UNIVERSITY OF ESWATINI

FACULTY OF SCIENCE & ENGINEERING

DEPARTMENT OF ELECTRICAL & ELECTRONIC ENGINEERING

RESIT EXAMINATION

JANUARY 2020

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 eight (8) pages including this page.

Question 1 [25 Marks]

a. Consider breakdown strength of an insulator;

i. Define breakdown strength of an insulator. [2 marks]

ii. Why should we care about breakdown strength of an insulator? [2 marks]

b. Show the connections required to establish 4kΩ from three terminals of a 10kΩ potentiometer. [2 Marks]

c. How would you check the status of a fuse with an ohmmeter? [2 Marks]

d. A short circuit across a current source draws 15A. If a 10Ω resistor across the source draws 13A, what is the internal resistance of the source? [3 Marks]

e. A copper wire has a resistance of 50Ω at 10^0C. What is the maximum operating temperature if the resistance of the wire is to increase by at most 10 percent? [4 Marks]

f. Two copper wires each of diameter 0.64mm and length 1.2m are used for connecting the positive and negative terminals of a 5V d.c. supply to an electronic circuit board which takes a current of 0.5A. Calculate the supply voltage appearing across the electronic circuit board. You are given that the resistivity of copper is $1.7\text{x}10^{-8}$ Ω-m. [6 Marks]

g. What is the greatest voltage and current that can be applied across a $^1/_8$W, 2.7MΩ resistor without causing it to overheat? [4 Marks]

Question 2 [25 Marks]

a. Reduce the resistor network between terminals a and b of Figure Q.2a to a single resistor. [9 Marks]

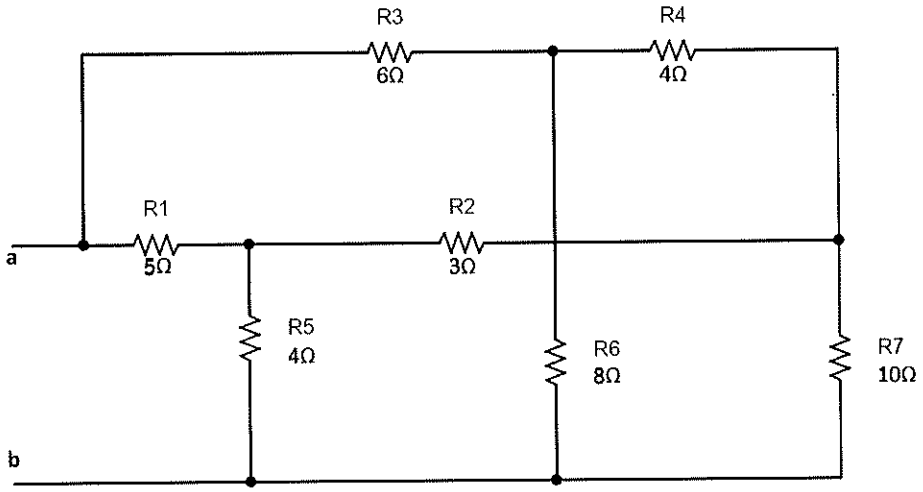

Figure Q.2a

b. Using mainly source transformation find the current through the 6Ω resistor in Figure Q.2b. [5 Marks]

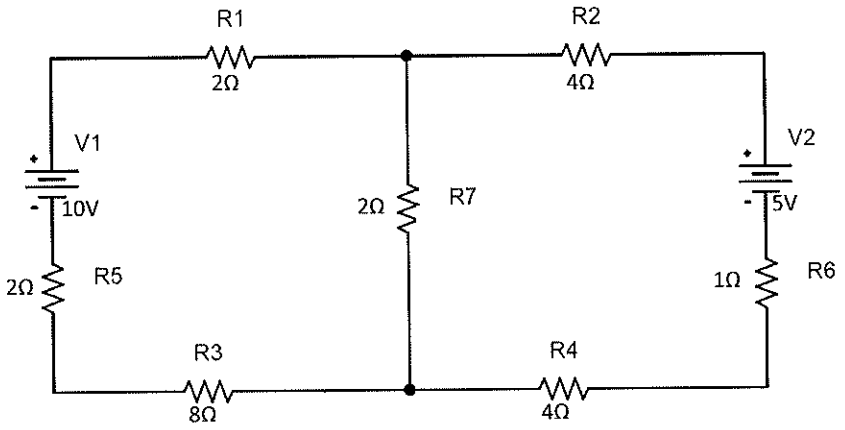

Figure Q.2b.

