KIBABII UNIVERSITY

UNIVERSITY EXAMINATIONS
2021/2022 ACADEMIC YEAR

FIRST YEAR SECOND SEMESTER
MAIN EXAMINATIONS

FOR THE DEGREE OF B.SC (SCIENCE)

COURSE CODE: SPC 121

COURSE TITLE: ELECTRICITY AND MAGNETISM I

DATE: 11/05/2022 **TIME: 2:00PM-4:00PM**

INSTRUCTIONS TO CANDIDATES

TIME: 2 Hours

Answer question ONE and any TWO of the remaining

QUESTION ONE (30 marks) compulsory

a) State and briefly discuss Coulomb's law (3mks)
b) Outline three conditions for validity of coulomb's law (3maks)
c) Define the term electric field and state its SI unit (2mks)
d) State any three applications of magnets (3mks)
e) Outline the properties of electrostatic field lines (6mks)
f) State Gauss law (1mk)
g) Define the term electric flux and state its equation (2mks)
h) What are ferromagnetic materials? State any two uses of ferromagnetic materials (3mks)
i) Given three charges q_1, q_2 and q_3 having charge 6C, 5C and 3C enclosed in a surface. Find the total flux enclosed by the surface (4mks)
j) Outline three properties of magnets (3mks)

QUESTION TWO (20 marks)

(a) A charge of 4×10^{-8} is distributed uniformly on the surface of a sphere of radius 1cm. it is covered by a concentric hollow conducting sphere of radius 5cm.
(i) Find the electric field at a point 2cm away from the centre (6mks)
(ii) A charge of 6×10^{-8} C is placed on the hollow sphere. Find the surface charge density on the outer surface of the hollow sphere. (4mks)

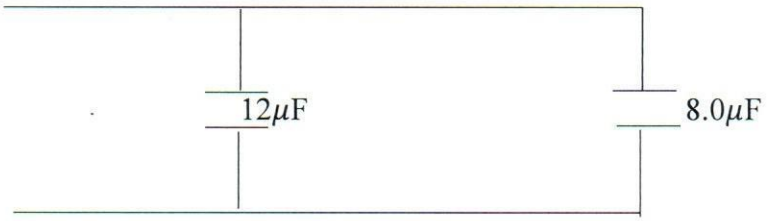
(b) Consider a thin spherical shell of surface charge density, σ, and radius, R. assuming that the shell is symmetrical, determine the electric field:
(i) Outside the spherical shell (7mks)
(ii) Inside the spherical shell (3mks)

QUESTION THREE (20 marks)

Discuss magnetic materials and their uses (20mks)

QUESTION FOUR (20 marks)

(a) Define the term capacitance (1mk)
(b) Show that the capacitance is given by, $C = \frac{Ak\varepsilon}{d}$ where k is the dielectric constant, A is area of overlap and d is the distance of separation between the plates (8mks)
(c) Proof that the effective capacitance for three capacitors in parallel arrangement is given by: $C_T = C_1 + C_2 + C_3$, where C_T is the effective/total capacitance and C_1, C_2 and C_3 are individual capacitances of capacitors in parallel network. (4mks)
(d) A 12μF capacitor is charged with 200V source then placed in parallel with uncharged 8.0μF



(i) The initial charge on the $12\mu F$ capacitor. (3marks)

(ii) The final charge on each capacitor. (4marks)

QUESTION FIVE (20 marks)

(a) State Gauss' law (1mk)

(b) Show that the electric flux of charge Q over a closed spherical surface of radius R is:

$$\Phi_E = \frac{Q}{\varepsilon_0}$$ (8mks)

(c) Consider an ink particle of mass m carrying charge q ($q<0$). Assuming that the mass of the ink drop is small, determine its y deflection (5mks)

(d) Consider a uniformly-charged ring with charge density λ. By considering a point P at a distance z from the centre of the ring, show that the electric potential exists between them and is given by:

$$V = \frac{Q}{4\pi\varepsilon_0|z|}$$ (6mks)