CHUKA   **UNIVERSITY**

UNIVERSITY EXAMINATIONS

EXAMINATION FOR THE AWARD OF DEGREE OF BACHELOR OF

PHYS 313: ELECTRICITY AND MAGNETISM II

STREAMS: **TIME: 2 HOURS**

DAY/DATE: MONDAY 4/12/2017   **2.30 P.M – 4.30 P.M**

INSTRUCTIONS:

- **Answer question one and any other two questions**
  1. (a) State any three applications of Gauss's law.
  2. [3marks]

(b) Derive an expression for electric potential V of a point charge Q.   [4marks]

(c) Calculate the potential at a point 0.05 m inside a charged sphere of radius 0.1 m and volume charge density 2.4 x 10^{-7}C/m^3.   [5marks

(d) Distinguish between a conductor and a dielectric .   [2marks]

(e) Derive an expression for the work done in changing the orientation of a dipole in electric field E from 90° to θ°.   [4marks]

(f) Derive Gauss's law in the form

$$\int_S E.da = \frac{Q}{\in 0}$$ [5marks]

(g) Write down Maxwell's equations of electromagnetism in their general differential form in a vacuum.   [4marks]

(h) Explain the reason as to why charges only reside on the surface of a conductor.

          [3marks]

2. (a) Show that potential due to the dipoles at a point P is given by $V_p = \frac{Qa \cos \varphi}{4\pi \in \pi r 2}$

[7marks]

(b) From the equation for potential due to a dipole at point P, show thata the electric field component in the Z –direction is given by

$E_z = \frac{p}{4\pi\varepsilon 0} \left(\frac{3 \cos^2 \theta - 1}{r^3}\right)$ [10marks]

(c) Explain any three types of filters.   [3marks]

3. (a) Laplace equation in Cartesian rectangular coordinates is

$\frac{\sigma 2v}{\sigma x 2} + \frac{\sigma 2v}{\sigma y 2} + \frac{\sigma 2v}{\sigma z 2} = 0$

Assuming that the solution of this equation is a product of three functions which are separately functions x,y and z. Show the mos general form of this solution. [9marks]

(b) Derive an expression for electric field E at a point P outside a sphere of radius R and uniform volume change density p.   [7marks]

(c) Calculate the electric field at a point 0.001m from the surface of a charged sphere of radius 0.05 m and volume change density is given by.

$\rho_b = -\nabla . P$ [6marks]

(c) Derive the equation of continuity.   [8marks]

5.   (a) Starring from sphere's law, derive Maxwell electromagnetic equation . [8marks]

(b) For a series arrangement of R,L and C circuit and given that R =3x 10^5 Ω, L = 10^{-3} H and C = 60PF. Calculate:

 (i) The total current in each arm when a voltage of 20 V r.m.s at a frequency of 0.1 MHZ is applied.   [5marks]

(ii) The phrase of the total current drawn from the generator.   [5marks]

(c) Define polarization.   [2marks]