KNT/KW/16/5111

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

302 : PHYSICS

(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) Explain the principle, construction and working of the Michelson's interferometer with the help of neat labelled diagram. 5

(B) (i) How is the Michelson's interferometer used to determine the difference in wavelength of the two D lines of Sodium ? 3

(ii) In an experiment of the Michelson's interferometer when sodium light source is used, two consecutive positions of indistinctness of fringes are obtained at position of the movable mirror 0.6862 mm and 0.9787 mm respectively. If the mean wavelength of sodium light is 5893 Å, calculate the difference in wavelengths. 2

OR

(C) Derive the conditions for brightness and darkness in case of interference in thin films due to transmitted light. 2½

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

(E) In a Newton's rings experiment, the diameter of 5^{th} ring was 0.3 cm and diameter of 25^{th} ring was 0.8 cm. If the radius of curvature of the plano convex lens is 100 cm, find the wavelength of light used. 2½

(F) Explain how the refractive index of a liquid can be determined by using Newton's rings. 2½

EITHER

2. (A) Explain Fresnel diffraction due to a straight edge in detail. 5

(B) (i) Explain Fraunhofer diffraction at a circular operature. 3

(ii) In Fraunhofer diffraction due to single slit of width 0.15 mm, screen is placed at 1.5 m from the lens to obtain the diffraction pattern. The distance of the first minimum lies at 5 mm on either side of central maximum. Calculate the wavelength of light used. 2

OR

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

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

(E) A grating having 600 lines per cm is used to observe the sodium D_1 and D_2 lines of wavelength 5890Å and 5896Å. Will the grating resolve the lines :

(i) in first order

(ii) in second order ? 2½

(F) Distinguish between grating spectra and prism spectra. 2½

EITHER

3. (A) Explain principle, construction and working of Nicol' prism. 5

(B) (i) Define quarter waveplate. Derive the expression for minimum thickness of quarter wave plate to convert plane polarised light into elliptically polarised light. 3

(ii) Calculate the minimum thickness of the quarter wave plate of quartz for light of wavelength 6000 Å. Given : $\mu_0 = 1.544$ and $\mu_e = 1.553$. 2

OR

(C) State and prove Brewster's law. 2½

(D) Explain Huygen's theory of double refraction in a uniaxial crystals. 2½

(E) Define optic axis and principal plane of a crystal. 2½

(F) For a monochromatic beam of light travelling through a crystal, calculate :

(i) the speed of ordinary wave

(ii) the speed of the extraordinary wave along the optic axis

(iii) the speed of the extraordinary wave in the direction perpendicular to the optic axis.

Given : $\mu_0 = 1.66$, $\mu_e = 1.49$ and $C = 3\times10^8$ m/s. 2½

EITHER

4. (A) Derive Maxwell's second equation, $\nabla \times E = -\frac{\partial B}{\partial t}$ and Maxwell's third equation, $\nabla . D = \rho$.

5

(B) (i) Deduce Poynting theorem for the flow of energy in an electromagnetic field. 3

(ii) Calculate the Poynting vector of propagation of energy on the surface of sun if the radius of sun is 7×10^8 m and energy emission is 38×10^{28} Watt/sec. 2

OR

(C) State the characteristics of Electromagnetic Waves. 2½

(D) Derive the relation $\nabla^2 E = \mu_0 \in_0 = \frac{\partial^2 E}{\partial t^2}$. 2½

(E) Show that at any instant, the electric field vector in free space is 377 times the value of magnetic field vector if $\mu_0 = 4\pi \times 10^{-7}$ SI unit and $\in_0 = 8.85 \times 10^{-12}$ SI unit. 2½

(F) Show that $\vec{E}$ and $\vec{B}$ are at right angles to each other. 2½

5. Attempt any **TEN** :

(i) Define coherent sources.

(ii) State the relation between phase difference and path difference.

(iii) State any two differences between constructive and destructive interference.

(iv) What is diffraction ?

(v) State Rayleigh's criterion for resolution.

(vi) In a plane diffraction grating, there are 196 lines per cm. Calculate the grating element.

(vii) State the characteristics of E-rays.

(viii) The refractive index of Diamond for sodium light is 2.417. Find the angle of incidence for which the light reflected from diamond is completely plane polarised.

(ix) Write two examples each of positive and negative crystals.

(x) Define uniform plane wave.

(xi) Calculate the speed of electromagnetic waves in free space. (Given $\mu_0 = 4\pi \times 10^{-7}$ SI unit and $\in_0 = 8.85 \times 10^{-12}$ SI unit.)

(xii) Define characteristic impedance. 1×10=10