QP CODE: 23507029

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Reg No : .....

Name : .....

INTEGRATED MSC DEGREE EXAMINATION, AUGUST 2023

Second Semester

NTEGRATED MSC BASIC SCIENCE-PHYSICS

CORE - IPH2CR04 - ELECTROSTATICS AND MAGNETOSTATICS

2021 Admission Onwards

66F0B747

Time: 3 Hours

Weightage: 30

Part A (Short Answer Questions)

*Answer any **eight** questions.*

*Weight **1** each.*

1. Calculate the number of electrons in one coulomb of negative charge.
2. State the superposition principle regarding electric fields.
3. State Gauss's law in electrostatics.
4. Given $\mathbf{E} = \mathbf{E}_1 + \mathbf{E}_2 + \ldots$, where $\mathbf{E}_1, \mathbf{E}_2, \ldots$ etc., are the fields due to the individual charges $q_1, q_2, \ldots$ respectively. Calculate $\nabla \times \mathbf{E}$.
5. Discuss the notion of the equipotential surface.
6. Get Laplace's equation in electrostatics.
7. What are the conclusions that we can draw from the magnetic Lorentz force.
8. State Ampere's circuital law.
9. Explain three different forms of Faraday's law and explain the symbols.
10. Define self-inductance with unit.

(8×1=8 weightage)

Part B (Short Essay/Problems)

*Answer any **six** questions.*

*Weight **2** each.*

11. Find the electric field (magnitude and direction) at a distance z above the midpoint between two equal charges, q, a distance apart. Check that the result is consistent with when $z \gg d$.

12. Twelve equal charges, q, are situated at the corners of a regular 12-sided polygon (for instance, one on each numeral of a clock face).
    (a) What is the net force on a test charge Q at the center?
    (b) Suppose one of the 12 q's is removed (the one at "6 o'clock"). What is the force on Q?

13. Find the potential inside and outside a spherical shell of radius R, which carries a uniform surface charge.

14. Use the equation $V(r) = \frac{1}{4\pi\epsilon_0}\int \frac{\rho(r')}{r} d\tau'$ to calculate the potential inside a uniformly charged solid sphere of radius R and total charge q.

15. An electron moving with a velocity $8\text{x}10^6$ $\hat{i}$ ms^{-1} enters a magnetic field of $0.2\hat{k}$ T. Calculate the force acting on it. $1.6\text{x}10^{-19}$ C.

16. Explain Biot-Savart law. Obtain an expression for magnetic field due to current in a straight wire.

17. If $\bar{A} = 5(x^2 + y^2 + Z^2)^{-1} i$. Find B.

18. Calculate the energy stored in the magnetic field of a solenoid of inductance 5 millihenies when a maximum current of 3.0 amp flows through it.

(6×2=12 weightage)

Part C (Essay Type Questions)

*Answer any **two** questions.*

*Weight **5** each.*

19. Find the electric field at a distance z above the center of a flat circular disk of radius R, which carries a uniform surface charge σ. Also get the formula for the following cases
    (a) when $z \gg R$,
    (b) in the limit $R \to \infty$

20. A long coaxial cable carries a uniform volume charge density ρ on the inner cylinder of radius a, and a uniform surface charge density on the outer cylindrical shell of radius b. This surface charge is negative and of just the right magnitude so that the cable as a whole is electrically neutral. Find the electric field in each of the three regions
    (a) Inside the inner cylinder (at a distance s < a)
    (b) Between the cylinders (a < s < b)
    (c) Outside the cable (s > b).

21. Discuss in detail electrostatic boundary conditions.

22. Derive the magnetostatic boundary conditions of the tangential component of the magnetic field.

(2×5=10 weightage)