THE MOMBASA POLYTECHNIC UNIVERSITY COLLEGE

(A Constituent College of JKUAT)

Faculty of Applied & Health Sciences

DEPARTMENT OF MATHEMATICS & PHYSICS

UNIVERSITY EXAMINATION FOR BACHELOR OF SC./ENG./TECH. IN ELECTRICAL & ELECTRONICS, MECHANICAL & AUTOMOTIVE, BUILDING & CIVIL ENGINEERING & INFORMATION TECHNOLOGY

SPH 2171/APS 4102: PHYSICS II

SPECIAL/SUPPLEMENTARY EXAMINATION
SERIES: FEBRUARY/MARCH 2012
TIME: 2HOURS

Instructions to Candidates:
You should have the following for this examination
- *Answer booklet*

This paper consists of **FIVE** questions
Answer Question **ONE** (**Compulsory**) from **SECTION A** and any other **TWO** questions from **SECTION B**
Maximum marks for each part of a question are clearly shown
This paper consists of **THREE** printed pages

Take: Acceleration due to gravity, g = 10 m/s^2

$$\mu_{o=} 4\pi \times 10^{-7} \, NA^{-2}$$

Permeability of free space,

$$\varepsilon_o = 8.85 \times 10^{-12}$$

Permittivity of free space,   C/(Nm^2)

SECTION A (Compulsory)

QUESTION ONE (30 MARKS)

a) State the Coulomb's law for a medium of permittivity, ε.   What is the main difference between the Coulomb's force and the gravitational force   (3 marks)

b) A metallic hollow container is placed on an insulated table. A positively charged metallic ball is allowed into the bottom of the container using an insulated string, then taken out.

(i)   Give the distribution of charge on the surface of the hollow container   (2 marks)
(ii)   Explain the final state of charge on the ball   (2 marks)

c) A capacitor does not conduct either direct or alternating current. Explain   (3 marks)
d) Distinguish an electric dipole moment and a magnetic dipole moment   (2 marks)

e) Define an ampere and verify its value suing the flux density due to two conductors placed a unit distance from each other.   (4 marks)

f) Two copper plates are placed parallel to each other some distance apart. How can the capacitance between the plates be increased.   (3 marks)

g) If the potential in a certain region is given by V = 80Y2 – 60Z +25, find the components of the electric field **E**, at the point (2, -4, 5) metres.   (6 marks)

h) Two isolated metal spheres of radii r_1 and r_2 are connected using a long conductor. Find the ratio of their final surface charge densities σ_1 and σ_2 respectively.

SECTION B (Attempt any TWO questions)

QUESTION TWO (20 MARKS)

a) Show that the electric field strength of a dipole whose moment is 2*aq* is inversely proportional to the cube of the radius r^3, where r>>a   (10 marks)

b) Determine the electric field along the axis of a dipole involving an electron separated by a distance of 2 x 10^{-3} mm in free space at a point that is 0.2m from the line joining them.
     (3 marks)
c) At what point on the line joining two charges q1 and q2 placed 2cm apart in free space is the electric field zero if q_1 = 3 x10^{-6} C and q_2 = 2 x 10^{-6}C   (7 marks)

QUESTION THREE (20 MARKS)

a) (i) Determine the electric potential for all the points at a distance r on the axis of a uniformly charged circular disc of radius *a* whose surface charge density is σ (7 marks)

(ii) Show that such a disc behaves as a point charge when r>>a.   (7 marks)

b) Show that the potential due a dipole at any point r in space is given by $V = \dfrac{p\cos\theta}{4\pi\varepsilon r^2}$, where p is the dipole moment.   (6 marks)

QUESTION FOUR (20 MARKS)

a) State the Ampere's law
     (2 marks)
b) A long straight wire carries a current of 20A. An electron moving at 10^7 m/s is 2cm form the wire. Using Biot-Sevart Law, find the force acting on the electron if the motion is in the following directions:-

    (i)   Towards the wire   (5 marks)
    (ii)   Parallel to the wire   (2 marks)
    (iii)   At a right angle the direction given in (i)   (2 mark)

c) The circuit below is connected to 2V battery as shown in the diagram