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 following in the 3Ω in the circuit of Fig. Q1 c). [8 marks]

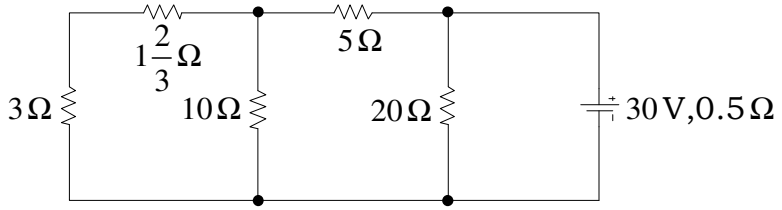

Fig. Q1 c)

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:
   (i) the value of capacitance, C
   (ii) the supply voltage,
   (iii) the phase angle between the supply voltage and current
   (iv) the voltage across the resistor, and
   (v) the voltage across the capacitor.
   (vi) 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]

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

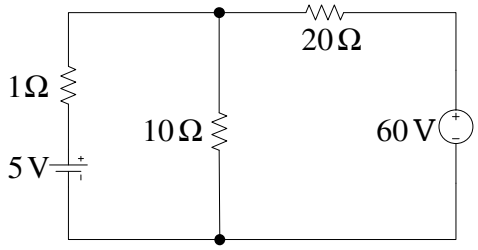

Fig. Q2 b)

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

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 [12 marks]

QUESTION THREE [20 MARKS]

a) A resistance of 20Ω and a capacitance of 100μF are connected in series across a 200V, 50 Hz supply. Find
(i) Circuit impedance
(ii) Circuit current
(iii) Apparent power
(iv) Reactive power
(v) Reactive power
(vi) 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 $18\,\Omega$, in parallel with a capacitor of capacitance $64.96\,\mu\text{F}$. If the supply voltage is $250\angle 0^0$ V at 50 Hz, determine

i) Total equivalent circuit impedance,
ii) The supply current,
iii) The circuit phase angle,
iv) The current in the coil, and
v) 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]

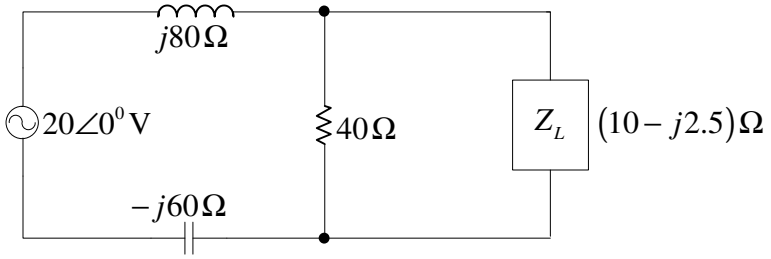

Fig.Q4 a)

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

(i) 0.0025 second and 0.0125 second after passing through a positive maximum value.
(ii) 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 $20\,\Omega$ resistor in the circuit of Fig. Q4 c). [5 marks]

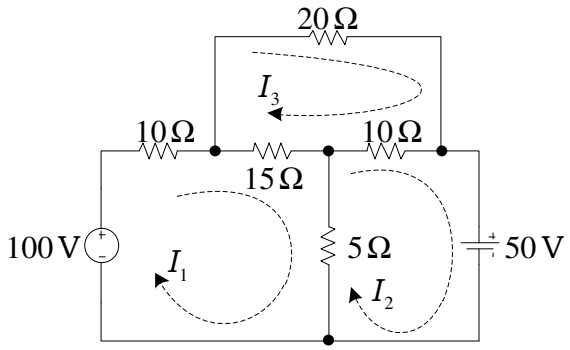

Fig. Q4 c)

QUESTION FIVE [20 MARKS]

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

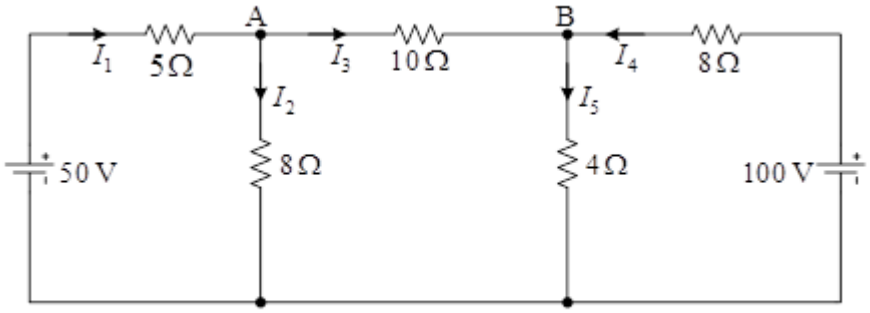

Fig. Q5 a

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

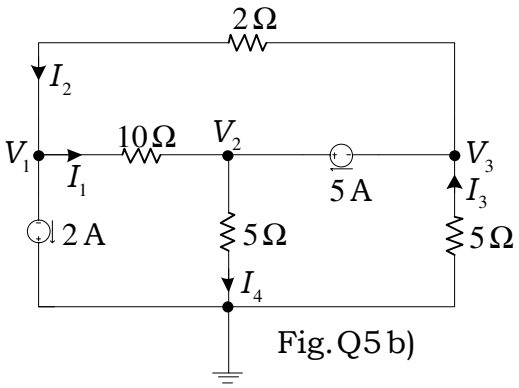

Fig. Q5 b)