[This question paper contains 3 printed pages.]

Your Roll No. 17009558026

Sr. No. of Question Paper : 2247 **A**

Unique Paper Code : 32511603-OC

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 an expression for double slit diffraction pattern. Draw and explain resultant intensity distribution for the same. Also explain what are missing orders. (7)

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

(c) Light of wavelength 5×10^{-7}m is incident normally on a plane transmission grating. Find the difference in the angle of deviation in the first and third order spectra. The number of lines per cm on the grating surface is 6000A°. (4)

2. (a) Explain with diagram how Newton ring experiment is used to determine the wavelength of monochromatic source of radiation. Also explain why rings get closer as you move away from centre? (8)

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(b) Explain the formation of white central band and coloured bands on either side of centre when white light is incident normally on a transmission grating. Find an expression for dispersive power of a transmission grating. (4)

(c) Find out if two Sodium lines (589nm &589.6nm) would be clearly resolved in first order and second order spectrum by a diffraction grating having 1000 lines/cm. (4)

3. (a) Explain how we can obtain linearly polarized, circularly polarized and elliptically polarized light using the phenomenon of double refraction. (7)

(b) What is quarter-wave plate? Calculate the thickness of a calcite plate which would convert plane polarized light into circularly polarized light. $\mu_o = 1.658$, $\mu_e = 1.486$ and $\lambda = 5890A^\circ$ (5)

(c) State and Explain Brewster's law. (3)

4. (a) Explain the working of LED. Which material is used for their construction and how different colour LED's are made? (5)

(b) Describe with diagram Michelson interferometer. How can it be used for measuring unknown wavelength? What is the role of compensating plate? (7)

(c) What do you understand by responsivity? Calculate it for a photodiode having 90% quantum efficiency at 800nm. (3)

5. (a) Discuss the Young's Double slit experiment and drive an expression for (i) intensity at a point on the screen (ii) Fringe width. (7)

(b) A white light is incident on two parallel glass plates separated by an air film of 0.001cm thickness and the reflected light is examined by the spectroscope. Find the number of dark bands seen in the spectrum between wavelengths $4x10^{-5}$cm and $7x10^{-5}$ cm, when light is incident at an angle of 30° to the normal to surface. (5)

(c) Distinguish between radiation mode and guided mode. A waveguide has a V number 2.37. How many modes does it support? (3)

6. (a) Determine the relation between Einstein Coefficients. (4)

(b) In a four level He-Ne laser system $\lambda o = 0.6328 \times 10^{-4}$ cm, $t_{sp} = 10^{-7}$ sec, $\Delta v = 10^{9}$ Hz, $n_o = 1$, $g(\omega_o) = 1.5 \times 10^{-10}$ sec, resonator length=10cm, $R_1 = R_2 = 0.98$ and assuming absence of loss mechanisms($\alpha_1 = 0$). Calculate t_c cavity lifetime, threshold population inversion and threshold pump power. (6)

(c) Explain different types of photodiodes and their modes of operation. (5)

7. (a) For a symmetric waveguide with $n_1 = 1.505$ and $n_2 = 1.50$, and propagation constant of the lowest mode is 1.50125 at $\lambda o = 0.633$ μm. Estimate the guide thickness. (3)

(b) Distinguish between intermodal and intramodal dispersion. Obtain an expression for material dispersion in a single mode fibre. (7)

(c) Give various factors contributing for attenuation of signal through optical fibre. Find the value of acceptance cone for typical fibre, with $n_1 = 1.45$ and $\Delta = 0.01$ (5)

(100)