



MACHAKOS UNIVERSITY

University Examinations 2018/2019

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF MECHANICAL AND MANUFACTURING ENGINEERING

SECOND YEAR SPECIAL/SUPPLEMENTARY EXAMINATION FOR

BACHELOR OF SCIENCE IN MECHANICAL ENGINEERING

EMM 209: ELECTRICAL ENGINEERING I

DATE: 26/9/2019

TIME: 11.00-1.00 PM

INSTRUCTIONS:

Answer question 1 (compulsory) and any other TWO questions

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) For the circuit shown in Fig. Q1 a),
- (i) Find the current supplied by the battery and the current through each resistor.
 - (ii) The circuit gets open circuited at point A. Find the total resistance of the circuit and the circuit current.
- [10 marks]**

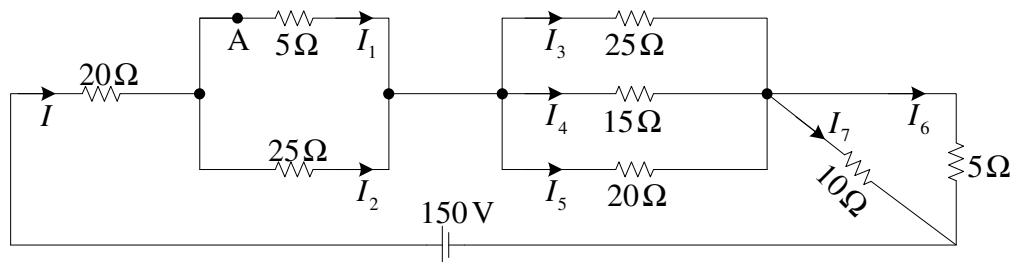


Fig. Q1 a)

- b) Apply Thevenin's theorem to find the current through the 15Ω resistor of the Fig.Q1b).

[7 marks]

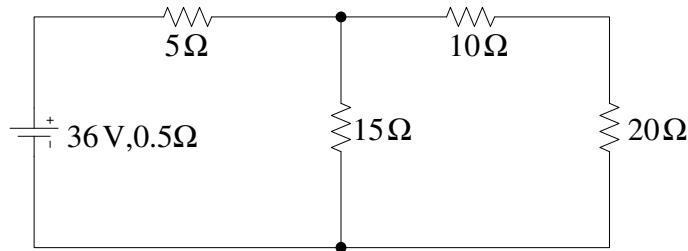


Fig.Q1b)

- c) A circuit has a 400Ω resistance in one branch, a 50Ω inductive reactance in the second and 40Ω capacitive reactance in the third. It is fed from a 240 V, 50 Hz supply. Find

- Current in all branches
- Total current
- Circuit impedance
- Circuit admittance
- Power factor
- Apparent power
- Active power
- Reactive power
- Parameters of equivalent series circuit

[13 marks]

QUESTION TWO [20 MARKS]

- a) For the circuit shown in Fig. Q2 a), find the current through and power dissipated in the 6Ω resistor.

[7 marks]

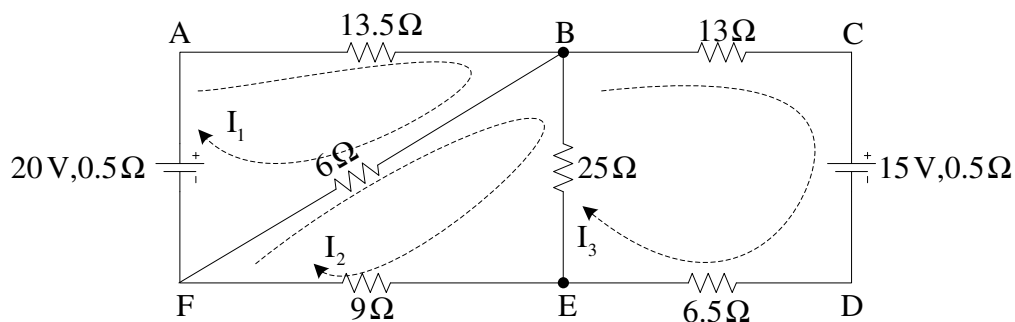


Fig.Q2 a)

