THE CATHOLIC UNIVERSITY OF EASTERN AFRICA

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MAIN EXAMINATION

JANUARY – APRIL 2019 TRIMESTER

FACULTY OF SCIENCE

DEPARTMENT OF PHYSICS

REGULAR PROGRAMME

PHY 202: ELECTRICITY AND MAGNETISM II

Date: APRIL 2019	**Duration: 2 Hours**
INSTRUCTIONS: Answer Question ONE and any other Two Questions	

Q1. a) Define magnetic **(3marks)**

i) Susceptibility **(2marks)**

ii) Permeability **(2marks)**

b) How are magnetic susceptibility measured in practice? **(3marks)**

c) Explain

i) magnetic flux density B,

ii) magnetic flux intensity H

iii) Magnetization M. How are they related to each other? **(8marks)**

d) An electron is traveling to the right with a speed of 8.5 x 10^6 m/s when a magnetic field is turned on. The strength of the magnetic field is 0.050 T, and it is directed into the paper. Describe the path of the electron after the field has been turned on. **(6marks)**

e) Write an expression for the force $\vec{F}$ acting on a particle of charge q, moving with a velocity of v, in the presence of both electric field E and magnetic field B. Obtain the condition for which the particle moves un deflected through the fields. **(6marks)**

Q2. a) A point charge of 5μ C is on the y axis at y= 3 cm and a second charge of -5μ C is on the y axis at y - 3 cm

i) Draw a diagram of this arrangement **(3marks)**

ii) Find the force on a charge of $2\mu C$ on the x axis at x = 8cm

(7marks)

b) State Gauss's law for

i) Electrostatics **(2marks**

ii) Magnetism **(2marks)**

c) A circular plane with radius 2.2 m is immersed in an electric field E with a magnitude of $800\frac{N}{C}$. The field makes an angle of $20°$ with the plane. What is the magnitude of the flux through the plane? **(6marks)**

Q3. a) Two tiny conducting balls of identical mass m and identical charge hang from nonconducting threads of length l. Each ball forms an angle θ with the vertical axis. Assume that θ is so small that tan = sin ≈ θ $tan\theta \approx sin\theta$

i) Show that, at equilibrium, the separation between the balls is

$$r^3 = \frac{q^2 l}{2\pi \varepsilon_0 mg}$$

(8marks)

ii) If $If\ l = 1.2\,x\,10^2\,cm \wedge m = 1.0\,x\,10^2\,g \wedge r = 5.0\,cm\,, what\ is\ q\ ?$ **(5marks)**

b) A transformer used to step down ac mains from 240V to the 12V ac needed to operate a doorbell has a 1000 turns in the primary coil.

i) How many turns are there in the secondary? **(3marks)**

ii) If the resistance introduced in the secondary circuit when the bell is pushed is 20Ω, what are the r.m.s currents in the primary and secondary coils assuming the transformer is 95% efficient?

(4marks)

Q4. a) A parallel plate capacitor has a capacitance of 112 pF, a plate area of 96.5 cm2, and a mica dielectric ¿¿5.40) at a 55 V potential difference, Calculate

i) The electric field strength in the mica; **(5marks)**

ii) The magnitude of the free charge on the plates**; (5marks)**

iii) The magnitude of the induced surface charge;

(5marks)

b) A point charge of $1\,\mu C$ is 12mm from a point charge of $-2\,\mu C$ in a vacuum. Determine

i) The electric flux density and **(3marks)**

ii) The electric field strength at a point on the line joining the charges which is 4mm from the positive charge **(2marks)**

Q5. A series AC circuit consists of three components: an EMF source with $\varepsilon = V_0 sin\omega t$,where $V_0 = 110\,V$, a 50 mH inductor, a $50\mu F$ capacitor, and a 20 Ωresistor.

a) Draw a circuit diagram for this circuit. **(5marks)**
b) What is the impedance for this circuit? **(5marks)**
c) Draw the phasor diagram for the circuit. **(5marks)**
d) At what frequency ωwill the power dissipated in the resistor be the largest?. **(5marks)**

END