বিদ্যাসাগর বিশ্ববিদ্যালয়

VIDYASAGAR UNIVERSITY

Question Paper

B.Sc. Honours Examinations 2020

(Under CBCS Pattern)

Semester - VI

Subject: PHYSICS

CC - 13 (T + P) (Electromagnetic Theory – Theory + Practical)

Full Marks: 40 (Theory) + 20 (Practical) = 60

Time: 4 Hours

Candiates are required to give their answer in their own words as far as practicable.

Questions are of equal value.

Answer any **one question** [within 250 words] from each Part.

Part A: Electromagnetic Theoryg (Theory)

1. What do you mean by gauge transformation? Write as short notes on Coulomb and Lorentz gauge.

2. For an electromagnetic wave travelling free space, find the expressions for average values of Pointing vector, energy density and momentum density in terms of amplitude.

3. (a) Write down the Maxwell's electromagnetic field equations and explain the physical significance of each.

   (b) Show that Maxwell's equations obey the equation of continuity.

4. A plane electromagnetic wave is incident normally on a metal of electrical conductivity ó. Show that the electromagnetic wave gets damped inside the conductor. Obtain the expression of skin depth.

5. Derive the electromagnetic wave equation in dilute plasma. Find the condition on frequency for which electromagnetic wave propagation is possible.

6. An electromagnetic plane wave undergoes reflection and refraction at the interface of two isotropic dielectric media. Using Maxwell's equations and proper boundary conditions obtain (i) the Snell's law, (ii) the laws of reflection.

7. Derive Fresnel's formula (coefficients of reflection and transmission) when a light beam incidents normally from one linear dielectric medium to another.

8. What is birefringence? How does it explain double refraction? Give some applications of birefringence.

9. Explain how different types of polarization occur when two linearly polarized light (direction of polarization are perpendicular) superpose.

10. Explain how polarized light can be produced by reflection and double refraction.

11. Show that transverse electromagnetic wave cannot occur in a hollow wave guide.

12. Describe the structure of a typical optical fibre giving the necessary diagram. What do you mean by acceptance angle and numerical aperture? Give an expression for numerical aperture.

Part B: Electromagnetic Theoryg (Practical)

1. Describe a procedure to verify the Malus law for plane polarized light.

2. Write the steps to determine the specific rotation of sugar solution using polarimeter.

3. Explain how one can analyze elliptically polarized light using a Babinet's compensator.

4. Write the procedure to study dependence of radiation on angle for a simple dipole antenna.

5. Mention the steps to determine the wavelength and velocity of ultrasonic waves in a liquid by studying the diffraction through ultrasonic grating.

6. Describe a method to study the reflection and refraction of microwaves in a laboratory set up.
7. Discuss a procedure to study polarization and double slit interference for microwaves.
8. Describe, in detail, how to determine the refractive index of liquid by total internal reflection usingWollaston's air-film.
9. How can we determine the refractive Index of (1) glass and (2) a liquid by total internal reflection using a Gaussian eyepiece – describe the procedure with schematics.
10. Narrate the procedure to study the polarization of light by reflection and determine the polarizing angle for air glass interface.
11. Write down the theory to verify the Stefan's law of radiation and determine Stefan's constant. Mention the apparatus to be needed. Describe the procedure.
12. Explain how to determine the Boltzmann constant using V-I characteristics of PN junction diode.