THE MOMBASA POLYTECHNIC UNIVERSITY COLLEGE

Faculty of Engineering & Technology

DEPARTMENT OF MECHANICAL & AUTOMOTIVE ENGINEERING

CERTIFICATE IN MECHANICAL ENGINEERING (PLANT)
CERTIFICATE IN MECHANICAL ENGINEERING (PRODUCTION)
CERTIFICATE IN REFRIGERATION AND AIR CONDITIONING

ELECTRICAL SCIENCE

SEMESTER I EXAMINATIONS

SERIES: APRIL, 2010.

TIME: 2 HOURS

Instructions to Candidates:

You should have the following for this examination:

- Answer Booklet

- Calculator

This paper consists of **FIVE** questions.

Answer any **THREE** questions.

Maximum marks for each part of a question are as shown.

Q.1   (a)   Define the following quantities and state their SI units.

      (i)   Resistance

      (ii)   Electromotive force

      (iii)   Electrical energy

      (iv)   Electric power.   (4 marks)

      (b)   State

      (i)   Ohm's law

      (ii)   Kirchoff's laws (KVL & KCL)   (3 marks)

      (c)   In the process of troubleshooting, an electric circuit, a technician
            found out that it has the circuit arrangement like in fig.1.
            Find the current in the branches of the circuit.   (13 marks)

Q.2   (a)   Explain any **THREE** factors that affect the resistance of a conductor
            in an electric circuit.   (6 marks)

      (b)   The resistors with values $5\Omega, 6\Omega$ and 7Ω are connected in parallel.
            The combination is connected in series with another parallel
            combination of 3Ω and 4Ω. If the complete circuit is connected
            across a $20V$ supply.
            Calculate:

      (i)   the total resistance

      (ii)   the total current

      (iii)   the voltage across the 3Ω resistor.   (9 marks)

      (c)   Calculate the resistance of a copper wire 100m long and 1.5mm
            diameter. The resistivity of copper is $17.3 x 10^{-9} \Omega m$.   (5 marks)

Q.3   (a)   With the aid of a diagram, describe how the magnetic effect of an
            electric current can be used to measure current in a circuit. (9 marks)

      (b)   The wire used in a heater element has a resistance of $57\Omega.$ Calculate

      (i)   the power in Kilowatts when the heater is taking a current of

53.8*A.*

    (ii)   the energy absorbed in 4 hours in kilowatt hours.

    (iii)   The cost of energy consumed if the charge is shs.15 per Kilowatt hour.   (7 marks)

(c)   If a current of 15A is maintained constant for 20min. Calculate the quantity of electricity in

    (i)   Coulombs

    (ii)   Ampere hours.

Q.4   (a)   (i)   Define Capacitance.

    (ii)   Sketch any **THREE** types of capacitors.

    (iii)   Briefly explain any **THREE** factors that affect capacitance of a capacitor.   (13 marks)

(b)   Three capacitors of values $6\mu F, 8\mu F$ and $10\mu F$ respectively are connected (i) in series and (ii) in parallel. Calculate the resultant capacitance in each case.   (7 marks)

Q.5   (a)   If three capacitors C_1, C_2 and C_3 are connected in parallel their resultant capacitance is given by

$$C_T = C_1 + C_2 + C_3$$

    (6 marks)

(b)   Explain any **THREE** characteristics of lines of magnetic flux.   (3 marks)

(c)   A capacitor is charged by a steady current of 0.2A flowing for 3 seconds. What is the final value of the charge stored in the capacitor and the p.d between the plates? If the capacitor is subsequently discharged in 60 microseconds, what is the average discharge current?   (11 marks)

Fig.1

I_1 I_2 I_3

2V   10V

6Ω

5Ω

5Ω