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

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) (i) What is a thin film ? 1

(ii) Derive the conditions for obtaining bright and dark fringes due to interference of reflected light in thin films. 4

(B) (i) Draw a well labelled diagram of Newton's rings experiment. Explain the Newton's rings experiment to determine the refractive index of a transparent liquid. 3

(ii) The diameter of 15^{th} dark ring in Newton's rings experiment when air is in between plane glass plate and plano-convex lens is 0.4 cm. If air is replaced by transparent liquid then the diameter of the ring shrinks to 3.5 mm. Calculate the refractive index of liquid if the light of wavelength 6000 Å was used. 2

OR

(C) Explain with well labelled diagram how the Michelson Interferometer is used to determine unknown wavelength of light. 2½

(D) A parallel beam of light of wavelength 5890 Å is incident on a thin glass plate of refractive index 1.5, such that the angle of refraction in the plate is 60º. Calculate the smallest thickness of the plate which will appear dark by reflected light. 2½

(E) Explain the phase change of π when reflection takes place in a rarer medium at a surface backed by a denser medium. 2½

(F) What is interference ? State conditions to obtain a steady interference pattern. 2½

EITHER

2. (A) What is a zone plate ? Name the different types. Derive an expression for its focal length. Compare zone plate with converging lens. 5

(B) (i) Explain, how plane transmission grating is used to determine the wavelength of monochromatic light. 3

(ii) A beam of parallel rays of red light of wavelength 600 nm is incident normally on a plane transmission grating of 5000 lines per cm. Calculate the angular separation between the second and third order spectral lines. 2

OR

(C) Explain Rayleigh's criterion for unresolved, just resolved and well resolved spectral lines. 2½

(D) Distinguish between interference and diffraction. 2½

(E) A parallel beam of light of wavelength 5000 Å is incident normally on a narrow slit of width 0.02 cm. A convex lens of focal length 2m is placed to observe the Fraunhofer diffraction. Calculate the distance between first two minima. 2½

(F) Show that the area of each fresnel half period zone is constant. 2½

EITHER

3. (A) Explain the construction and working of Nicol prism. 5

(B) (i) What are phase retardation plates ? Derive an expression for thickness of a quarter wave plate. 3

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

(Given $\mu_0 = 1.65$; $\mu_e = 1.48$; and $\lambda = 5890Å$) 2

OR

(C) Compare the properties of O-ray and e-ray in uniaxial crystals. 2½

(D) What is scattering of light and hence explain, why the colour of the sun during sunset or sunrise is red. 2½

(E) Explain the production of elliptically polarized light. 2½

(F) A transparent material has a refractive index 1.732. If the reflected ray is plane polarised then find the angle of incidence. 2½

EITHER

4. (A) State and prove Poynting theorem. 5

(B) (i) Derive electromagnetic wave equation in conducting medium. 3

(ii) If a 2 k watt LASER beam is concentrated by a lens into a cross-sectional area of 10^{-10} m^2, find the value of poynting vector and the amplitude of electric field (Given : 9×10^{-12} S. I. unit). 2

OR

(C) Calculate the speed of electo magnetic waves in vacuum if $\epsilon_0 = \frac{1}{36\pi\times10^9}\text{Coul}^2\text{Sec}^2/\text{Kgm}^3$ and $\mu_o = 4\pi\times10^{-7}\,\text{kg m/Coul}^2$. 2½

(D) State Maxwell equations. Give their word statements. 2½

(E) Show that electromagnetic waves are transverse in nature. 2½

(F) State the characteristics of electromagnetic waves. 2½

5. Attempt any **ten** :

(i) Why is the central fringe dark in Newton's rings experiment by reflected light ?

(ii) Why is the compensating glass plate introduced in the path of transmitted beam in Michelson's Interferometer ?

(iii) In Michelson's Interferometer, the initial and final position of micrometer screws are 12.70 mm and 12.75 mm, when 100 fringes pass from the field of view. Calculate, the wavelength of light used.

(iv) State any two differences between Fresnel and Fraunhofer diffraction.

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

(vi) If the focal length of the zone plate is 2m for light of wavelength 400 nm, what will be its focal length for wavelength 500 nm ?

(vii) What is optic axis ?

(viii) State Brewster's law.

(ix) If a grating has 15000 lines per cm then, calculate the grating element.

(x) What is the origin of electromagnetic waves ?

(xi) Obtain the unit of impedance of dielectric medium.

(xii) Write any two applications of EM waves. 1×10=10