UNIVERSITY OF SWAZILAND

FACULTY OF SCIENCE

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

MAIN EXAMINATION DECEMBER 2010

TITLE OF PAPER: **BASIC ELECTRICAL ENGINEERING**

COURSE CODE**: EE251**

TIME ALLOWED: **THREE HOURS**

INSTRUCTIONS TO CANDIDATES

1. Answer all the **seven questions**.
2. Questions do not carry equal marks.
3. Show all your steps clearly in any calculations.
4. State clearly any assumptions made.
5. Start each question on a fresh page.

This paper has 6 pages including this page.

DO NOT OPEN THE PAPER UNTIL PERMISSION HAS BEEN GRANTED BY THE INVIGILATOR.

Question no 1: (10 Marks)

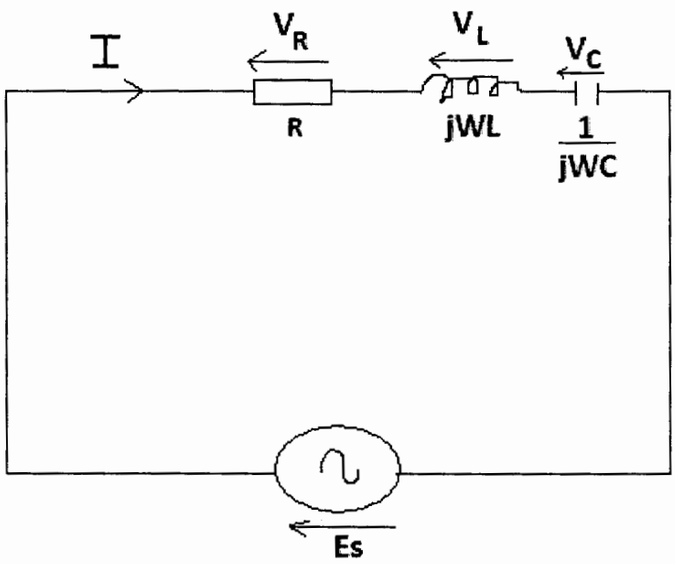


Fig. Q.1a

Consider the fig. Q.1a . If the magnitude of Voltage across the inductor and across the capacitor are the same, explain which adjustments can be made in this circuit so as to obtain

a) A small amount of current in the circuit. [**5 marks**]

b) A high quality factor (Q). [**5 marks**]

Question no 2: (15 Marks)

The University of Swaziland wishes to introduce an internal electrical Locomotive system to transport students whose Lecture rooms are far from the Campus' main entrance.

a) Which D.C motor would you recommend to drive such a system? Give reasons for your recommendation [**3Marks**]

b) Draw the circuit diagram for motor you recommended in (a). [**2Marks**]

c) Derive the factor by which the speed of the motor in (a) changes, if the excitation current reaches only 50% of its full value? [**5Marks**]

If the same machine worked as a generator,

d) Draw the circuit diagram [**2 Marks**]

e) Derive the Mathematical expression for the E.M.F generated in the armature windings [**3 Marks**].

Question no 3: (20 Marks)

Find the Thévenin equivalent circuit for the network **outside the shaded area** of the bridge network in the following figure (Fig.Q.3b)

[17 Marks]

Hence or otherwise find the magnitude and direction current flowing in RL when RL= 7 Ω **(3Marks)**

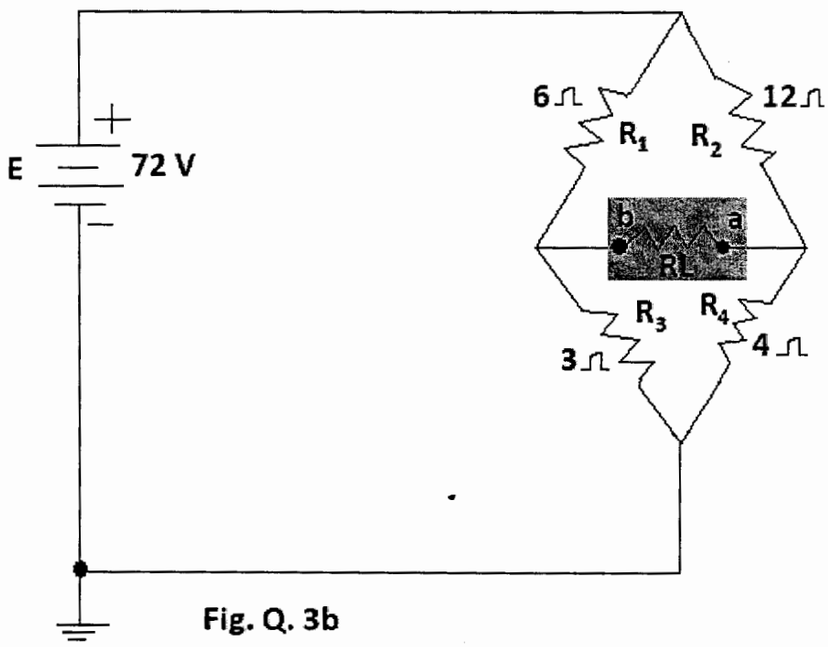


Fig. Q. 3b

Question no 4: (16 Marks)

a) Draw a phasor diagram for a loaded single-phase transformer assuming that the transformer is having negligible voltage drop in windings. Define all the symbols used. **[8 Marks]**

b) Explain each step used in the complete construction of the phasor diagram

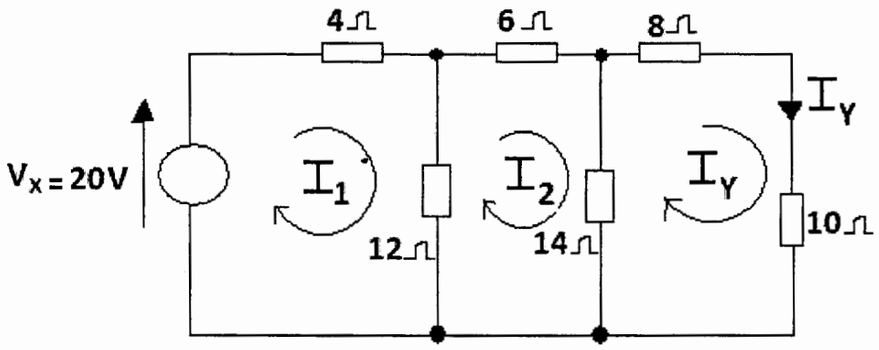
[8 Marks]

Question no 5: *(20 Marks)*

In this problem demonstrate the reciprocity theorem by solving part (a) and (b) as follows:

a) Calculate I_Y in the single-source linear bilateral network in the following figure, (**Fig.Q.5c**). **[10Marks]**

b) Also consider removing the source **Vx** and replacing it in the branch in which I_Y flows, and verify the prediction of the reciprocity theorem.**[10 Marks]**



(Fig.Q.5c)

Question no 6: ***(9Marks)***

A single-phase 50 Hz transformer has 80 turns on the primary winding and 400 turns on the secondary winding. The net cross-sectional area of the core is 200 cm^2 . If the primary winding is connected to a 240V, 50 Hz supply; determine:

a) E.M.F induced in the secondary [3Marks]

b) The maximum value of the flux density in the core [4 Marks]

c) Tell if the magnetic circuit of such a transformer is having high or low Retentivity, justify your answer. [2 Marks]

Question 7: (10Marks)

A coil of L = 5.00 μH and a capacitor of C= 200 pF are in series. The frequency is f= 4.00 KHz. What is the net reactance vector jX? **[10 Marks]**

END OF PAPER