May - 2022

[This question paper contains 3 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 1354 **A**

Unique Paper Code : 32511603

Name of the Paper : Photonics

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

Semester : VI

Duration : 3½ Hours Maximum Marks : 75

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. There are **seven** questions in all, out of which you have to attempt any **five** questions
2. **All** questions carry equal marks
3. Scientific non-programmable calculators allowed.

1. (a) Derive grating equation and explain, how it can be used to determine unknown wavelength. (7)

   (b) What is Rayleigh's criteria of resolution? Derive an expression for resolving power of a microscope.(4)

P.T.O.

(c) For a plane transmission grating with 5000 lines/cm at the normal incidence

(i) What is the longest wavelength for which spectrum can be observed?

(ii) For a wavelength of 6×10^{-7}m, what is the highest order of spectrum which can be observed?(4)

2. (a)What are coherent sources? Derive the equations for interference of two coherent sources and explain constructive and destructive interference.(8)

(b) What are missing orders? Describe Michelson interferometer with diagram & explain the formation of circular fringes in it. In moving one mirror through 0.015 mm, 500 fringes cross the centre of the field of view. What is the wavelength of light? (5)

(c)Draw the diffraction pattern of a single slit and explain why intensity falls on either side of central maximum.
(2)

3. (a)Explain the phenomenon of double refraction in a uniaxial crystal when light is incident normally on it for optic axis lying in the plane of incidence and inclined to the refracting surface. (5)

(b)Explain the phenomenon of Double refraction. Write the properties of E-ray and O-ray. Also distinguish between positive and negative crystals. (6)

(c) Plane polarized light of wavelength 6000A° is incident normally on a calcite plate of thickness 0.04mm. Calculate the phase retardation introduce between the e-ray and o-ray at emergence. Given that μ_o=1.642 and μ_e=1.478. (4)

4. (a) Explain the construction and working of Liquid Crystal Display. Also explain the positive & negative image and reflective& transmissive type displays. Compare LCD and LED displays.(8)

(b) What are photodetectors? Explain the working of Charge Coupled Devices. (4)

(c) What is Faraday rotation and Electro-optic effect? (3)

5. (a) Discuss the condition for interference in young's double slit experiment.Derive the expression for shift of fringes, if a thin mice sheet is introduced in one of its path.(7)

(b) Discuss the Interference due to the reflected light in plane parallel thin film. Derive the formula for optical path difference. (5)

(c) State and explain Malus law. (3)

6. (a) Derive the threshold population inversion density required for oscillation of the laser. (6)

(b) For a Ruby rod to be used in a LASER with mirror reflectivities $R_1=R_2=0.9$, cavity length d=5cm, n_o=1.76, what is the threshold gain required in dB/cm? (4)

(c) What are photomultiplier tubes. Explain its working and give its application also.

(5)

7. (a) Starting from the equation for E_y, show that for symmetric planer waveguide with $n=n_1$ for $>|x|<d/2$ and $n=n_2$, for $|x|>d/2$, the symmetric TE modes satisfy an equation of the form :$\eta \tan \eta = (V^2-\eta^2)^{1/2}$Define V and η clearly. (6)

(b) Consider a step index optical fibre for which core index is 1.436 and cladding index is 1.426. Find

i) Intermodal Dispersion factor for the fibre
ii) Total dispersion in 10Km length of the fibre (4)

(c) Explain the construction and working for semiconductor Laser Diode (5)