MACHAKOS UNIVERSITY

University Examinations for 2019/2020Academic Year

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

THIRD YEAR SECOND SEMESTER EXAMINATION FOR

BACHELOR OF SCIENCE (TELECOMMUNICATION & INFORMATION TECHNOLOGY)

SPH 315 ELECTRODYNAMICS

DATE: 10/11/2020 **TIME: 8.30-10.30 AM**

INSTRUCTIONS

Answer Question One and Any Other Two Questions

QUESTION ONE (30 MARKS)

a) State the principle of superposition (2 marks)

b) Define (6 marks)

i) Dielectric

ii) Polar molecule

iii) Wave

c) Find the electric field a distance *z* above the midpoint between two equal charges *(q)*, a distance *d* apart (Fig. 1) (5 marks)

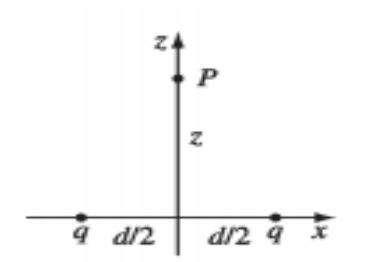

Fig.1

d) Find the magnetic field a distance *s* from a long straight wire (Fig 2.), carrying a steady current *I* (4 marks)

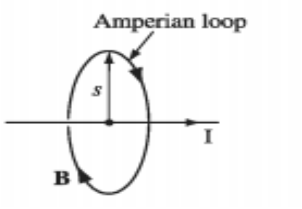

Fig. 2

e) A long straight wire, carrying uniform line charge A., is surrounded by rubber insulation out to a radius a (Fig. 3). Find the electric displacement. (5 marks)

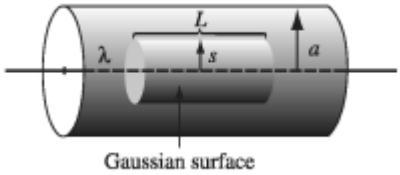

Fig. 3

f) State faraday's law and give the equation in differential form (4 marks)

g) From the differential form of Ampere's law, derive its integral equivalent. (4 marks)

QUESTION TWO (20 MARKS)

a) Form Gauss's integral equation, show that

$$\nabla \cdot \mathbf{E} = \frac{1}{\epsilon_0}\rho.$$

(6 marks)

b) Find the field outside a uniformly charged solid sphere of radius *R* and total charge *q*.

(5 marks)

c) A point charge *q* is situated a distance *a* from the center of a grounded conducting sphere of radius *R* (Fig. 4). Find the potential outside the sphere and the force between the charge and the sphere. (9 marks)

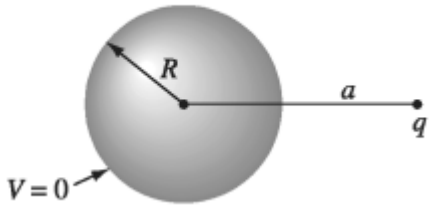

Fig. 4

QUESTION THRE (20 MARKS)

a) An infinite plane carries a uniform surface charge *a*. Find its electric field. (6 marks)

b) Derive the poisson's equation (4 marks)

c) Show that the potential is *constant* inside an enclosure completely surrounded by conducting material, provided there is no charge within the enclosure. (6 marks)

d) Outline Maxwell's equations (4 marks)

QUESTION FOUR (20 MARKS)

a) Find the vector potential of an infinite solenoid with n turns per unit length, radius R, and current I. (8 marks)

b) Find the electric field a distance *z* above the midpoint of a straight line segment of length *2L* that carries a uniform line charge. (Fig. 5). (8 marks)

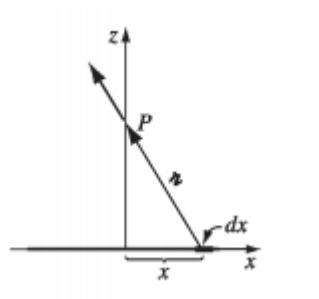

Fig. 5

c) How different are insulators from conductors? (4 marks)

QUESTION FIVE (20 MARKS)

a) A long cylindrical magnet of length *L* and radius *a* carries a uniform magnetization M parallel to its axis. It passes at constant velocity *v* through a circular wire ring of slightly larger diameter (Fig. 6). Graph the emf induced in the ring, as a function of time. (7 marks)

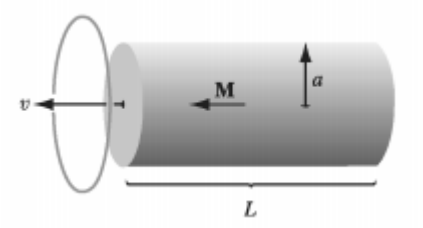

Fig. 6

b) A charge *Q* is located at the center of a sphere of radius *R*. Calculate the flux going out through the surface of the sphere (6 marks)

c) A long cylinder (Fig. 7) carries a charge density that is proportional to the distance from the axis: $p = ks$, for some constant *k*. Find the electric field inside this cylinder. (7 marks)

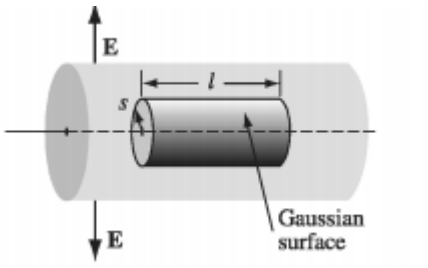

Fig. 7