Bachelor of Science (B.Sc.) Semester—III Examination

PHYSICS-302

Physical Optics And Electromagnetic Waves

Paper—II

Time—Three Hours] [Maximum Marks—50

N.B. :— (1) All questions are compulsory.

(2) Draw neat diagrams wherever necessary.

EITHER

1. (a) (i) Describe Michelson Interferometer to determine the difference in wavelength of sodium D-line. 3

(ii) By how much distance the movable mirror of a Michelson Interferometer be moved to obtain consecutive positions of maximum distinctness for sodium D-lines λ_1 = 5896 A° and λ_2 = 5890 A°. 2

(b) State the principle of superposition of light waves. Derive the conditions of interference for bright and dark fringes due to reflected light from a thin film. 5

19

OR

(c) Describe an experimental arrangement to obtain Newton's rings by reflected light. 2½

(d) A parallel beam of light of wavelength $\lambda = 5890$ A° is incident on a thin glass plate of refractive index 1.15 such that the angle of refraction into the plate is 45°. Calculate the smallest thickness of the glass plate which will appear dark by reflection. 2½

(e) Explain the principle of Fabry-Perot Interferometer. State its superiority over Michelson Interferometer. 2½

(f) Explain the need of a broad source of light for interference in thin films. 2½

EITHER

2. (a) Explain with necessary theory, the phenomenon of Fraunhoffer diffraction at a single slit. 5

(b) (i) Describe the phenomenon of Fresnel diffraction due to a narrow slit. 3

(ii) In an experiment with straight edge diffraction, the distance from slit to straight edge is 1 m and edge to screen is 2 m. If $\lambda = 5000$ A°, determine the positions of the 1st and 2nd order bright fringes. 2

OR

(c) What is zone plate ? Compare the zone plate with a convex lens. 2½

(d) A plane grating containing 15000 lines per inch is illuminated normally by a monochromatic light of wavelength $\lambda = 5893$ A°. Find the maximum numbers of visible orders for a grating. 2½

(e) Derive an expression for resolving power of plane grating. 2½

(f) Explain the construction of Fresnel's half period zones of plane wavefront. 2½

EITHER

3. (a) What is double refraction in uniaxial crystal ? Plane polarised light is incident normally on a calcite plate with refracting faces cut along its optic axis. Obtain the condition under which the emergent light is elliptically polarised. 5

(b) (i) State and derive Brewster's law. What does the law become when the rays of light travel from denser to rarer medium ? 3

(ii) A ray of light is incident on the surface of a glass plate of refractive index 1.55 at the polarising angle. Calculate the angle of refraction. 2

OR

(c) Explain the production of plane polarised light using Nicol prism. 2½

(d) Calculate the thickness of a calcite plate which would convert plane polarised light into circularly polarised light.

Given : $\mu_o = 1.658$, $\mu_e = 1.486$ and wavelength of light used $\lambda = 5890$ A° 2½

(e) Explain red colour of the sky at sunset and sunrise. 2½

(f) What is plane polarised light ? Explain :

(i) Plane of polarisation and

(ii) Plane of vibration. 2½

EITHER

4. (a) (i) Using Maxwell's equation, derive an equation of electromagnetic wave in free space. 3

(ii) Calculate the speed of electromagnetic wave in a sea water. Given : $\mu = 4\pi \times 10^{-7}$ N/A^2, $\epsilon = 6 \times 10^{-10}$ C^2/Nm^2. 2

(b) What is Poynting vector ? Explain its significance. Deduce Poynting theorem for the flow of energy in an electromagnetic field. 5

OR

(c) What is phase difference between $\overline{E}$ and $\overline{H}$? Explain with diagram. 2½

(d) Discuss the Maxwell's equation $\overline{\nabla}.\overline{B} = 0$. 2½

(e) State the characteristics of electromagnetic waves in free space. 2½

(f) Calculate the value of Poynting vector on the surface of the star, if the power radiated by it is 5×10^{26} watt. The average distance between the star and the earth is 2×10^{11} m. 2½

5. Attempt any **TEN** (**1 mark each**) : 10×1=10

(i) What are coherent sources ?

(ii) What do you mean by 'Fringes of equal inclination' ?

(iii) In the Newton's ring experiment, the diameters of n^{th} and $(n + 8)^{th}$ bright rings are 4.2×10^{-3} m and 7×10^{-3} m respectively. If the radius of curvature of plano-convex lens is 2 m, calculate the wavelength of light used.

(iv) What is Airy's diffraction pattern ?

(v) State Rayleigh's criterion of resolution.

(vi) In a grating, there are 15000 lines per inch. Find the number of lines per centimeter.

(vii) What are retardation plates ? State their uses.

(viii) If the wavelength of light is 5890 A.U. convert it into nanometer.

(ix) Draw the ray diagram in Wollaston prism made of quartz.

(x) If the magnitude of $\overline{H}$ in a plane wave is 1 A/m, find magnitude of $\overline{E}$ for a plane wave in free space.

(xi) Give two examples of two appliances using E-M. waves that are encountered in everyday life.

(xii) Give the physical significance of Maxwell's equation $\nabla . E = \frac{\rho}{\epsilon_0}$