[This question paper contains 2 printed pages.]

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Your Roll No.....

No. of Question Paper : 1104

Code of Paper : 251604

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

Name of the Paper : Optics and Optical Electronics [ELHT-603]

Semester : VI

Time : 3 Hours

Maximum Marks : 75

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. Attempt five questions in all.
3. Question No. 1 is compulsory.
4. Use of scientific calculators is allowed.

1. (a) Why is a Compensating glass plate needed in Michelson's interferometer ? (3)

(b) Write the wavelengths of emission for He-Ne, CO_2 and Nd-YAG Lasers. (3)

(c) In a plane transmission grating the angle of diffraction for the second order principal maximum for the wavelength 5×10^{-5} cm is 30°. Calculate the number of lines in 1 cm of the grating surface. (3)

(d) State Malu's Law of Polarization. (3)

(e) What is Rayleigh criterion for the resolution of two spectral lines ? (3)

2. (a) Describe the construction and Working of a Michelson interferometer. Show with necessary theory how this interferometer can be used to measure wavelength of monochromatic light. (8)

(b) What are coherent sources ? How can these be obtained ? (4)

(c) For a sodium lamp, the distance traversed by a mirror between two successive disappearances is 0.289 mm. Calculate the difference in the wavelengths of the D_1 and D_2 lines. Given $\lambda = 5890$ Å. (3)

3. (a) Describe a method for the measurement of wavelength of light using Newton's rings. Deduce the necessary formula. (8)

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(b) In the Newton's rings arrangement, the diameter of the 5th and 15th rings are 0.336 cm and 0.590 cm respectively. Find the radius of curvature of the plano-convex lens if the wavelength of light used is 5890 Å. (4)

(c) Discuss the phenomenon responsible for the different colours seen on the surface of soap bubble created in air. (3)

4. (a) Derive an expression for the intensity distribution in a single slit Fraunhofer diffraction pattern. Also give the positions of maxima and minima. (7)

(b) In a double slit Fraunhofer pattern with slit width $b = 8.8 \times 10^{-3}$ cm, separation between the slits $d = 7.0 \times 10^{-2}$ cm and $\lambda = 6.328 \times 10^{-5}$ cm, how many interference minima will occur between the two diffraction minima on either side of the central maximum ? (5)

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

5. (a) Obtain the relationship between Einstein Coefficients A and B for an atomic system. (6)

(b) What is a Hologram ? Explain the basic principle involved in recording and reconstruction of Hologram. (5)

(c) Obtain an expression for the numerical aperture of a step index optical fiber. (4)

6. (a) What is meant by chromatic aberration and achromatic doublet ? Two glasses have dispersive powers in the ratio 2:3. These glasses are to be used in the manufacture of an achromatic objective of focal length 20 cm. What are the focal length of the lenses. (8)

(b) What is the missing order in a N-slit diffraction pattern ? (4)

(c) Give some application of LEDs. (3)

7. (a) A left circularly polarized beam ($\lambda_0 = 5893$ Å) is incident on a quartz crystal (with its optic axis cut parallel to the surface) of thickness 0.01 mm. What will be the state of polarization of the emergent beam ? (Assume $n_0 = 1.54425$, $n_e = 1.55336$). (7)

(b) Describe the phenomenon of double refraction. What are positive and negative crystals ? (5)

(c) Describe Semiconductor Lasers. (3)