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Bachelor of Science (B.Sc.) Semester—III
Examination
302 : PHYSICS
(Physical Optics & Electromagnetic Waves)
Paper—II

Time—Three Hours] [Maximum Marks—50

N.B. :— (1) All questions are compulsory.
(2) Draw neat diagram wherever necessary.

EITHER

1. (A) (i) With a neat diagram, describe the construction and working of Michelson's Interferometer.

(ii) In a Michelson's Interferometer, 300 fringes cross the field of view when the movable mirror is displaced through 0.0825 mm. Calculate the wavelength of monochromatic light used. 3+2

(B) Derive the conditions of interference for bright and dark fringes due to transmitted light from a thin film. 5

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5. Attempt any **TEN** questions :

(i) What do you mean by monochromatic light ?

(ii) Give any two advantages of Fabry-Perot interferometer over Michelson's interferometer.

(iii) If the top and bottom surface of the thin film are of glass plate having refractive index 1.52. calculate the reflectivity of the top surface.

(iv) What is grating element ?

(v) Draw the intensity distribution curve in Fresnel's diffraction at a straight edge.

(vi) In a double slit Fraunhofer pattern find the missing orders of interference maxima, when b = 2a.

(vii) State Malu's Law.

(viii) What are negative and positive crystals ?

(ix) If the angle between a polarizer and analyzer is 60º. What will be the intensity of transmitted light if I_o be the intensity of incident light.

OR

(C) Explain the difference between Fresenel and Fraunhofer diffraction. 2½

(D) Explain Rayleigh's criterion of resolution. 2½

(E) What is plane diffraction grating ? Obtain an expression for resolving power of grating. 2½

(F) Monochromatic light of wavelength 6560×10^{-8} cm falls normally on a grating 2 cm wide. The first order spectrum is produced at an angle of 18º 14′ from the normal. What is the total number of lines on the grating ? (Given : sin 18º 14′ = 0.3129) 2½

EITHER

3. (A) Give construction and working of Nicol Prism. How it is used as a polarizer and analyser ? 5

(B) (i) What is quarter wave plate ? How is it used to produce circularly polarised light ? 3

(ii) Calculate the minimum thickness of a quarter wave plate of quartz for a light of wavelength 6000 Å, when refractive indices of o-rays and e-rays are 1.533 and 1.544 respectively. 2

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OR

(C) State the basic postulates of Huygen's theory of double refraction in uniaxial crystal. 2½

(D) Explain the structure of Calcite crystal and define optic axis. 2½

(E) Explain the formation of ordinary and extra-ordinary rays in uniaxial crystal for oblique incidence, when optic axis is in the plane of incident and parallel to the crystal surface. 2½

(F) Calculate the polarizing angle at the surface of separation of water and glass for reflection in water. The refractive indices of water and glass are 4/3 and 3/2 respectively. 2½

EITHER

4. (A) State Maxwell's equations in electromagnetic wave theory. Show by mathematical treatment that electromagnetic waves are transverse in nature. 5

(B) (i) Derive an expression for the equation of continuity for time varying field. 3

(ii) Find the amplitude of the displacement current density inside a large oil filled power capacitor if

$E = 80 \cos (6.277 \times 10^{-8} t - 2092\ y)\ a_z$ V/m.

(Given = $\epsilon_0 = 8.85 \times 10^{-12}$ SI unit). 2

OR

(C) Discuss the important contribution made by Maxwell in the form of modification of Ampere's circuital law and hence obtain Maxwell's first relation of electromagnetic field. 2½

(D) Show that electric and magnetic field vectors in an electromagnetic waves are perpendicular to each other and they are also perpendicular to the direction of propagation of waves. 2½

(E) Describe electromagnetic spectrum with a neat labelled diagram and state frequency/wavelength ranges of various types of waves. 2½

(F) Calculate the Poynting vector on the surface of the sun if power radiated by it is 3.8×10^{26} watt and if average distance between the sun and the earth is 1.5×10^{11} m. Hence, show that the value of solar constant is 1.34×10^3 watt/m^2. 2½

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OR

(C) With the help of neat diagram, describe the construction and working of Fabry-Perot interferometer. 2½

(D) Show that in Newton's rings the diameter of bright ring is directly proportional to the square root of odd natural number. 2½

(E) How will you determine the refractive index of liquid using Newton's ring ? 2½

(F) A soap film of refractive index 4/3 and thickness 1.5×10^{-4} cm is illuminated by white light incident at an angle of 45°. The light reflected by it gives dark band corresponding to wavelength 5×10^{-5} cm. Calculate the order of interference band. 2½

EITHER

2. (A) Give the theory of Fresnel's diffraction due to straight edge and explain the intensity distribution in the diffraction pattern. 5

(B) (i) Give construction and theory of zone plate. 3

(ii) If the diameter of a central zone is 2.5 mm and a point source of light of wavelength 7.5×10^{-5} cm is placed 5 m away from the zone plate. Find the position of primary and secondary image. 2

(x) What are current density and current displacement density ?

(xi) What is characteristic impedance ?

(xii) Draw a labelled diagram of travelling electromagnetic wave. 1 mark each

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