



MACHAKOS UNIVERSITY

University Examinations for 2018/2019

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

SECOND YEAR SPECIAL/SUPPLEMENTARY 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 [30 MARKS]

- a) State the Ohm's law [1 mark]
- b) Two resistors are connected in series across a 30 V supply and a current of 5 A flows in the circuit. If one of the resistors has a resistance of 5Ω , determine
- (i) the value of the other resistor, and
 - (ii) the p.d. across the 5Ω resistor.
 - (iii) how much energy is used if the circuit is connected for 50 hours
- [4 marks]

- c) State the Thevenin's theorem and use it to determine the current flowing in the 3Ω in the circuit of Fig. Q1 c). [8 marks]

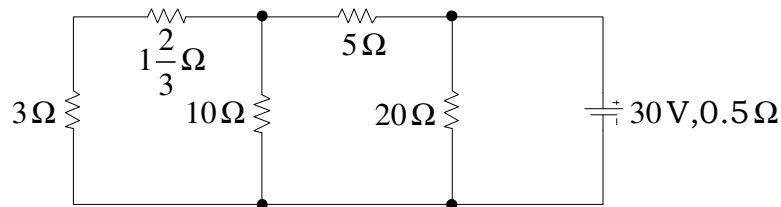


Fig. Q1 c)

- d) A capacitor C is connected in series with a 50Ω resistor across a supply of frequency 50 Hz. A current of 4 A flows and the circuit impedance is 60Ω . Calculate:

- the value of capacitance, C
- the supply voltage,
- the phase angle between the supply voltage and current
- the voltage across the resistor, and
- the voltage across the capacitor.
- draw the phasor diagram.

[9 marks]

- e) Three voltages represented by; $e_1 = 20\sin\omega t$, $e_2 = 30\sin(\omega t - \pi/4)$ and $e_3 = 40\cos(\omega t + \pi/6)$ act together in a circuit. Find an expression for the resultant voltage. Represent them by appropriate vectors. [8 marks]

QUESTION TWO [20 MARKS]

- State the Thevenin's theorem. [2 marks]
- Find the power dissipated in the 10Ω resistance of the circuit shown in Fig. Q 2 b) using Thevenin's theorem. [6 marks]

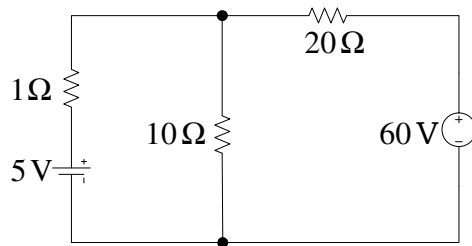


Fig. Q2 b)

- c) 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
- Current in each branch
 - Total circuit current
 - Circuit impedance
 - Power factor
 - Parameters of equivalent series circuit
 - Draw a phasor diagram of the circuit
- [12 marks]

QUESTION THREE [20 MARKS]

- a) A resistance of 20Ω and a capacitance of $100\mu\text{F}$ are connected in series across a 200V, 50 Hz supply. Find
- Circuit impedance
 - Circuit current
 - Apparent power
 - Reactive power
 - Reactive power
 - Taking circuit current as reference quantity, write the expressions for current, applied voltage, voltage across resistance and voltage across capacitance.
- [9 marks]
- b) Determine the resistance and tolerance ratings for the following colour code: Green, Blue, Brown and Silver
- [2 marks]

- c) An a.c. network consists of a coil, of inductance 79.58 mH and resistance 18Ω , in parallel with a capacitor of capacitance $64.96\mu\text{F}$. If the supply voltage is $250\angle 0^\circ\text{ V}$ at 50 Hz, determine
- Total equivalent circuit impedance,
 - The supply current,
 - The circuit phase angle,
 - The current in the coil, and
 - The current in the capacitor
- [9 marks]

QUESTION FOUR [20 MARKS]

