The Open University of Sri Lanka
Department of Electrical and Computer Engineering

ECX3210 – Electro -Techniques

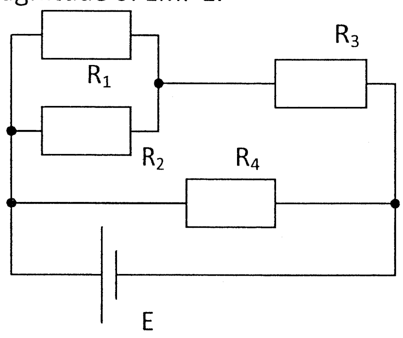
Final Examination 2014/2015 **Closed Book Test**

Date: 09th August 2015 Time: 13.30-16.30

Answer any 5 questions. All questions carry equal marks. Show all relevant steps of calculation.

1) a. What is the possible **resistance range** of a resistor displaying colour bands Green, Blue, Black, Gold?

b. In the circuit of fig. Q1 the current through R_1 is 4 mA. Calculate the currents through the other branches, and the magnitude of EMF **E**.



$R_1 = 6\ k\Omega$ $R_2 = 8\ k\Omega$

$R_3 = 2\ k\Omega$ $R_4 = 20\ k\Omega$

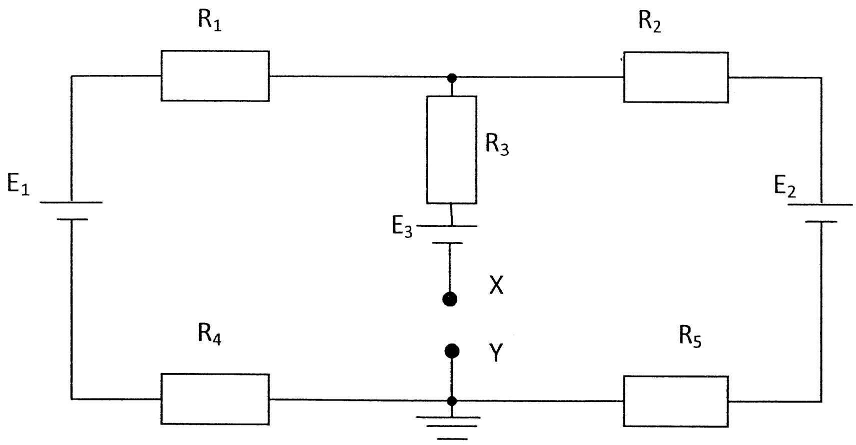
Figure Q1

c. A 200 Ω, 2 W resistor is needed, but only several 200 Ω, 1.2 W resistors are available.

i. What two different combinations of the available resistors give the required resistance and power rating? Sketch each circuit.

ii. For each of the resistor networks above, what power is dissipated in each resistor when 2 W are dissipated by the combination?

2) a. Describe briefly the two Kirchhoff's Laws of electric circuits, indicating the underlying conservation laws.



$\mathbf{R_1} = 12\ \Omega$; $\mathbf{R_2} = 22\ \Omega$; $\mathbf{R_3} = 36\ \Omega$; $\mathbf{R_4} = 20\ \Omega$; $\mathbf{R_5} = 46\ \Omega$;

$\mathbf{E_1} = 12$ V; $\mathbf{E_2} = 48$ V; $\mathbf{E_3} = 18$ V

Figure Q2

b. Calculate the potential difference between terminals X and Y in Figure Q2.

c. Now points XY are connected using a conductor (short circuit). **Write** three equations based on **superposition principle** so that the current flowing through XY can be calculated. (No calculations required!)

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3) a. Describe Lenz's Law of induction.

b. The triangular loop of wire shown in Fig. Q3 carries a current I = 5 A in the direction shown. The loop is in a uniform magnetic field that has magnitude B = 3 T and the same direction as the current inside PQ of the loop. PQ = 0.6 m, PR = 0. 8m

i. Find the force exerted by the magnetic field on each side of the triangle.

ii. What is the netforce on the loop?

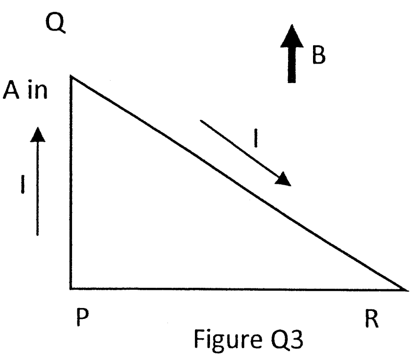

Figure Q3

c. The loop is pivoted about an axis that lies along the side PR. Calculate the magnitude of the net torque on the loop.

d. When released from rest, under the influence of above torque, it was observed that after some time the loop reached a constant angular velocity. Explain this observation.

4) a. State the formula for the Capacitance of a parallel-plate capacitor, and discuss briefly how a change in each parameter value affects the capacitance.

b. Two capacitors give an equivalent capacitance of 9 pF when connected in parallel and give an equivalent capacitance of 2 pF when connected in series. What is the capacitance of each capacitor?

c. Capacitors C_1 = 6 μF and C_2 = 2 μF are charged as a parallel combination across a 250 V battery. The capacitors are disconnected from the battery and from each other. They are then connected positive plate to negative plate and negative plate to positive plate. Calculate the resulting charge on each capacitor.

d. By how much does the total energy of the system change in c.?

5) For circuit in fig Q5, given L = 150 mH, C = 1 μF, and R = 400 Ω. It is found that voltage across the inductor $v_L(t)$ = 17 sin 2000t V.

i. Sketch the phasor diagram for the circuit using minimum calculations. (qualitative only)

ii. Based on the phasor diagram, or otherwise, calculate the currents through all the components.

iii. Calculate the value of e(t).

iv. What is the power factor of the circuit?

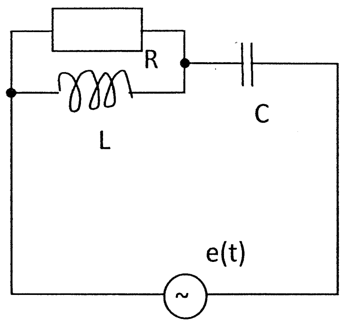

Figure Q5

6) a. What is the **main** characteristic of a circuit at resonance?

b. The circuit in fig. Q5 is brought to resonance with R = 500 Ω and the other components remaining unchanged. The amplitude of the input voltage is fixed at 34 V. Calculate currents through all the components at resonance.

7) a. Sketch and explain the principles of operation of a simple AC generator (dynamo).
   b. How can you transform this (without the help of electronic components/circuits) to a DC generator? Explain.
   c. What is a simple method of increasing the smoothness of the DC generator?

   d. Go back to simple AC generator. What is the output of a simple half-wave rectifier when it is connected across the output terminals of the simple AC generator?

   e. Describe the functioning of the bridge rectifier, and compare this to the half-wave rectifier.

8) a. One of the most popular special diodes we encounter is the LED. Describe briefly the basic functioning of the LED in a circuit.

   b. Where are the LEDs mainly used today? Why have they replaced earlier technologies? Explain.

   c. Describe the behaviour of a LDR when connected to a circuit.

   d. Design a simple circuit with a single LDR that turns off a LED when there is enough light in the surroundings.