2019

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)

(*Marks* : 40)

1. Answer the following questions : 1×4=4

(a) What is a non-linear medium?

(b) Write one difference between prism spectra and grating spectra.

(c) What type of pumping process is used in case of ruby laser?

(d) What is monomode fiber?

2. Answer the following questions : 2×3=6

(a) Optical pumping is not generally used in gases to produce laser. Explain why.

(b) Write the advantages of optical fiber over conventional copper cable in communication system.

(c) Why second harmonic generation cannot occur in liquids or gases?

3. Explain the working principle of Babinet compensator. 5

Or

Describe how Rochon prism is used to separate the plane polarized O-rays and E-rays.

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 5×10^{14} Hz at temperature $T=10^3$ K stimulated emission is negligible compared to spontaneous emission. 2+6+2=10

Or

Write two differences between photography and holography. Explain mathematically the construction and reconstruction of hologram. 2+8=10

5. Describe the construction and working of Ramsden eyepiece. The focal length of field lens and eye-lens of a Ramsden eyepiece is 12 cm and they are separated by a distance 8 cm. If the final image is formed at infinity, find the position of the cross wire. 3+4+3=10

Or

Show graphically the refractive index distributions for step index and graded index fiber. What is intermodal dispersion? Show that after travelling a distance L through a step-index fiber, light rays spread in space by a length

$$\nabla L = L\left(\frac{n_1}{n_2}-1\right)$$

where n_1 and n_2 are refractive indices of core and cladding regions. 2+2+6=10

6. Write short note on (any *one*) : 5

(a) Second harmonic generation

(b) Optical fiber communication system

GROUP—B

(Electromagnetic Theory)

(*Marks* : 20)

7. Answer the following questions : 1×3=3

(a) What is the unit of E/B, where E and B are the amplitudes of electric and magnetic fields?

(b) "A space varying electric field can produce a magnetic field." Correct the sentence.

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

8. Define Poynting vector. What is its unit? 1+1=2

9. Show that electromagnetic waves are transverse in nature with the electric and magnetic field vectors at right angle to the direction of propagation. 5

Or

What is meant by polarization of electromagnetic wave? Derive the wave equation for a circularly polarized light. 2+3=5

10. Answer *either (a)* and *(b) or (c)* and *(d)* :

(a) Derive the laws of reflection and refraction of electromagnetic wave by considering a plane electromagnetic wave incident on an interface of two dielectric media. 5

(b) Obtain the expression for the energy density of electromagnetic field. 5

(c) Write down the conditions under the light of electromagnetic theory for which a medium would be conducting medium or dielectric medium or quasi-conducting medium. 3

(d) Deduce Fresnel's law of reflection and refraction from electromagnetic theory of light with electric field vector perpendicular to the plane of incidence. 7

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