UNIVERSITY OF ESWATINI

FACULTY OF SCIENCE & ENGINEERING

DEPARTMENT OF ELECTRICAL &ELECTRONIC ENGINEERING

RESIT EXAMINATION

DECEMBER 2018

TITLE OF PAPER: BASIC ELECTRICAL ENGINEERING

COURSE CODE: EEE251

DURATION: 3 HOURS

INSTRUCTIONS:

1. There are five (5) questions in this paper. Answer question 1 and any other three (3) questions.
2. Each question carries equal marks.
3. Start each question in a new page.

This paper should not be opened until permission has been given by the invigilator.

This paper contains six (6) pages including this page.

Question 1

a. Describe a rheostat and potentiometer. Give two examples where they can be used. [2 Marks]

b. Using simple circuit diagrams illustrate how each can be connected in a circuit. [4 Marks]

c. An experimenter building the voltage circuits shown in Figure Q.1c predicted that varying the resistance **R2** and **R3** should give the results shown on the graphs below the circuits.

(i) Make pairs of each voltage divider circuit (a) or (b) with a corresponding graph (c) or (d). Give reasons for your pairs. Further determine what the axis variables **X** and **Y** should be. [6 Marks]

(ii) Define the labeling of the graphs by working out, from the circuit variables, expressions for the voltages labelled **A, B, C, D** and **E**. [10 Marks]

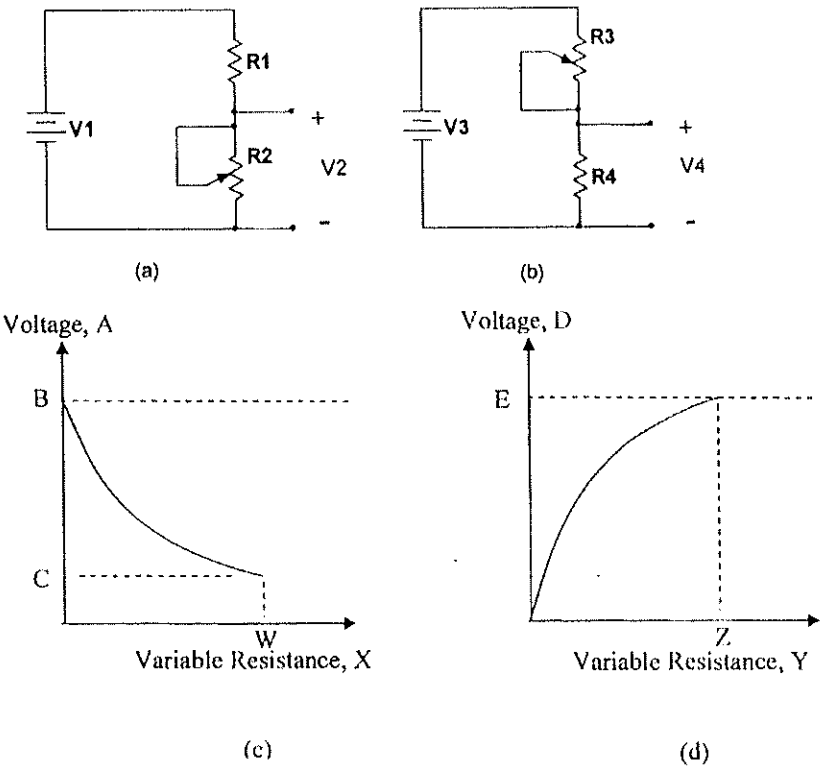

Figure Q.1c

d. Determine the ratio of powers dissipated in two resistors, each having the same length and each made of copper wire of circular cross section, but one having a diameter twice that of the other, and each being connected across the same voltage. [3 Marks]

Question 2

a. Use wye-delta or delta-wye transformation to evaluate the current supplied by the source in Figure Q.2a.

[10 Marks]

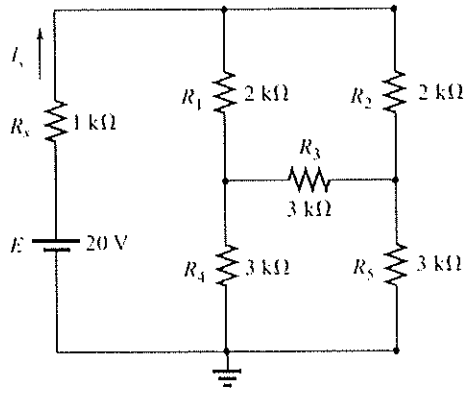

Figure Q.2a

b. In Figure Q.2b, use the mesh current analysis technique to find;

i. The loop and branch currents. [10 Marks]

ii. The voltage across 1 Ω and 4 Ω resistor. [5 Marks]

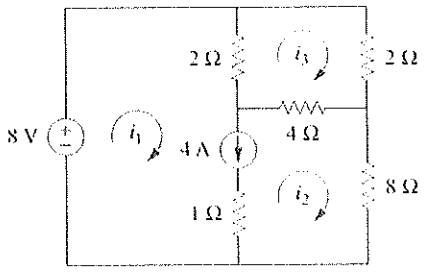

Figure Q.2b

Question 3

a. Consider the circuit shown in figure Q3a.

i. Find the Thevenin equivalent of the circuit across the points a and b. [5 Marks]

ii. If a variable resistor were connected between the points a and b, what will be the maximum power dissipated in the variable resistor? [2 Marks]