c. Consider the circuit of Figure Q.2c, for the following;

i. Find all the branch currents in the circuit. [8 Marks]

ii. Find the power supplied by the current source. [3 Marks]

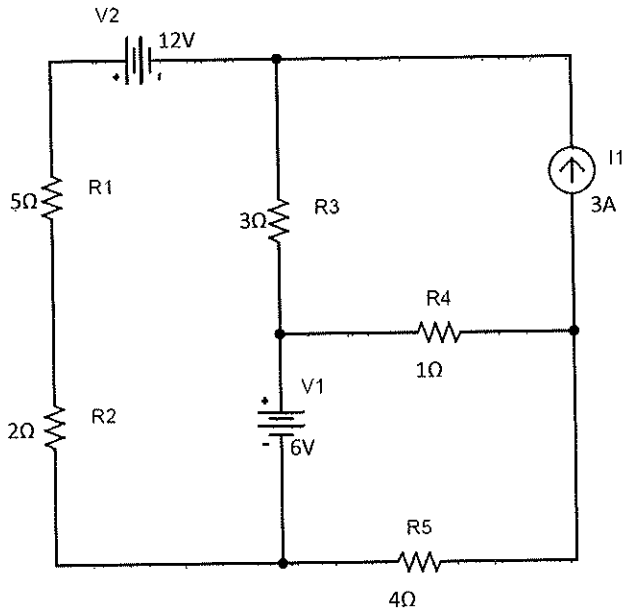

Figure Q.2c

Question 3 [25 Marks]

a. Use nodal analysis to find current I_1 and I_2 in the circuit shown in Figure Q.3b. [10 Marks]

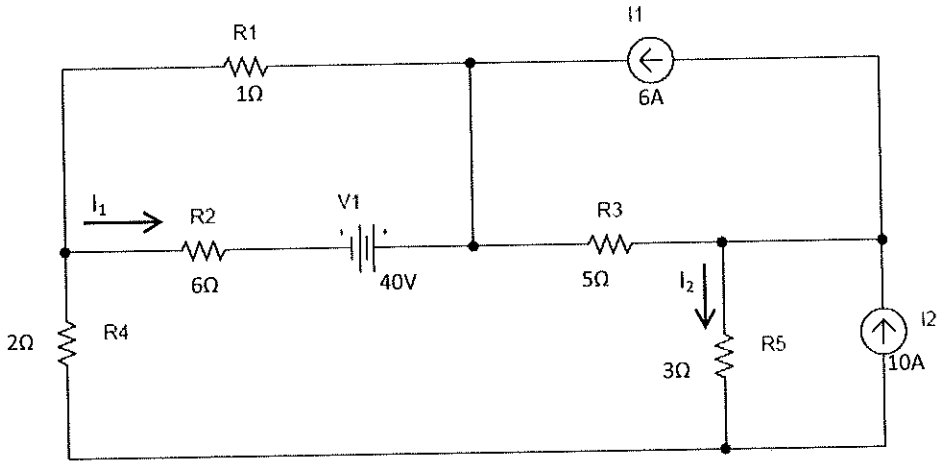

Figure Q.3b.

b. Find the Thevenin equivalent circuit with respect to terminal a,b for the circuit shown in Figure Q.3b. [7 Marks]

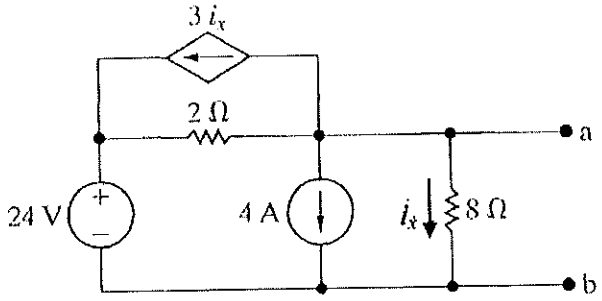

Figure Q.3b

c. Using superposition find the node voltages V_1 and V_2 in the circuit shown in Figure Q.3c. [8 Marks]

