

Total number of printed pages-7

3 (Sem-6) PHY M 3

2020

PHYSICS

(Major)

Paper : 6:3

Full Marks : 60

Time : Three hours

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

Group - A

(Modern Optics)

Marks : 40

1.2 Answer the following questions : $1 \times 4 = 4$

(a) What is CW laser ?

(b) What does the word "holography" mean ?

(Contd.)

- (c) You are going to study radiations of wavelength between 350 nm and 200 nm with the help of a prism spectrograph. Name the material of the prism you should use.
- (d) Why Huygen's eyepiece cannot be used for measurement purpose?
2. Answer the following questions :
- (a) In optical communication system, why infrared is preferred over visible light? 2
- (b) Second harmonic generation is not possible with conventional light o. Explain. 2
- (c) The field lens of a Huygen's eyepiece is 12 cm . Calculate the equivalent focal length of the eyepiece. 2
3. Explain how phase matching condition for Second Harmonic Generation can be achieved. 5

OR

Calculate the angular separation between the E-rays and O-rays emerging out of a Wollaston prism made of calcite crystal when the unpolarised beam is incident normally on its surface.

(Given refractive indices of calcite for E-rays and O-rays are 1.658 and 1.486 respectively)

5

4. Explain the construction and working principle of Ruby laser. Discuss its disadvantages. 4+4+2=10

OR

What is population inversion? A beam of light is passing through a medium. Show that for amplification of the light within the medium N_2 should be greater than N_1 , where N_1 and N_2 are electron population density of the lower and upper energy levels associated with emission process. Discuss briefly the optical pumping process. 2+5+3=10

5. Define acceptance angle of an optical fiber.
Derive an expression for numerical aperture.
The critical angle for core-cladding interface of a fiber is 30° . Calculate the value of acceptance angle, if the core of the fiber has refractive index 1.5.
Discuss the advantages of monomode fiber and multimode fibre. $2+4+1+3=10$

OR

- Explain the working principle of oil immersion objective. How spherical and chromatic aberration are minimised in such objective? Discuss its advantages over dry objective. $4+4+2=10$
6. Write short note on : **(any one)** 5
- (a) Liquid Crystal Display
- (b) Optical Communication.

Group - B

(Electromagnetic Theory)

Marks : 20

7. Answer the following questions : $1 \times 3 = 3$

(i) The value of refractive index of a non-magnetic material with relative permittivity equal to 16 is:

(a) 16

(b) 256

(c) 4

(d) 8

(ii) The correct sequence to find \vec{H} , when \vec{D} is given is:

(a) $\vec{D} \rightarrow \vec{E} \rightarrow \vec{B} \rightarrow \vec{H}$

(b) $\vec{D} \rightarrow \vec{B} \rightarrow \vec{E} \rightarrow \vec{H}$

(c) $\vec{D} \rightarrow \vec{H}$

(d) It cannot be computed from the given data

(iii) Identify the polarisation of the e-m wave, given $E_x = 2 \sin \omega t$ and $E_y = 3 \sin \omega t$.

(a) Linear

(b) Elliptical

(c) Circular

(d) Parabolic

8. Calculate the magnitude of conduction current density, if the magnetic flux intensity is $(\hat{i}y + \hat{j}z + \hat{k}x)$ units. 2

9. State and prove Poynting's theorem. 5

OR

Obtain an expression for the energy density of an electromagnetic field. 5

10. (a) Starting from Maxwell's equations, obtain the electromagnetic wave equation. 4

- (b) Define skin depth. Derive an expression for the skin depth in case of a homogeneous and isotropic conducting medium. 1+5=6

OR

- (a) Derive an expression for reflection coefficient considering oblique incidence of an electromagnetic wave with electric field vector parallel to plane of incidence. 7
- (b) Derive the expression for Brewster's angle. Why is it called angle of polarisation? 2+1=3
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