a)

b) When a voltage $v = 100\sin\left(1000t + 60^0\right)\text{V}$ is applied to a series ac circuit, the current is $i = 25\sin\left(1000t + 15^0\right)\text{A}$. Find

(i) power factor **[1 mark]**

(ii) apparent power **[1 mark]**

(iii) active power **[1 mark]**

(iv) circuit parameters **[3½ marks]**

c) Determine the resistance, tolerance, and range for the following colour code: Orange-Orange-Black-Brown-Violet. **[2 marks]**

d) Use four band colour code system, write down the colour code for the following resistor: $2.7k\Omega \pm 10\%$ **[2 marks]**

QUESTION FOUR [20 MARKS]

a) For the circuit shown in Fig. Q4 a), find

(i) Total circuit impedance **[3 marks]**

(ii) Current drawn from supply **[1 mark]**

(iii) Voltage across the parallel branches, V_2 **[1 mark]**

(iv) Currents in I_1 and I_2 **[2 marks]**

(v) Power factor **[1 mark]**

(vi) Apparent power **[1 mark]**

(vii) Active power **[1 mark]**

(viii) Draw the phasor diagram showing V, I, I_1 and I_2. **[2 marks]**

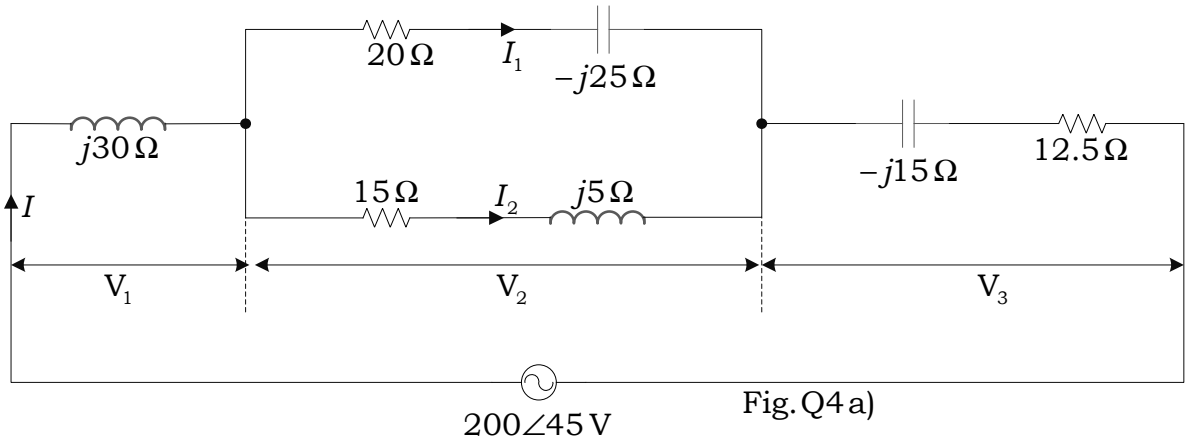

Fig. Q4 a)

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

(i) Norton's equivalent circuit at terminal A-B and **[6 marks]**

(ii) Voltage across the $(10 + j30)\Omega$ impedance. **[2 marks]**

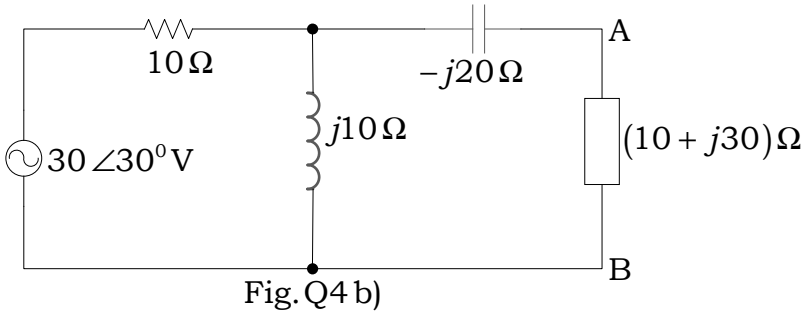

Fig. Q4 b)

QUESTION FIVE [20 MARKS]

a) Two resistors are connected in series across a 25 V supply and a current of 5 A flows in the circuit. If one of the resistors has a resistance of 4Ω, determine

(i) the value of the other resistor, and

(ii) the p.d. across the 2Ω resistor.

(iii) how much energy is used if the circuit is connected for 50 hours. **[5 marks]**

b) Using superposition theorem, calculate the current I in the circuit shown in Fig. Q 5 b). **[11 marks]**

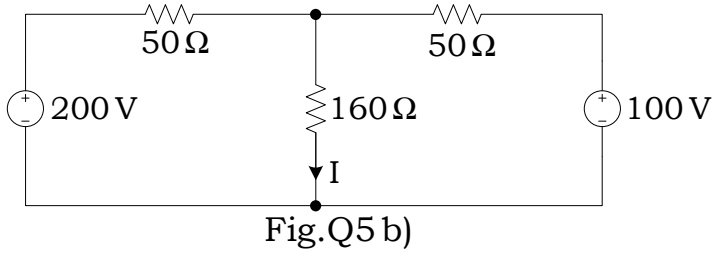

Fig. Q5 b)

c) Three voltages represented by $v_1 = 25\sin\left(\omega t + 15^0\right); v_2 = 15\sin\left(\omega t + 60^0\right)$ and $v_3 = 20\sin\left(\omega t + 45^0\right)$ act together in a circuit. Find an expression for the resultant voltage graphically. **[4 marks]**