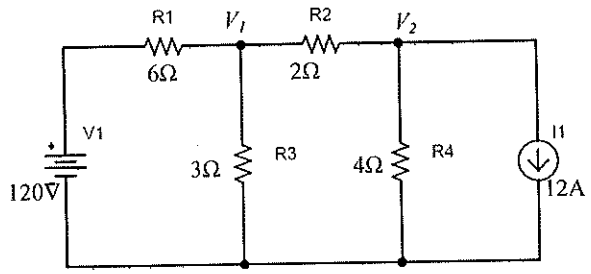

Figure Q.3c

Question 4 [25 Marks]

a. Given the circuit shown in Figure Q.4a, answer the following:

i. Use mesh analysis to determine current I_1 and I_2 [16 Marks]

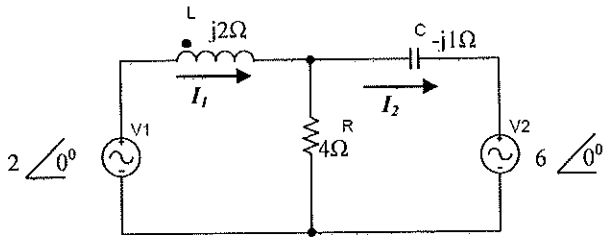

Figure Q.4a

ii. Find the power supplied (or absorbed) by each source of the circuit. [4 Marks]

b. An impedance $Z_1 = (4 + j4)\Omega$ is connected in parallel with an impedance $Z_2 = (12 + j6)\Omega$. If the input reactive power is 2500VAR (lagging), what is the total active power? [5 Marks]

Question 5 [25 Marks]

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

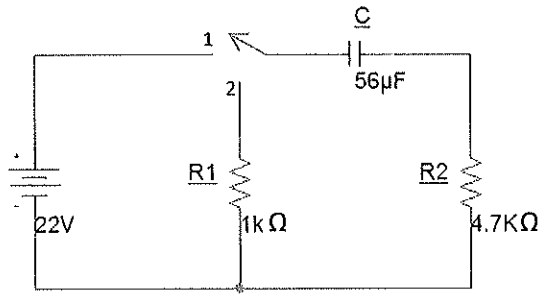

Figure Q.5a

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 0.1 H is connected across a 50 V, 60 Hz supply, in parallel with it is a 100 μF capacitor which is also in parallel with a 30 Ω resistor as shown in Figure Q.5b. Determine:

i. The total impedance of the circuit. [4 Marks]

ii. The branch currents [3 Marks]

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

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

v. The apparent power supplied. [2 Marks]

vi. The power factor of the circuit stating whether it is leading or lagging. [2 Marks]

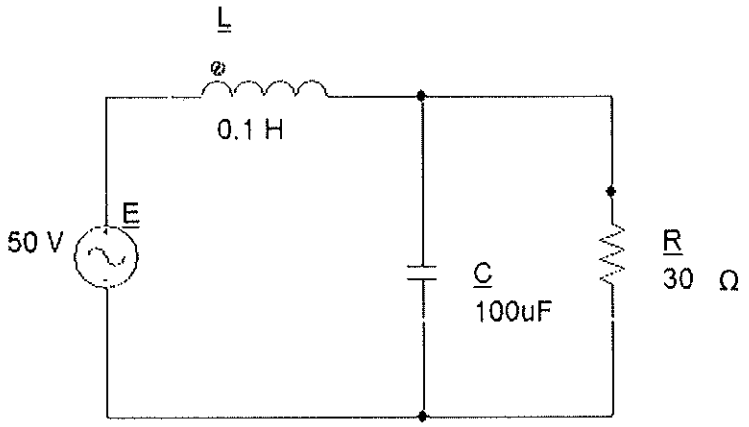

Figure Q.5b.

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