MASENO UNIVERSITY

UNIVERSITY EXAMINATIONS 2015/2016

FIRST YEAR FIRST SEMESTER EXAMINATIONS FOR THE DEGREE OF BACHELOR OF SCIENCE IN COMPUTER SCIENCE AND TECHNOLOGY

MAIN CAMPUS

CCT 105: ELECTRIC CIRCUITS I

Date: 14th January, 2016 Time: 2.30 - 4.30 pm

INSTRUCTIONS:

- **Answer Question ONE Compulsory and any other TWO Questions.**

QUESTION ONE (30 Marks)

a) With the aid of an illustrated sketch, explain Ohm's law of an electrical circuit. **[3 marks]**

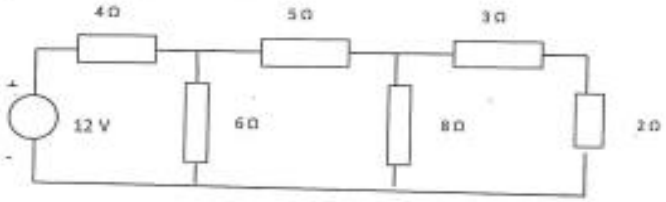
b) For the circuit shown below, calculate

i) the effective circuit resistance **[5 marks]**

ii) the current drawn from the power supply **[2 marks]**

iii) the voltage dropped across 5 Ω **[3 marks]**

iv) power developed in 3 Ω **[3 marks]**



c) Explain what is meant by terms Resistivity and Temperature coefficient of resistance of a material. **[2 marks]**

i) A copper conductor has a resistance of R_1 Ω at θ_1 °C, and a temperature coefficient of resistance, α, referred to 0 °C. Write down the expression for the resistance R_2 of the conductor at θ_2 °C. **[2 marks]**

ii) A resistor used in an electric circuit has a value of 250 Ω at 20 °C. The circuit, after sometime of use, attains an average temperature of 50 °C. Determine the new value of resistance at this temeprature, taking $\alpha = 4.28 \times 10^{-3}$/ °C referred to 0 °C. **[5 marks]**

d) A battery is rated as 3500 mAh. If the terminal voltage is 3.7 volts, what energy is this battery able to supply? What is the magnitude of charge represented? **[5 marks]**

QUESTION TWO (20 Marks)

a) Explain what is meant by the terms waveform, frequency, peak value, average value and rms value. Use a simple illustration. **[6 marks]**

b) An alternating current i is represented by $i = 10 \sin 942t$ amperes. Determine: (a) the frequency; (b) the period; (c) the peak value, (d) the average value, and (e) the r.m.s. value of the waveform. **[5 marks]**

c) An ac circuit consists of R = 12 Ω in series with L = 0.1 H. Supply voltage is 100 V at 50 Hz. determine

i. Inductive reactance **[2 marks]**

ii. The impedance **[3 marks]**

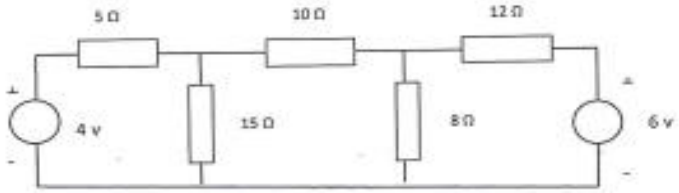
iii. The circuit current **[2 marks]**

iv. Power factor **[2 marks]**

QUESTION THREE (20 Marks)

a) With the aid of an illustrated skectch state and explain the superposition theorem of electrical cicuits. **[6 marks]**

b) Use the superposition theorem to determine the direction and magnitude of the current through and the power developed in the 8 Ω resistor. **[14 marks]**



QUESTION FOUR (20 Marks)

a) A capacitor, C, is connected in series with a resistor R_1 Ω through a switch S terminal 1. Terminal 2 of the switch connects to another resistor, R_2, through which the capacitor can discharge. Draw the circuit and hence derive the equation for the voltage across the charging capacitor, any time after the switch is at 1, assuming zero voltage at initial conditions. **[8 marks]**

b) The value of the capacitor in a) above is 8 μF and that of the resistor R_1 is 0.5 MΩ. Determine

i) The circuit time constant. **[2 marks]**

ii) The time taken for the voltage across the capacitor to grow to 160 V after switch on. **[4 marks]**

iii) The voltage across and the current through the capacitor 4 seconds after it disconnected from the supply, giventhat R_2 is 200 kΩ. **[6 marks]**

QUESTION FIVE (20 marks)

a) Draw the circuits for a voltage source and a current source, connected to a load resistance, R_L. For respective each case, derive and explain the condition for the maximum transfer of voltage and current to the load. **[6 marks]**

b) A voltage source, E volts, and a source resistance r Ω, connects to a variable load resistor R_L. Derive the condition for the maximum transfer of power to the load. **[8 marks]**

c) The output stage of a power amplifier is connected to a loud speaker of 4 Ω. The amplifier output stage can be represented by a Thevenin voltage of 12 V. What is the value of the Thevenin resistance to ensure maximum power is transferred to the load? Calculate the value of this maximum power. **[6 marks]**