Total number of printed pages–4

3 (Sem–6) PHY M 3

2021

PHYSICS

(Major)

Paper : 6·3

Full Marks : 60

Time : Three hours

The figures in the margin indicate full marks for the questions.

Both the group contains questions of Modern Optics and Electromagnetic Theory.

Group–A

Marks : 30

1. Answer the following questions : 1×5=5

   (a) What is the essential physical principle of an optical fiber ?

   (b) What is rainbow holography ?

   (c) What is the spontaneous emission of radiation ?

Contd.

(d) State *two* characteristics of an electromagnetic wave.

(e) What is the basic difference between conduction current and displacement current ?

2. Answer the following question : 2×5=10

(a) What is an eyepiece ? Why should it consist of two lenses ?

(b) What is the meaning of holography ? Why is it so called ?

(c) Draw a schematic diagram to show the ray path in a graded index fiber.

(d) What oscillates in e. m. waves ? Give two examples of e. m. waves.

(e) Calculate the velocity of e. m. waves in vacuum. Given, $\mu_0 = 4\pi \times 10^{-7} kg.m/C^2$, $\varepsilon = 1/\left(36\pi \times 10^9\right) C^2 S^2/kg.m^3$.

3. Answer the following questions : 5×3=15

(a) Outline the main characteristics of laser light.

(b) Explain the working principle of Babinet compensator.

Or

What do you mean by Einstein's A and B coefficients ? Show that the ratio

$$\frac{A_{nm}}{B_{nm}} = \frac{8\pi h\nu^3}{c^3}$$

(c) Show that electromagnetic waves are transverse in nature with the electric and magnetic field vectors at right angle to the direction of propagation.

Or

Show that the electromagnetic waves obey Snell's laws when they suffer refraction at the interface separating two dielectric media.

Group – B

Marks : 30

4. What is stimulated emission of radiation ? Obtain a relation between rate of spontaneous emission and rate of stimulated emission. Show that for visible light of frequency $5\times10^{14}Hz$ at temperature $T = 10^3K$, stimulated emission is negligible compared to spontaneous emission. 2+6+2=10

Or

Describe the principle and construction of an optical fiber. Obtain the expression for its numerical aperture. 2+3+5=10

5. What are the two steps which explain the basic principle of holography ? Explain briefly. Give a brief mathematical theory of holography. 5+5=10

6. Derive wave equation in a conducting medium from Maxwell's electromagnetic field equation. 10

Or

For an electromagnetic wave with electric vector parallel to the plane of incidence, calculate the reflection coefficient. Hence explain total internal reflection. 7+3=10