NKT/KS/17/5111

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) Describe the experimental arrangement for formation of Newton's rings. Derive an expression for the diameters of dark rings. 5

(B) (i) With a neat diagram, describe the construction of Michelson's interferometer. 3

(ii) In Michelson's Interferometer, 400 fringes cross the field of view when the movable mirror is displaced through 0.1178 mm. Calculate the wavelength of monochromatic light used. 2

OR

(C) How will you determine the refractive index of a liquid by using Newton's rings ? 2½

(D) Explain the phase change of π when light is reflected into a rare medium at a surface backed by a denser medium. 2½

(E) A soap film of refractive index 4/3 and of thickness 1.5×10^{-6} metre is illuminated by white light incident at an angle of 60°. The light reflected by it is examined in which a dark band is found corresponding to a wavelength 5000 Å. Calculate the order of interference of the dark band. 2½

(F) What are Haidinger's fringes ? Explain their formation. 2½

EITHER

2. (A) Explain the construction of Fresnel's half period zones with neat diagram and also show that radii of Fresnel's half period zones are directly proportional to the square root of natural numbers. 5

(B) (i) Explain Rayleigh's criterion of resolution. 3

(ii) A single slit of width 0.2 mm is illuminated by a parallel beam of light of wavelength 6000Å. Find the angular half width of central maximum. 2

OR

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

(D) Describe the construction of zone plate. 2½

(E) Derive an expression for width of central maxima in Fraunhofer diffraction due to a single slit. 2½

(F) What is the radius of the first half period zone in a zone plate behaving like a convex lens of focal length 60 cm for light of wavelength 6000 Å ? 2½

EITHER

3. (A) Define uniaxial and biaxial crystals. Describe the construction of Nicol Prism. 5

(B) (i) State and prove Brewster's law. 3

(ii) Calculate the least thickness of a calcite plate which would convert plane polarized light into cirularly polarized light. Given :

$\mu_o = 1.792$ $\mu_e = 1.523$ and

wavelength of light is 5890 Å. 2

OR

(C) What is a quarter wave plate ? How it is used to produce circularly polarized light ? 2½

(D) What do you mean by positive and negative crystals ? 2½

(E) Explain Huygen's theory of double refraction. 2½

(F) Unpolarized light falls on two palarizing sheets placed one on top of the other. What must be the angle between the characteristic directions of the sheets if the intensity of the transmitted light is one-third the intensity of the incident beam ? 2½

EITHER

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

(B) (i) State and prove Maxwell's first equation $\overrightarrow{\nabla \times H} = \overrightarrow{J} + \frac{\overrightarrow{\partial D}}{\partial T}$. 3

(ii) If the radius of sun is 7×10^8 meter and energy emission is 38×10^{28} Watt sec^{-1}, then calculate the poynting vector of propagation of energy on the surface of sun. 2

OR

(C) Show that EM waves are transverse in nature. 2½

(D) Derive the electromagnetic wave equation in free space. 2½

(E) State poynting vector and give its significance. State SI unit of poynting vector. 2½

(F) An electromagnetic wave is propagating in free space with amplitude of electric vector 5 V/m. Find the intensity of the wave. (Given characteristic impedance of free space is 1/377 Ω) 2½

5. Attempt any **ten** questions :

(i) Write any two conditions to get steady interference pattern.

(ii) What is the need of extended source of light ?

(iii) In Newton's rings experiment the diameter of 10^{th} ring changes from 1.40 cm to 1.27 cm when a drop of liquid is introduced between the lens and the glass plate. Calculate the refractive index of the liquid.

(iv) Define grating element.

(v) Why are lenses necessary to observe Fraunhofer diffraction pattern ?

(vi) Calculate the resolving power of a telescope if the limit of resolution is 27.08×10^{-7} radians.

(vii) What do you mean by E-ray ?

(viii) How will you define linearly polarized light ?

(ix) Calculate the velocity of ordinary ray in calcite in a plane perpendicular to the optic axis. (Give $\mu_0 = 1.658$ and $C = 3 \times 10^8$ m/sec)

(x) What is the significance of Maxwell's fourth equation, $\nabla.B = 0$?

(xi) Write any two characteristics of electromagnetic waves.

(xii) What is characteristic impedance ? 1×10=10