

RAN-2103000206021002

B.Sc. (Sem. VI) Examination March - 2026

Physics : Electrodynamics & Optics (Old) (Paper - PH-607)

Time: 2 Hours]

[Total Marks: 50

સૂચના : / Instructions

- (1) ઉપરોક્ત દર્શાવેલ વિગતો ઉત્તરવહી પર અવશ્ય લખવી.
Fill up strictly the above details on your answer book.
- (2) Q 1 is compulsory.
- (3) Symbols used in the question paper have their usual meanings.
- (4) Students are permitted to use non-programmable scientific calculator.
- (5) Figures on the right indicate the total marks carried by the question.

Seat No.:

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Student's Signature

Q. 1. Answer any ten in brief.

(10)

1. Give relation between resistance and resistivity.
2. State Joule's heating law.
3. What is the principle of an ac generator?
4. Inductance plays a role in the electric circuits which is identical to that played by _____ in the mechanical systems.
5. What does the minus sign indicate in Faraday's law of electromagnetic induction?
6. What is meant by TE polarization?
7. The modified form of Ampere's circuital law shows that a changing electric field induces _____.
8. State boundary condition for the field $\vec{D}$ across an interface of two media.
9. What are the sources of magnetic field?
10. What is the unit of normalized waveguide parameter?
11. The output is one-half of the input from an optical fiber. Hence, the loss will be _____.
12. If white light is coupled into a long optical fibre, the output will look _____ in colour.

Q. 2 (A) Attempt any one of the following.

(7)

1. Consider a conducting loop kept in a uniform magnetic field ($\vec{B}$) such that the plane of the loop remains perpendicular to the field lines. When this loop is pulled out of the magnetic field, current is induced in it. If the charges move with velocity $\vec{u}$ because of the induced current, prove that the force per unit charge with which the loop is pulled out is given by $f_{pull} = uB$.
2. What is self-induction? Derive an expression for self-induced *emf*.

(B) Solve any one of the following.

1. When 2.5 A current is passed through a resistance of $12 M\Omega$, how much energy will be dissipated by it per second in the form of heat? If the current is doubled, what happens to the value of the dissipated energy? How much will it be?

2. A cylindrical resistor of cross-sectional area A and length L is made from material with conductivity σ . If the potential is constant over each end, and the potential difference between the ends is V , what current flows through it?

Q. 3 (A) Attempt any one of the following. (7)

1. Prove that in the presence of matter, Faraday's law gets modified to $\vec{\nabla} \cdot \vec{D} = \rho f$.
2. State Maxwell's equations. Show that divergence of curl of electric field is always zero, but that of magnetic field is not zero, using these equations.

(B) Solve any one of the following. (3)

1. Electric field in an electromagnetic wave is given by $E = 8 \cos 5\pi (3 \times 10^{10}t - 10^2x)$ where all the quantities are in SI units. Find
(i) wavelength, (ii) frequency and (ii) speed of this wave.
2. Using Maxwell's equations, prove that $\nabla^2 \vec{E} = \frac{1}{c^2} \frac{\partial^2 \vec{E}}{\partial t^2}$ for free space, provided $c = \frac{1}{\sqrt{\mu_0 \epsilon_0}}$.

Q. 4 (A) Attempt any one of the following. (7)

1. Consider a linearly polarized electromagnetic wave to be incident normally at the interface of two lossless dielectrics. State expressions for electric field and magnetic field corresponding to the incident wave, transmitted wave and reflected wave. Show that the reflectivity of the surface is given by

$$R = \left(\frac{n_1 - n_2}{n_1 + n_2} \right)^2$$

2. Consider an electromagnetic wave to be incident normally on a perfect conductor. Show that the incident wave and the reflected wave produce stationary wave.

(B) Solve any one of the following. (7)

1. The refractive index of water is $4/3$. Find speed of light in water. If a ray of light in air is incident on the surface of water at 60° , what will be its angle of refraction in water? What will be the angle of deviation in water? ($c = 3 \times 10^8$ m/s).
2. State an expression for intrinsic impedance of vacuum and from it, obtain its unit.

Q. 5 (A) Attempt any one of the following. (7)

1. Write a short note on the attenuation limit and its significance in optical fiber.
2. Explain in detail the principle on which optical fibers operate.

(B) Solve any one of the following. (3)

1. Find critical angles for (i) air-water interface, (ii) water-glass interface and (iii) air-glass interface.
($n_{air} = 1, n_{water} = \frac{4}{3}, n_{glass} = 1.72$)
2. The refractive index of the core and the cladding of an optical fibre are 1.455 and 1.475 respectively. Find its numerical aperture and the maximum angle of incidence for which TIR is possible.