B.Sc. Semester-II Examination, 2022-23

PHYSICS [Honours]

Course ID : 22411 Course Code : SH/PHS/201/C-3(T3)

Course Title : Electricity and Magnetism

Time : 1 Hour 15 Minutes Full Marks : 25

The figures in the right-hand margin indicate marks.

Candidates are required to give their answers in their own words as far as practicable.

SECTION–I

1. Answer any **five** questions: 1×5=5

   a) What is ferromagnetism?

   b) What is mutual inductance?

   c) Discuss Norton's theorem.

   d) Write the mathematical statement that describe local conservation of charge.

   e) What is vector potential?

   f) Define quality factor of an LCR circuit.

   g) Write Poisson's equation in electrostatics.

   h) Write two important properties of displacement vector.

SECTION–II

2. Answer any **two** questions: 5×2=10

   a) Write Maxwell's equations and state the physical significance of each. Write the expression for velocity of EM wave in free space. 1+3+1

   b) i) The electric field in a region is given by $\vec{E} = Ar^2\hat{r}$ using spherical polar coordinate. Find the charge density.

      ii) Find the electric potential energy corresponding to a charge Q spread uniformly over a spherical surface of radius R. 2+3

   c) Show Ampere's law in integral form. Find an expression for field due to a long straight wire using Ampere's law. 2+3

   d) What is the unit of Polarizability? Find capacitance per unit length for a cylindrical capacitor of shell radii a and b respectively $(a < b)$. 1+4

SECTION–III

3. Answer any **one** question: 10×1=10

   a) i) A particle with charge q projected successively along the x-axis and y-axis

with same speed v in magnetic field $\vec{B}$. The force on the charge particle in these situations is given by $qvB\left(-\frac{1}{2}\hat{j}+\frac{\sqrt{3}}{2}\hat{k}\right)$ and $qvB\left(\frac{1}{2}\hat{i}\right)$ respectively. Find the magnetic field $\vec{B}$.

ii) Does magnetic field do any work on a charged particle? Explain.

iii) A wire is in the form of a rectangular polygon of n sides just enclosed by a circle of radius a. If i be the current through it

A) find the magnetic field at the centre and

B) show that for $n \to \infty$ the result approaches that of circular loop.

4+2+(3+1)

b) State and explain maximum power transfer theorem. Find expression for resonant frequency for series and parallel LCR circuit. What is quality factor for LCR circuit?

(1+2)+(3+3)+1

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