2071
B.A./B.Sc. (General) Second Semester
Physics
Paper – C: Electricity and Magnetism – II

Time allowed: 3 Hours

Max. Marks: 44

NOTE: *Attempt five questions in all, including Question No. VII (Unit- III) which is compulsory and selecting two questions each from Unit I - II. Use of non-programmable scientific calculator is allowed.*

x-x-x

UNIT – I

I. a) Derive an expression for the electric field of a point charge moving with velocity $\vec{v}$.

b) Electric field in a stationary frame of reference is $\vec{E} = (3\hat{i} + 4\hat{j})Vm^{-1}$. Calculate the electric field in frame of reference moving with velocity $\vec{v} = (2\hat{i} + 1.5\hat{j}) \times 10^8\, ms^{-1}$ w.r.t laboratory frame. (4,5)

II. a) Discuss Langevin's theory of diamagnetism.

b) The volume of the core of a transformer is 1000 cm^3. It is fed with an arc of 50 Hz. If the loss of energy due to hysteresis per hour be 36 J, calculate the area of the $\vec{B} - \vec{H}$ loop. (4,5)

III. a) Derive and discuss the equation of continuity $\vec{\nabla}.\vec{J} + \dfrac{\partial \rho}{\partial t} = 0$

b) Derive Ohm's law from its macroscopic form $\vec{J} = \sigma\vec{E}$. (4,5)

UNIT - II

IV. a) Using Biot-Savart's law find magnetic field due to straight current carrying conductor. Also find magnetic field due to infinite straight conductor.

b) A wire of square shape of each side 10 cm long is carrying a current of 2A in anti-clockwise direction. Calculate magnetic field at its centre. (6,3)

P.T.O.

V.   a) State and prove reciprocity theorem of mutual induction.

b) A coil of 100 turns and area of cross-section 20 cm^2 is placed in magnetic field of 0.01 Wb m^{-2} in such a manner that magnetic flux passes through all the turns. Calculate induced e.m.f. if magnetic field is reversed 100 times in one second.

(6,3)

VI.   a) What is vector potential? Derive expression for it. Show that divergence of vector potential is zero.

b) Show that energy density in magnetic field B set up in a solenoid is $\dfrac{B^2}{2\mu_0}$. (6,3)

UNIT - III

VII.   Attempt any eight of the following:-

a) Write down vector form of Ohm's law.

b) What is difference between conservation and invariance of charge?

c) What is Bohr's magneton?

d) Write down equation which shows that magnetic monopoles do not exist?

e) A positive charge moving downward enters in earth's magnetic field. In which direction the particle is deflected?

f) What is Hall effect?

g) A closed loop is rotated in its own plane in magnetic field B with angular speed ω. What is the e.m.f. induced in the loop?

h) State the conditions under which the potential in a conductor satisfies Laplace's equation.

i) Drift velocity of electrons is only few millimetres per second. Then why bulb glows immediately when switched on?

j) What type of magnetic field is used in induction motor?

(8x1)

x-x-x