

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.

( 2 )

- (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  $5 \times 10^{14}$  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

A9/729

( Continued )

( 3 )

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?

A9/729

( Turn Over )

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

★ ★ ★