- a) For the circuit of Fig. Q4 a), find the voltage across the resistor Z_L using Norton's theorem.
- [8 marks]

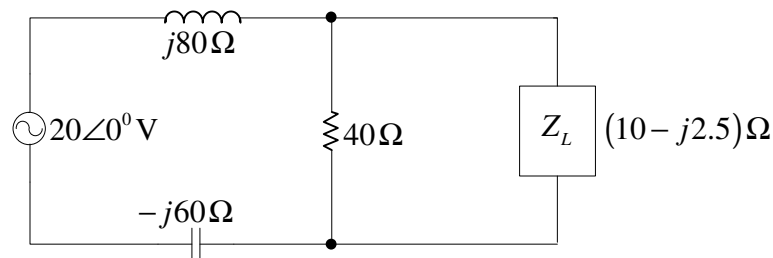


Fig.Q4 a)

- b) An alternating current varying sinusoidally with a frequency of 50 Hz has an rms value of 20 A. write down the equation for the instantaneous value and find this value
- 0.0025 second and 0.0125 second after passing through a positive maximum value.
 - At what time, measured from a positive maximum value, will the instantaneous current be 14.14 A.
- [7 marks]
- c) Apply the mesh method to find the voltage across the 20Ω resistor in the circuit of Fig. Q4 c).
- [5 marks]

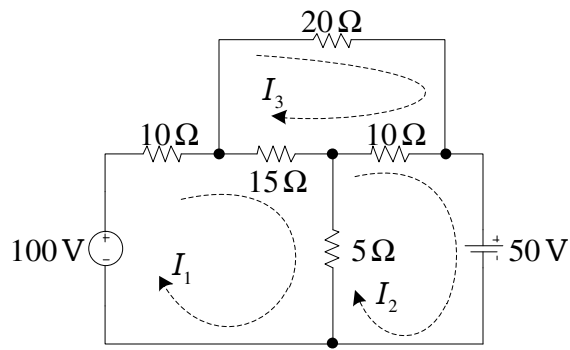


Fig. Q4 c)

QUESTION FIVE [20 MARKS]

- a) Find the current through the 10Ω resistor in Fig. Q5 a) by the principle of superposition. [12 marks]

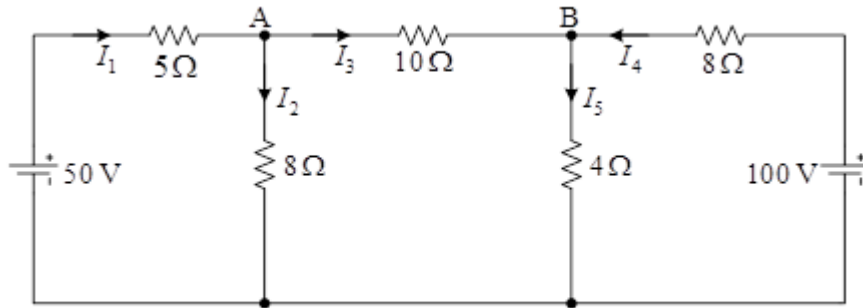


Fig. Q5 a)

- a) Use nodal analysis to find the different branch currents in the circuit of Fig. Q5 b). [8 marks]

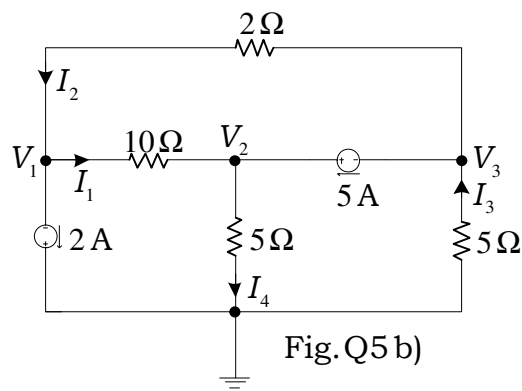


Fig. Q5 b)