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B.Sc. (Semester – VI) (Repeat) Examination, Oct./Nov. 2016
PHYSICS (Paper – IV)
Electromagnetic Theory – II and Relativity

Duration : 2 Hours   Max. 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 $\mu_0 = 4\pi \times 10^{-7}$ Ns²/C².

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

   a) A long wire carries a current of 5 mA. Using Ampere's circuital law, find the line integral of $\vec{B}$ around the path enclosing the wire.

   b) Define magnetization vector $\vec{M}$ of magnetic material. State its SI units.

   c) Briefly explain the cause of paramagnetism.

   d) State Faraday's law of electromagnetic induction. Express the same in integral form. Convert it to differential form by using Curl theorem.

   e) When a particle is in motion, its mass becomes larger than its rest mass ? Explain using necessary formula.

   f) The life time of pion moving with velocity 0.8c appears to be 2.5×10^{-7}s. Calculate its proper life time.

P.T.O.

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

   a) State Biot-Savart Law. Express the same in mathematical form.

   b) What are ferrites ? State any two properties and one application of ferrites.

   c) A toroid of mean radius 2 cm has 800 turns of wire wound on it. If the wire can safely carry maximum current of 3.6 A, Calculate maximum value of magnetic intensity that can be generated in the volume of toroid.

   d) If a 500 W laser beam is concentrated by a lens into cross sectional area of $10^{-10} m^2$, find the value of Poynting vector.

   e) Discuss the expected and observed results of Michelson-Morley experiment.

   f) Calculate the ratio of mass of the particle to its rest mass if it is moving with velocity 0.9 c.

3. A) What is Helmholtz coil ? Find the expression for maximum magnetic field at a mid point along axis of the Helmholtz coil.   6

            OR

   A) Using Biot-Savart law, obtain an expression for magnetic field at a point along the axis of a circular coil carrying current.   6

   B) Derive Ampere's circuital law in terms of magnetic intensity.   6

4. A) Show that the energy density of magnetic field equals $\frac{1}{2} \bar{H}.\bar{B}$.   6

            OR

   A) What are magnetic circuits ? Explain giving an example. Using Ampere's law, deduce basic magnetic circuit equation.   6

   B) i) Using Heisenberg's theory, explain the difference between ferromagnetism and anti-ferromagnetism.   3

      ii) Draw schematic representation of atomic spins in ordered spin structures for ferromagnetic, antiferromagnetic and ferromagnetic substances.   3

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

OR

A) State Poynting theorem. Define Poynting Vector. Write an expression for the same in terms of electric field and magnetic field ($\vec{E}$ and $\vec{B}$). Write equation of continuity, describing the conservation of energy in terms of Poynting Vector and explain the significance of each term. 6

B) Derive Einstein's relativistic velocity addition equation using Lorentz transformation equation. 6

6. A) i) The length of spaceship measured by stationary observer is exactly half its proper length. What is the speed of spaceship relative to observer frame ? 3

ii) Two electrons approach each other with the same velocity 0.7c relative to observer. Calculate their relative velocity. 3

OR

A) Using Lorentz transformation equation, derive relativistic equation for aberration of light. 6

B) Show that the kinetic energy E_K of a body of rest mass m_o and relativistic mass m is given by $E_K = mc^2 - m_oc^2$. 6

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