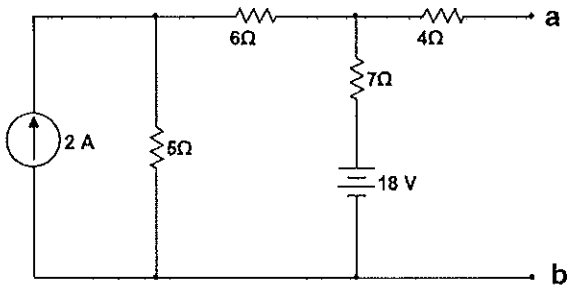

Figure Q.3a

b. Use nodal analysis to find the voltage through the 4 Ω resistor shown in figure Q3b. [8 Marks]

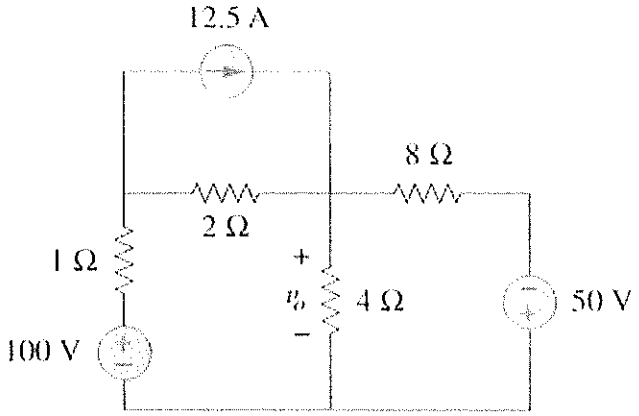

Figure Q.3b

c. The circuit shown in Figure Q.3c has two current sources one of which is a voltage dependent source. Find the following:

i. The voltage across the independent current source. [6 Marks]

ii. The power dissipated in each resistor. [2 Marks]

iii. The total power supplied by the sources. [2 Marks]

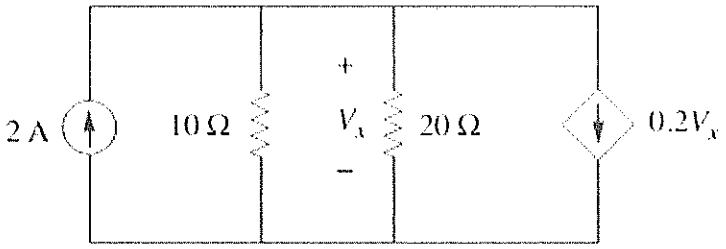

Figure Q.3c

Question 4

a. A 4 Ω resistor in series with a 7.96 mH inductor is connected across a 240 V 60 Hz source. Determine:

i. The total impedance. [3 Marks]
ii. The input current [2 Marks]
iii. The voltages across the resistor and the inductor. [4 Marks]
iv. Draw a phasor diagram showing the current and the voltages. [4 Marks]
v. The power factor. [2 Marks]
vi. The input power. [2 Marks]

b. Given that an inductor draws 5 A of current at 230 V 50 Hz, find the inductive reactance and the inductance. [4 Marks]

c. Given that a capacitor draws 2 A of current at 230 V 50 Hz. Find the capacitive reactance and the capacitance. [4 Marks]

Question 5.

a. Consider the circuit shown to answer the following. Assume the capacitor has already been fully charged.

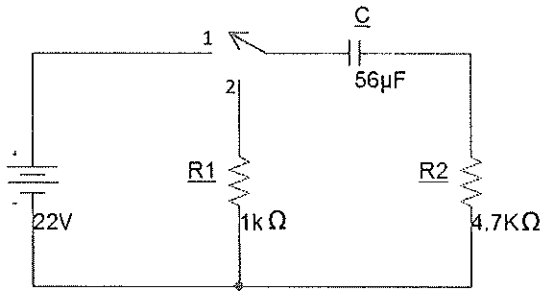

Figure Q.5a

i. Determine the time it takes for the capacitor to discharge i.e. when the switch is placed at position 2. [2 Marks]

ii. Give the mathematical expression for v_c and i_c when capacitor is discharging. [4 Marks]

iii. Sketch the transients of v_c and i_c. [4 Marks]

b. A coil of inductance 80mH and resistance 120 Ω is connected to a 230 V, 50Hz supply, in parallel with it is a 60 μF capacitor in series with a 40 Ω resistor as shown in Figure Q.5b Determine:

iv. The total impedance of the circuit. [6 Marks]

v. The power factor of the circuit stating whether it is leading or lagging. [3 Marks]

vi. The total Active Power taken from the supply. [2 Marks]

vii. The total reactive power supplied. [2 Marks]

viii. The apparent power supplied. [2 Marks]

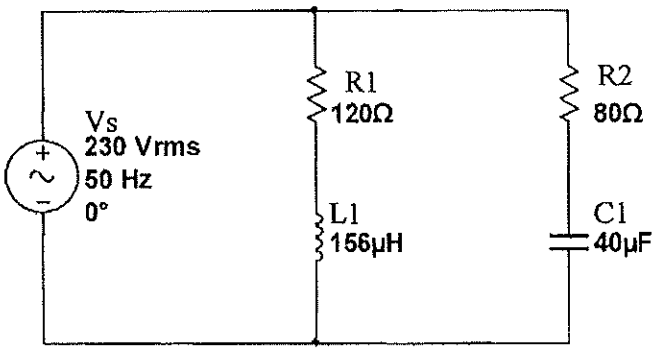

Figure Q.5b

End of Paper