- b) A star connected three phase load has a resistance of 10Ω and a capacitive reactance of 15Ω in each phase. It is fed from a 450 V 3 phase balanced supply.
- Find the line current, total amperes, active and reactive power.
 - Draw phasor diagram showing phase voltages, line voltages and currents. **[13 marks]**

QUESTION THREE [20 MARKS]

- Write down the colour code for a resistor with the following resistance value:
 $2.7\text{ k}\Omega \pm 10\%$ **[1 mark]**
- Determine the resistance and tolerance ratings for the following colour codes:
Blue-Brown-Green-Silver-Blue **[1 mark]**
- For the circuit shown in Fig. Q3 c), use nodal method to find the currents through each resistor and the voltage across the 10Ω resistor. **[10 marks]**

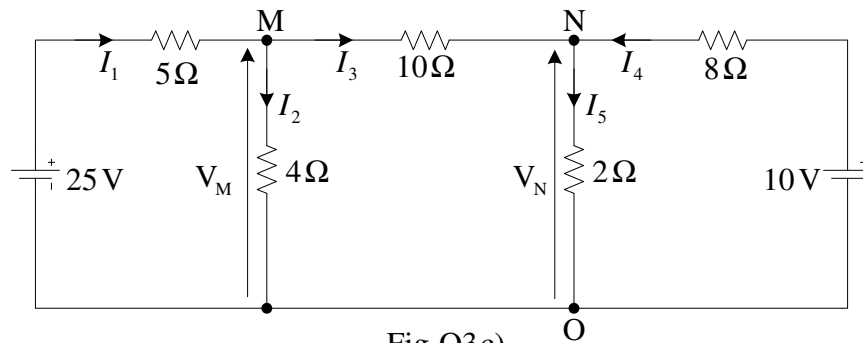


Fig.Q3c)

- A 50-Hz voltage of 230 V effective value is impressed on a capacitance of $100\mu\text{F}$.
 - Write the time equations for the voltage and resulting current. Let the zero axis of the voltage wave be at $t = 0$
 - Show the voltage and current on a time diagram
 - Show the voltage and current on a phasor diagram.
 - Find the maximum energy stored in the capacitor. **[8 marks]**

QUESTION FOUR [20 MARKS]

- Find the source voltage which should be applied in the circuit of Fig. Q4 a) so that $10\angle 0^\circ\text{ A}$ may flow through the capacitor. **[8 marks]**

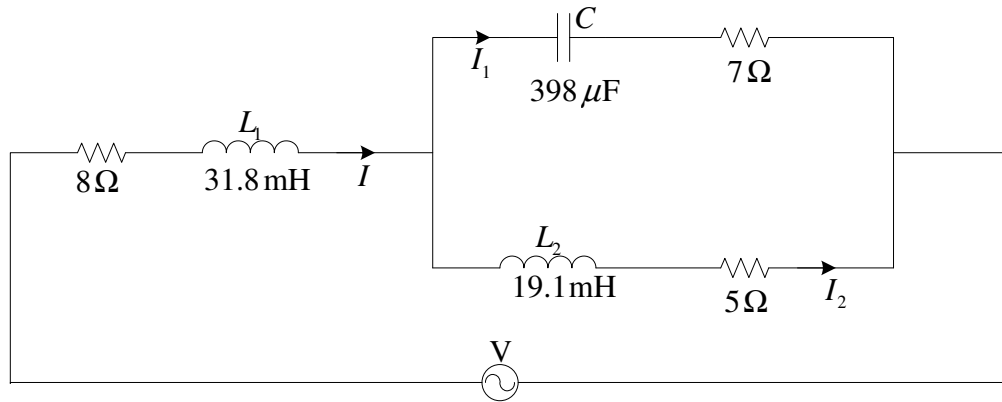


Fig. Q4 a)

- b) Apply Kirchhoff's laws to determine the voltage across and power dissipated in the $25\ \Omega$ resistor in the circuit of Fig Q4 b). [6 marks]

