RAN-2103000206021002

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B.Sc. (Sem. VI) Examination March - 2025

Physics Paper VII (PH - 607)

(Electrodynamics and Optics)

New Syllabus

Time: 2 Hours] **[Total Marks: 50**

સૂચના : / Instructions

(૧) નીચે દર્શાવેલ ☛ નિશાનીવાળી વિગતો ઉત્તરવહી પર અવશ્ય લખવી.
Fill up strictly the details of ☛ signs on your answer book

Name of the Examination:
☛ **B.Sc. (Sem. VI)**

Name of the Subject :
☛ **Physics Paper VII (PH - 607) (Electrodynamics and Optics) New Syllabus**

Subject Code No.: **2103000206021002**

Seat No.:

Student's Signature

(2) Q1 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.

Q-1. Answer any ten in brief. **(10)**

1. Give *SI* unit of resistivity.
2. State Joule's heating law.
3. State Oerstead's observation.
4. State any two factors on which the value of the self inductance of an inductor depend.
5. What does the minus sign indicate in Faraday's law of electromagnetic induction?
6. Divergence of curl of electric field is always zero. Agreed?
7. The continuity equation is a direct consequence of one of the fundamental laws of Physics. Which is that law?
8. State boundary condition for the field $\vec{B}$ across an interface of two media.

9. The unit of the ratio of the electric field (E) and the intrinsic impedance (η) is _____ .
10. What is polarization of light?
11. The output is one-tenth of the input from an optical fiber. Hence, the loss will be _____ dB.
12. If white light is coupled into a long optical fibre, the output will look _____ .

Q.2. (A) Attempt any one of the following. **(7)**

1. What is motional *emf*? 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. Show that when this loop is pulled out of the magnetic field with velocity $\vec{v}$, the induced *emf* in it given by $\varepsilon = Bvh$, where h is the separation between the two arms of the loop in the magnetic field.
2. State and explain Faraday's law of electromagnetic induction. Derive its integral form.

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

1. When 2 A current is passed through a resistance of 220 kΩ, 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. An infinitely long straight wire carries a slowly varying current I (t). Determine the induced electric field, as a function of the distance from the wire.

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

1. Prove that in the presence of matter, Ampere's law gets modified to $\vec{\nabla} \times \vec{H} = \vec{J}_f + \frac{\partial \vec{D}}{\partial t}$
2. Explain how Maxwell fixed Ampere's law using continuity equation.

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

1. Electric field in an electromagnetic wave is given by
$$E = 7 \cos 7\pi \, (3 \times 10^{11} t - 10^3 x)$$
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 an electromagnetic wave to be incident normally on a perfect conductor. Show that the transmission coefficient of the surface is given by $t = \frac{2(1 - i)h}{1 + (1 - i)h}$
2. Consider a plane polarized electromagnetic wave incident on an interface of two media. State and prove laws of reflection.

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

1. The refractive index of water is 1.33. Find speed of light in water. If a ray of light in air is incident on the surface of water at 30°, 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. Show that the intrinsic impedance of a medium η and its refractive index *n* are related by $\eta = \frac{\eta_o}{n}$, where η_o is intrinsic impedance of free space.

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

1. Write short notes on coherent bundle and incoherent bundle.
2. What is cladding? Compare its refractive index with that of the core. Why is it required to have cladded fiber?

(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.
   ($n_{air} = 1$, $n_{water} = 1.33$, $n_{glass} = 1.52$)
2. The refractive index of the core and the cladding of an optical fibre are 1.450 and 1.465 respectively. Find its numerical aperture and the maximum angle of incidence for which total internal reflection is possible.

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