RDN – 10

# B.Sc. (Semester – VI) Examination, April/May 2019
## PHYSICS (Paper – IV)
## Electromagnetic Theory – II and Relativity

Duration : 2 Hours | Total Marks : 80

***Instructions*** : 1) ***All*** *questions are* ***compulsory***. ***Internal*** *choices are available.*
2) *Figures to the* ***right*** *indicate* ***full*** *marks.*
3) *Symbols have their usual meaning, unless otherwise stated.*
4) *Draw illustrated diagrams* ***wherever*** *necessary to support your answers.*
5) *Use of log tables and calculators is* ***allowed***.
6) *Start* ***each*** *question on a fresh page.*

**Constants** : $c = 3 \times 10^8$ m/s and $\mu_0 = 4\pi \times 10^{-7}$ $Ns^2/C^2$

1. Answer **any four** of the following : **(4×4=16)**

a) State Ampere's circuital law in integral form. Express the same in mathematical form. Hence deduce its differential form.

b) State the difference between conventional currents and atomic current. Hence define magnetization current density and state its SI units.

c) Define the term 'magnetic susceptibility'. Classify the magnetic materials on the basis of magnetic susceptibility.

d) Show that $\vec{\nabla}.\vec{B} = 0$ and hence give its physical significance.

e) The density of the gold is 193 gm/cm$^3$ when it is at rest relative to observer. Calculate its density, when it is moving with velocity of 0.9 c.

f) A muon formed high up in the atmosphere travels with a speed 0.99 c for the distance of 5.4 km before it decays. What is the life of muon as measured by muon itself ?

P.T.O.

2. Answer **any four** of the following : **(4×4=16)**

   a) Calculate the magnetic induction at distance of 10 cm from the wire carrying current of 10 A.

   b) Define magnetic intensity, hence state Ampere's circuital law in terms of magnetic intensity.

   c) The magnetic susceptibility of gold is $-3.6 \times 10^{-5}$. What is its relative permeability ?

   d) Prove that $\vec{E} = \cos(y - t)\,\hat{k}$ and $\vec{B} = \cos(y - t)\hat{i}$ constitute a possible electromagnetic field.

   e) Two electrons leave a radioactive sample in opposite direction, each having speed of 0.7 c relative to the sample. Find the relative velocity of one electron relative to other electron.

   f) The length of the rod is 100 m. If the length of the rod is measured by the observer moving parallel to its length is 51 m., find the speed of the observer.

3. A) Using Biot-Savart law, obtain an expression for magnetic field at a point due to infinitely long straight wire carrying current. **6**

   OR

   A) Using Biot-Savart law, find the magnetic field inside a solenoid of length L, having N turns uniformly wound round a cylinder of radius a. **6**

   B) Show that magnetic scalar potential satisfies Laplace's equation. **6**

4. A) Discuss Langevin theory of paramagnetism. **6**

   OR

   A) What are magnetic circuits ? Using Ampere's law derive a basic magnetic circuit equation. **6**

   B) What are ferromagnetic, anti-ferromagnetic and ferri-magnetic substances ? State any two properties and give one application of ferrites. **6**

5. A) Using equation of magnetic scalar potential, express magnetic pole density and surface density of magnetic pole strength in terms of magnetization vector $\vec{M}$. **6**

OR

A) Explain why a modification was necessary for Ampere's circuital law. Hence derive generalised Ampere's circuital law in differential form. **6**

B) Using relativistic equation for Doppler's effect of light, derive an expression for frequency observed when source of light recedes away from observer. Why is it called a red shift ? **6**

6. A) State Lorentz transformation equation for space and time coordinates. Show how these equations reduce to Galilean transformation form for small velocities. Also show that acceleration is invariant under Galilean transformation. **6**

OR

A) State Inverse Lorentz transformation of velocities equation and hence derive Einstein's relativistic velocity addition. **6**

B) Derive the relation which gives equivalence of mass and energy. **6**

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