[This question paper contains 2 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 5548 **J**

Unique Paper Code : 2512013602

Name of the Paper : Photonics

Name of the Course : **B.Sc.(H) Electronics**

Semester : VI

Duration : 3 Hours Maximum Marks : 90

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. **All** questions carry equal marks.
3. Sub-parts can be given.
4. **First** Question is Compulsory.

1. (a) State Malu's law of Polarization. (3)

   (b) Calculate the thickness of the half-wave plate for the light of wavelength 5000 A^0, the refractive indices for ordinary and extraordinary rays being 1.544 and 1.553, respectively. (3)

   (c) What is a missing order in the N-slit diffraction pattern? (3)

   (d) Distinguish between ordinary photography and Holography (3)

   (e) Name three components needed to make a laser. (3)

   (f) What is the difference between step index and graded index optical fiber? (3)

2. (a) Derive an expression for the intensity distribution in a two-slit Fraunhofer diffraction pattern. Also, plot the variation on the screen. (10)

   (b) Consider a plane wave incident normally on a long narrow slit of width 0.02 cm. The Fraunhofer diffraction pattern is observed on the focal plane of a lens whose focal length is 20cm. Assuming $\lambda = 6000A^0$, determine the position of 1^{st} and 2^{nd} minima. (8)

3. (a) What do you understand by elliptically polarized light? How can it be produced? How would you distinguish between partially polarized and elliptically polarized light? (9)

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(b) Explain the phenomena of double refraction in a calcite crystal. Compare the properties of O and E rays. (5)

(c) The refractive indices of quartz for ordinary and extraordinary rays of light of wavelength 5896 A^0 are 1.54 and 1.55, respectively. What should be the thickness of a quarter-wave plate? (4)

4. (a) What are Newton's rings and how are they formed? (Give the necessary theory) How would you employ this phenomenon for measuring wavelength of light? Why are Newton's rings circular? (10)

(b) In Newton's ring arrangements, the diameter of the 5^{th} and 15^{th} rings are 0.336cm and 0.590 cm, respectively. Find the radius of curvature of the planoconvex lens if the wavelength of light used is 5890 A^0. (8)

5. (a) Describe the construction and working of semiconductor laser. List out its merits and demerits. (9)

(b) Explain Brewster's Law (3)

(c) Explain the following terms :

(i) Metastable state

(ii) Population inversion

(iii) Pumping (6)

6. (a) Give the principle of optical fibers. How the terms angle of acceptance and numerical aperture are used in optical fibers discussed in detail? (9)

(b) Calculate the numerical aperture and acceptance angle of optical fiber with a core refractive index of 1.62 and cladding refractive index of 1.52. (5)

(c) What is the difference between step-index multimode fiber and graded-index multimode fiber? (4)

7. (a) Explain TE mode in a symmetric step-index waveguide. What factors depend on the number of modes supported in a waveguide? (9)

(b) What do you understand by dispersion in an optical fiber. (6)

(c) What is the difference between Photo transistors and photodiodes (3)