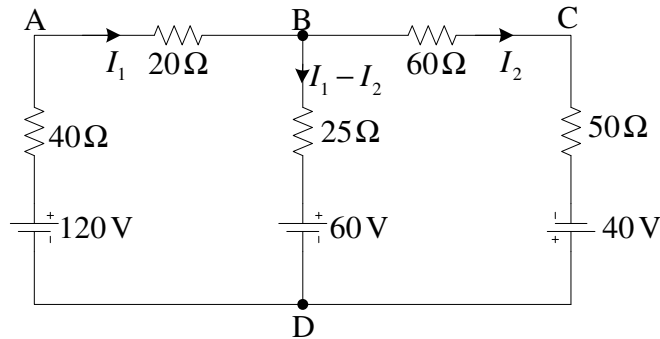


Fig. Q4 b)

- c) Two resistors are connected in series across a $24\ \text{V}$ supply and a current of $3\ \text{A}$ flows in the circuit. If one of the resistors has a resistance of $2\ \Omega$, determine
- the value of the other resistor, and
 - the p.d. across the $2\ \Omega$ resistor.
 - how much energy is used if the circuit is connected for 50 hour
- [4 marks]
- d) There are three ways of marking the resistance values on the body of a resistor. State any two. [2 marks]

QUESTION FIVE [20 MARKS]

a) Use Norton's theorem to find the current through 10Ω resistor in the circuit of Fig. Q5 a).

[8 marks]

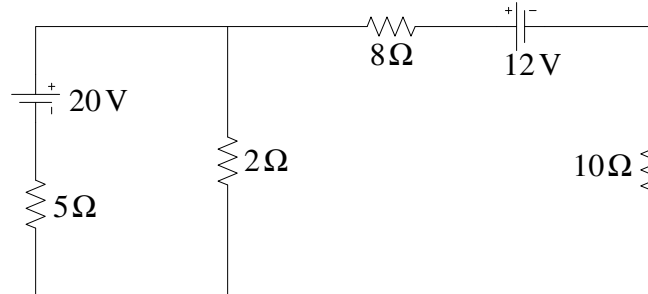


Fig.Q5a)

b) Fig. Q5 b) shows a circuit feeding a load resistance R_L .

(i) Find the value of R_L so that it can draw maximum power. Calculate this power.

(ii) When R_L is adjusted for maximum power transfer, what percentage of power delivered by battery reaches R_L ?

[5 marks]

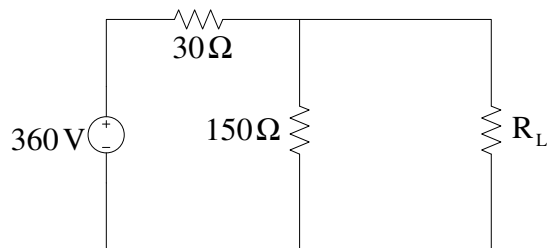


Fig.Q5b)

c) Find the current through the 10Ω resistor in Fig. Q5 c) by the principle of superposition.

[7 marks]

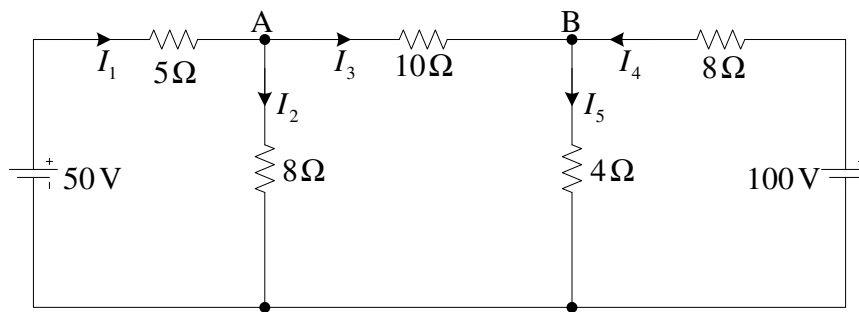


Fig.Q5c)