2 0 1 6

PHYSICS

(Major)

Paper : 6.3

Full Marks : 60

Time : 3 hours

The figures in the margin indicate full marks for the questions

GROUP—A

(Modern Optics)

1. Choose the correct option/Answer the following questions : $1 \times 4 = 4$

   (a) In Ramsden's eyepiece, two planoconvex lenses of focal lengths

   (i) f and $3f$ are separated by $3f/4$

   (ii) f and f are separated by $2f/3$

   (iii) $2f$ and $3f$ are separated by $f/2$

   (iv) None of the above

   (b) What is the essential physical principle of an optical fibre?

(*Turn Over*)

(c) What is a hologram?

(d) Why do you need population inversion in laser?

2. (a) Draw a schematic diagram to show the ray path in a graded index fibre.

(b) What is non-linear optics? Explain briefly.

(c) Calculate the numerical aperture and hence the acceptance angle for an optical fibre, given that the indices of core and cladding are 1·45 and 1·40 respectively.   2+2+2=6

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

$$\frac{A_{nm}}{B_{nm}} = \frac{8\pi h\nu^3}{c^3} \cdot$$ 5

Or

Describe the basic principle of a ruby laser.   5

4. Write a short note on any *one* of the following :   5

(a) Liquid crystal display (LCD)

(b) Rochon prism

5. What are spontaneous absorption and stimulated absorption? Describe the basic components of a laser. 6+4=10

Or

Derive the mathematical theory of second harmonic generation. Why is second harmonic generation not possible in centro-symmetric crystals? Give reasons. 6+4=10

6. Describe the construction and working principle of Huygens eyepiece and locate its cardinal points. 10

Or

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

GROUP—B

(Electromagnetic Theory)

7. Answer the following : 1×3=3

(a) According to e.m. theory, what vectors vary at right angles to the direction of propagation of light wave?

(b) Write the expression for the speed of electromagnetic waves in free space.

(*Turn Over*)

(c) Write down Maxwell's field equation indicating the meanings of symbols used.

8. Show that the displacement current in the dielectric of a parallel-plate capacitor is equal to the conduction current in the connecting loads.   2

9. Show that for a plane electromagnetic wave in free space, the unit vector in the direction of propagation, the electric field vector and the magnetic field vector are mutually perpendicular.   5

Or

State and prove Poynting's theorem.   5

10. (a) Establish the equation of continuity for an electromagnetic field.

(b) Show that the electromagnetic waves obey Snell's laws when they suffer refraction at the interface separating two dielectric media.   4+6=10

Or

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

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