# NRJ/KW/17/3078 

## 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 diagram wherever necessary.

## EITHER

1. (A) Give the Experimental arrangement for formation of Newton's Ring. Derive an expression for radii of Newton's ring.5
(B) (i) Explain how radius of plane convex lens can be determine by Newton's rings. 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.

## OR

(C) With a neat diagram describe the construction of Michelson's Interferometer.
(D) Derive the conditions for brightness and darkness in case of interference in thin films due to transmitted light.
(E) A Soap film of R.I. $4 / 3$ and of thickness $1.5 \times 10^{-6} \mathrm{~m}$ is illuminated by white light incident at an angle of $60^{\circ}$. The light reflected by it is examined in which a dark band is found corresponding to wavelength $5000 \AA$, Calculate the order of interference in the dark band.
(F) Write in brief about Haidinger fringes.

## EITHER

2. (A) Give the construction of Fresnel's half period zone with neat diagram and also show that radii of Fresnel's half period zones are directly proportional to the square root of natural number.
(B) (i) State and 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 $5896 \AA$. Find the half angular width of central maxima.
OR
(C) What is plane diffraction grating ? Obtain an expression for resolving power of a grating.
(D) Give the construction of zone plate. $2^{1 / 2} 2$
(E) Derive an expression for width of central maxima for Fraunhoffer diffraction due to a single slit.
(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 a light of wavelength $5896 \AA$ ?

## EITHER

3. (A) Define uniaxial and biaxial crystals. Give the construction of Nicole Prism.
(B) (i) State and Prove Brewster's law. 3
(ii) If the refractive indices for the ordinary ray in case of Calcite and Canada balsom are 1.658 and 1.550 respectively. Calculate the value of critical angle for the ordinary ray for Calcite 8 to Canada bolsom.
OR
(C) What is quarter wave plate ? How it is used to produce circularly polarized light ?
(D) What is positive and negative crystal ? Explain.
(E) Give Huygen's Explanation of double refraction in Uniaxial crystal.
(F) Calculate the least thickness of a calcite plate which would convert plane polarized light into circularly polarized light
Given : $\mu_{\mathrm{o}}=1.792 ; \mu_{\mathrm{e}}=1.523$
wavelength of light $=5890 \mathrm{~A}^{\circ}$.

## EITHER

4. (A) State and prove Poynting theorem.
(B) (i) State and prove Maxwell's equation in differential form, $\nabla \times \mathrm{H}=\mathrm{J}+\delta \mathrm{D} / \delta \mathrm{t}$.
(ii) Calculate the value of Poynting vector on the surface of star if power radiated by it is $4 \times 10^{26}$ watt. It the average distance between star and earth is $2 \times 10^{11}$ meter.

## OR

(C) Show that EM waves are transverse in nature. $2^{\frac{1}{1} 2}$
(D) Derive electromagnetic wave equation in free space. $2 \frac{112}{2}$
(E) Define Poynting vector and give its S.I. unit. $2^{1 ⁄ 2} 2$
(F) Electromagnetic wave is propagating in free space with amplitude of electric vector $5 \mathrm{~V} / \mathrm{m}$. Find intensity of the wave (Given : Characteristic impedance of free space is $\frac{1}{377}$.) $\quad 2 \frac{1}{2}$
5. Attempt any ten questions :
(i) Write any two conditions to get steady interference pattern.
(ii) What is the need of extended source ?
(iii) In Newton's ring experiment the diameter of $20^{\text {th }}$ 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 glass plate.
(iv) Define grating element.
(v) Why convex lens is necessary to observe Fraunhoffer diffraction pattern?
(vi) A grating has grating constant $5 \times 10^{-5} \mathrm{~m}$. Find out the number of lines on grating if the width of grating is 0.02 m .
(vii) State any two differences between E-ray and O-ray.
(viii) Define linearly polarised light.
(ix) Calculate the velocity of ordinary ray in calcite in a plane perpendicular to the optic axis. (Given : $\mu_{0}=1.658$ and $\mathrm{C}=3 \times 10^{8} \mathrm{~m} / \mathrm{s}$ )
(x) State the physical meaning of Maxwell's equation, $\nabla . \mathrm{D}=\rho$, symbols have their usual meaning.
(xi) State any two characteristics of EM wave.
(xii) Define characteristics impedance and its unit.

