1403

B.Sc. (Hons.) / II   A

ELECTRONIC SCIENCE – Paper 2.5 (XII)

(Modern Optics and Opto-electronics)

Time : 3 Hours   **Maximum Marks : 38**

(Write your Roll No. on the top immediately on receipt of this question paper.)

Attempt **Five** questions in all, including
Question No. **1**, which is compulsory.

1.   Attempt any **five** of the following :

    (a)   State Fermat's principle. With its help prove law of Reflection.

    (b)   Explain the terms : Spatial coherence and Temporal coherence.

    (c)   Mention the two similarities and two dissimilarities between zone plate and a convex lens.

    (d)   Write conditions for obtaining circular fringes in Michelson's interferometer.

(e) Name three main components of a Laser system.

(f) What is the difference between step index and graded index fibre ? **(2 × 5 = 10)**

2. (a) What is meant by chromatic aberration and achromatic doublet ? Deduce the condition for achromatic of two lenses separated by a distance 'd'. **4**

(b) The object glass of a telescope is an achromat of focal length 90 cm. If the magnitude of dispersive power of lenses are 0.015 and 0.030, Calculate their focal length. **3**

3. (a) What are Newton's ring and how are they formed ? How would you employ this phenomenon for measuring the wavelength of light ? (Give the necessary theory.) Why are Newton's rings circular ? **5**

(b) A thin planoconvex lens of focal length 1.8 m and of refractive index 1.6 is used to obtain Newton's ring. The wavelength of the light is 589 nm. Calculate the radius of 10th dark ring by **2**

(i) reflection and

(ii) transmission

4. (a) Show that in case of Fabry-Perot interferometer the intensity distribution is given by : **4**

$$I = \frac{I_{max}}{\left[1 + \frac{4r^2}{(1-r^2)} \sin^2\left(\frac{\delta}{2}\right)\right]}$$

where 'r' is the reflection coefficient for amplitude and 'δ' is the phase factor.

(b) White light is incident normally on a Fabry-Perot interferometer with a plate separation of 4×10^{-4} cm. Calculate the wavelengths for which there are interference maxima in the transmitted beam in the range 4000 Å to 5000 Å. **3**

5. (a) What do you understand by double refraction ? What are ordinary and extraordinary rays in an uniaxial crystal ? Under what condition can we have single image of a point object when light falls normally on a uniaxial crystal. **4**

(b) Describe the construction and working of a Nicol Prism. Discuss how it is used as a polarizer and an analyzer. **3**

6. (a) Write the laser rate equations for a three level Laser system and find the threshold pumping rate required for laser action. What is the advantage of a four level Laser over a three level Laser system ? **4**

(b) Discuss the working of a He – Ne Laser. **3**

7. (a) What is a Hologram ? Explain the basic principle involved in recording and reconstruction of Hologram. **3**

(b) Define the numerical aperture of an optical fibre and obtain an expression for it. **2**

(c) If a step index optical fibre has core refractive index 1.5 and cladding refractive index of 1.47, compute : **2**

   (i) The critical angle at core-cladding interface.

   (ii) The numerical aperture for the fibre.