

2071

M.Sc. (Physics) Fourth Semester  
PHY-7054: Fiber Optics and Nonlinear Optics

Time allowed: 3 Hours

Max. Marks: 60

**NOTE:** Attempt five questions in all, including Question No. IX (Unit-V) which is compulsory and selecting one question each from Unit I -IV.

x-x-x

UNIT-I

1. (a) Discuss different types of fibre and their properties. (8)  
(b) Describe the process of coating of optical fibre. (4)
2. (a) A single-mode doped silica fibre has a dispersive coefficient of 40 ps/nm-km at a center wavelength of 1.3  $\mu\text{m}$ . The light source has a spectral width of 1.5 nm. Find the material dispersion if the length of the fibre is 20 km. (4)  
(b) Describe various procedures for the mass production of the fibre. (8)

UNIT-II

3. (a) Explain geometric optical properties of anisotropic media using Huygenian constructions. (6)  
(b) Prove that two possible directions of the displacement vector 'D' for a given wave vector are orthogonal. (6)
4. (a) Prove that there are two possible values of the phase velocity of a monochromatic wave propagating through an anisotropic medium with wave vector  $\vec{k}$ . (8)  
(b) Write the equation of the uniaxial indicatrix and differentiate between positive and negative uniaxial crystals. (4)

UNIT-III

5. (a) Describe linear electro-optic effect. (6)  
(b) Explain transverse electro-optic modulation. (6)
6. (a) Find the change in dielectric permittivity,  $\Delta\epsilon$ , for a shear wave propagating in lithium niobite. (4)  
(b) Describe experimental set up and theory of Raman-Nath diffraction. (8)

UNIT-IV

7. (a) What do you understand by anharmonic potential? Explain and show its variation by taking the example of rectangular lattice structure. (8)  
(b) Describe nonlinear susceptibility tensor and nonlinear mixing tensor for a second order process involving the interaction of two fields. (4)
8. (a) Explain the macroscopic and microscopic susceptibilities and deduce a relation between them. (8)  
(b) Give an example of the nonlinear process which depend on magnetic field components of the nonlinearly interacting waves. (4)

UNIT-V

9. (a) Define attenuation.  
(b) Write the angular relationships between quantities  $\vec{D}$ ,  $\vec{E}$ ,  $\vec{H}$  and  $\vec{k}$ .  
(c) Why Raman-Nath modulators are not preferred for limited modulation bandwidths?  
(d) What is the significance of Fresnel's equation?  
(e) Write the relation between nonlinear susceptibility tensor and nonlinear mixing tensor.  
(f) What is the significance of indicatrix? (6 x 2 = 12)

x-x-x