UNIVERSITY OF SWAZILAND

FACULTY OF SCIENCE & ENGINEERING

DEPARTMENT OF ELECTRICAL & ELECTRONIC ENGINEERING

RESIT EXAMINATION

JULY 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 [25 Marks]

a. A wire of uniform cross section has a resistance of 0.8Ω. If the length of the wire is doubled and its cross sectional area increased 4 times, what is the resistance? (ignore the effect of temperature). [4 Marks]

b. Normally, heat energy is measured in joules (J). Given that you are required to design a heating element to boil a certain amount of water in 2 minutes using 200 kilojoules of energy. If the heating element is to operate at 240V, calculate its current and power rating. [4 Marks]

c. What is the total cost of using the following appliances at 1 Lilangeni 34 cents per kilowatt-hour?

i. 100W home theatre system for 2 hours. [1 Mark]
ii. 150 W LCD TV for 3hrs 20 minutes [1 Mark]
iii. 1500 W electric heater for 30 minutes [1 Mark]

d. Given that two resistors are wound with round copper wire, the length and the diameter of the first wire are l and A respectively and those of the second wire are 0.25l and 0.5A.

i. Determine the ratio of currents and powers of the two resistors if they are connected across the same voltage source. [6 Marks]
ii. If the same current flows through the two resistors, determine the ratios of voltage and power. [4 Marks]

e. Consider the circuit shown in **Figure Q1e**. Given that $I_2 = 2.5A$ and $I_3 = 1.5A$, find the values of R_2 and R_3

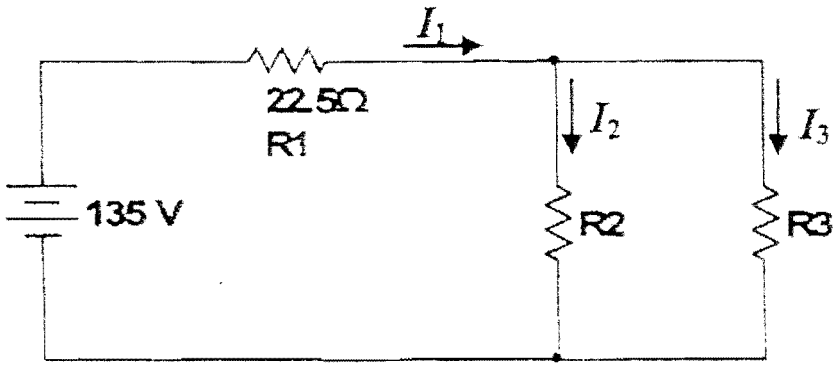

Figure Q2.e

[4 Marks]

10

Question 2 [25 Marks]

a. Reduce the resistor network between terminals A and B of Figure Q.2a to a single resistor. [3 Marks]

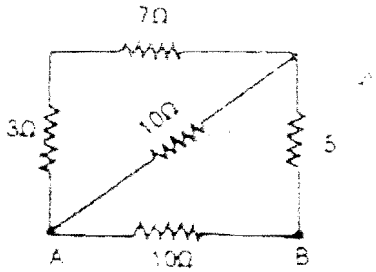

Figure Q.2a

b. For the series-parallel network shown in Figure Q.2b, find the following.
   (i) The current I_5.
   (ii) The currents I_2 and I_8.
   (iii) The current I_7.
   (iv) The voltage V_{ab}. [12 Marks]

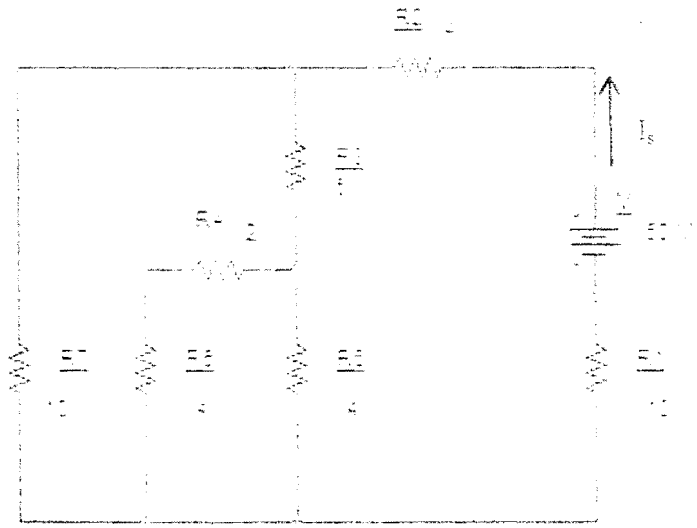

Figure Q.2b.

c. Given that $I_5 = 4A$, use the current divider rule to evaluate the currents I, I_1, I_2, I_3, I_4, and I_6 in **Figure Q.2c.** [11 Marks]

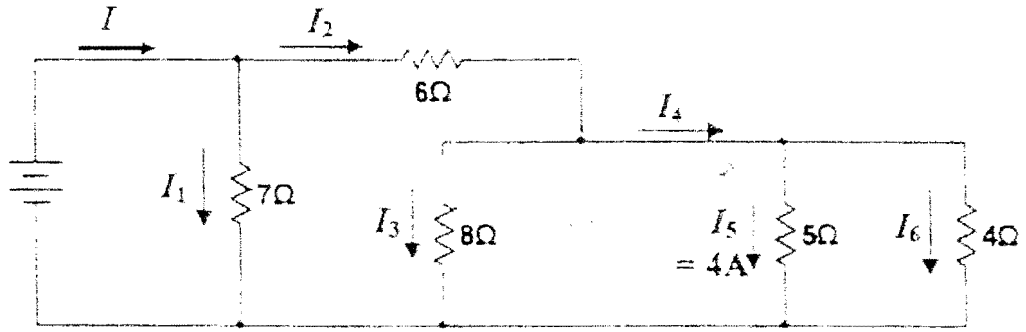

Figure Q.2c.

