



বিদ্যাসাগর বিশ্ববিদ্যালয়

VIDYASAGAR UNIVERSITY

Question Paper

B.Sc. General Examination 2023

(Under CBCS Pattern)

Semester — II

Subject : PHYSICS

Paper : DSC-1BT/2BT/3BT

(Electricity and Magnetism)

Full Marks : 40

Time : 2 hours

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

The figures in the margin indicate full marks.

Answer from **all** the Groups as directed.

GROUP—A

Answer **any five** questions from the following :

2×5=10

1. State and explain Gauss theorem in dielectric medium.

(2)

2. Find $\vec{\nabla} \left(\frac{1}{r^3} \right)$, where $\vec{r} = x\hat{i} + y\hat{j} + z\hat{k}$.

3. A conducting sphere of radius $R = 2$ m is kept in air medium, calculate its capacitance.

4. Using Biot-Savart's law, find the dimension of permeability μ_0 .

5. Write down the Maxwell's equations of electromagnetic theory.

6. Discuss why soft iron is suitable as core of a transformer.

7. Explain why electric field inside a conductor is zero.

8. Show that electrostatic energy density of an electric field in free space is $\frac{1}{2}\epsilon_0 E^2$.

GROUP—B

Answer **any four** questions from the following :

$5 \times 4 = 20$

9. A circular disc of radius a has a uniform surface charge density σ on it. Find the electric potential and the electric field intensity at an axial point P which is at a distance z from the centre of the circle.

$2+3=5$

(3)

10. Explain the hysteresis cycle for a ferromagnetic material. From it, how do you measure the retentivity and coercivity of the material? Define ferromagnetic domain. 2+2+1=5

11. Establish Poynting Theorem by using Maxwell's electromagnetic equations. Calculate the SI unit and dimension of Poynting vector. 3+2=5

12. (a) A parallel plate capacitor with air medium between the plates has a capacitance of 9 pF. The gap between its plates is now filled with two dielectrics, one of the dielectrics has dielectric constant $k_1 = 3$ and thickness $\frac{d}{3}$; while the other one has dielectric constant $k_2 = 6$ and thickness $\frac{2d}{3}$. Find out the capacitance of the capacitor.

(b) Show that; for propagation electromagnetic

wave in free space $C = \frac{1}{\sqrt{\mu_0 \epsilon_0}}$; where symbols have their usual meanings. 3+2=5

13. (a) Using $\vec{\nabla} \times \vec{B} = \mu_0 \vec{j} + \mu_0 \epsilon_0 \frac{\partial \vec{E}}{\partial t}$ and $\vec{\nabla} \cdot \vec{E} = \frac{\rho}{\epsilon_0}$, find the Continuity Equation for electromagnetic field.

(b) State Ampere's circuital law. 3+2=5

(4)

14. A solenoid with length 10 cm and radius 1 cm has 500 turns, carries a current of 0.6 A. Find the magnetic flux through the solenoid and self-inductance of the solenoid. 3+2=5

GROUP—C

Answer **any one** question from the following :

10×1=10

15. State and explain Lenz law. Using it, find out the expression for the differential form of Faraday's law. Show that the expression for the equivalent inductance for two inductors L_1 and L_2 connected in series will be $L_1 + L_2 - 2M$, where M is the mutual inductance between them. What is Eddy current? Write a few practical applications of it. 2+2+4+1+1=10

16. (a) Derive an expression for the potential energy of a dipole in a uniform electric field. Discuss the conditions of stable equilibrium and unstable equilibrium.

(b) Show that for the propagation of electromagnetic wave, the electric field (\vec{E}), magnetic field (\vec{H}) and the propagation vector (\vec{K}) are mutually orthogonal.

5+5=10