Question 3 [25 Marks]

a. Find the maximum power transferred to R in the circuit of Figure Q.3a. [10 Marks]

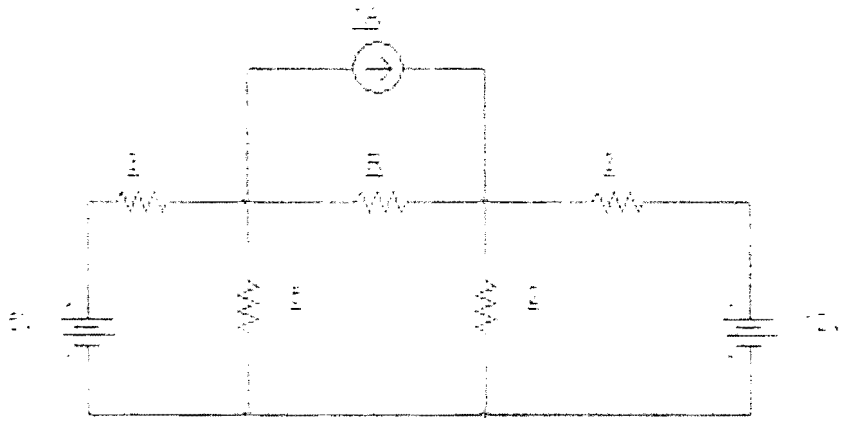

Figure Q.3a.

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

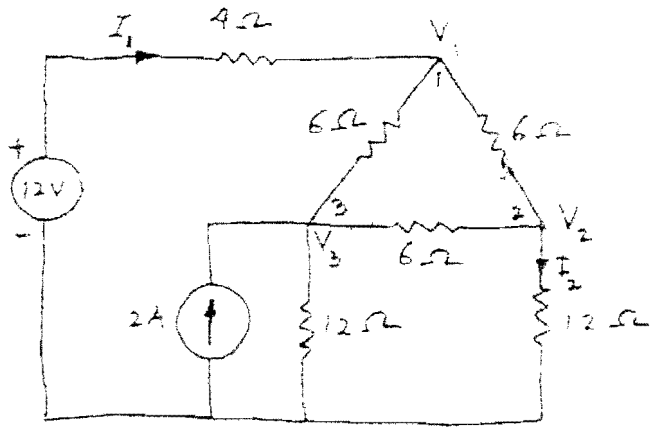

Figure Q.3b.

c. You are told that a capacitor stores 0.3 J of energy when 400V d.c. supply is connected across the capacitor. Find the following.

i. The capacitance.

[2]

ii. The charge on the capacitor.

[2]

Question 4 [25 Marks]

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

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

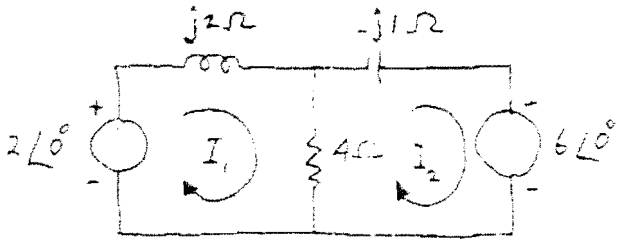

Figure Q.4a

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 $Z_2 = 7\angle 2^{\circ}$ $- j6\Omega$. If the input reactive power is 2500VAR (lagging), what is the total active power? [5 Marks]

Question 5 [25 Marks]

a. A circuit consisting of a coil of inductance 10 mH and resistance 30 Ω, in series with a capacitance of 4 μF is connected to a variable frequency supply which has a constant voltage 10 V. Determine:

i. The resonance frequency of the circuit. [2 Marks]
ii. The current in the circuit at resonance. [2 Marks]
iii. The voltages across the inductance and the capacitor at resonance. [3 Marks]
iv. The Q-factor of the circuit [2 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. [3 Marks]
v. The apparent power supplied. [2 Marks]
vi. The power factor of the combined circuits stating whether it is leading or lagging. [2 Marks]

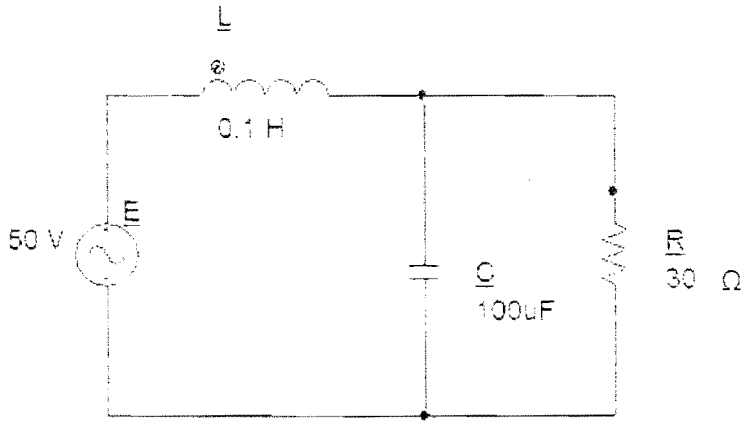

Figure Q.5b.

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