Name : .....

Roll No. : .....

Invigilator's Signature : .....

CS/B.OPTM/SEM-2/BO-201/2010

2010
PHYSICAL OPTICS — II

Time Allotted : 3 Hours *Full Marks :* 70

The figures in the margin indicate full marks.

Candidates are required to give their answers in their own words as far as practicable.

GROUP – A

(Multiple Choice Type Questions)

1. Choose the correct alternatives for the following : 10 × 1 = 10

   i) Laser is a device to produce

      a) a beam of white light

      b) coherent light

      c) microwaves

      d) *X*-rays.

   ii) Radii of Newton bright rings are

      a) proportional to the wavelength of light

      b) proportional to the square of the wavelength of light

      c) proportional to the square root of the wavelength of light

      d) inversely proportional to the wavelength of light.

iii) To demonstrate the phenomenon of interference, we require

a) two sources which emit radiation of the same frequency

b) two sources which emit radiation of nearly the same frequency

c) two sources which emit radiation of the same frequency and have a definite phase relationship

d) two sources which emit radiation of different wavelengths.

iv) In an S.H.M. during the motion

a) the kinetic energy is conserved

b) the potential energy is conserved

c) the total energy is conserved

d) none of these.

v) In Fraunhofer diffraction the incident wavefront is

a) plane b) spherical

c) circular d) cylindrical.

vi) Which one of the following waves cannot be polarized ?

a) *X*-rays b) Sound wave

c) UV rays d) Radio waves.

vii) Metastable state is a state where atom exists for

a) 10^{-3} sec b) 10^{-8} sec

c) 10^{-4} sec d) 10^{-5} sec.

viii) The planes of vibration and polarization are

a) orthogonal

b) parallel

c) non-existent

d) orthogonal and parallel.

ix) If grating constant is 0·000324 cm, then number of rulings of grating per cm is

a) 3085 b) 3090

c) 3080 d) 3086.

x) The wave theory of light was proposed by

a) Newton b) Planck

c) Huygens d) Brewster.

GROUP – B

(Short Answer Type Questions)

Answer any *three* of the following. $3 \times 5 = 15$

2. Write a note on anti-reflection coating.

3. Write a short note on zone plate.

4. Distinguish between Fresnel and Fraunhofer diffractions.

5. Distinguish between —

a) positive crystal and negative crystal

b) interference and diffraction. $2\frac{1}{2} + 2\frac{1}{2}$

GROUP – C

(Long Answer Type Questions)

Answer any *three* of the following. 3 × 15 = 45

6. a) What do you mean by laser ? What are the differences between laser light and normal light ? 1+ 3

   b) Explain the basic principle involved in laser action. 6

   c) Explain how ruby laser is produced. 5

7. a) What do you mean by interference ? Give the condition for the sustained interference. 3

   b) Briefly discuss Young's double slit experiment to find the interference expression & calculate the wavelength for which the constructive & destructive interferences occur. 8

   c) In Newton's ring experiment with a light containing two wavelengths λ_1 = 589 nm & λ_2 = 589·6 nm. Find the distance (from the point of contact of planoconvex lens with glass plate) at which the rings disappear. Take the radius of curvature of the curved surface as 1 m. 4

8. a) Explain the formation of coherent sources with the help of Fresnel biprism. 3

b) Derive the expression for the bright and dark fringe width found by the biprism. 6

c) The acute angle of biprism of refractive index 1·5 is 2°. A slit illuminated by a monochromatic light is placed 10 cm from the biprism. If the distance between the two dark fringes observed at a distance of 1 m from the biprism is 0·18 mm, find the wavelength of light used. 4

d) What is the difference between the fringes observed in Fresnal biprism experiment and Lloyd's single mirror experiment ? 2

9. a) Write down Huygens' principle of wavefront. 3

b) Prove the laws of refraction for a plane surface from Huygens' wave theory. 7

c) In Young's double slit experiment the slits are 0·589 nm apart and the interference is observed on a screen placed at a distance of 80 cm from the slit. It is found that the 10th bright ringe is at a distance of 9 mm from the dark fringe which is fourth from the fringe pattern. Find the wavelength of light used. 5

10. a) Explain the following terms : 2 + 2 + 3 + 2 + 3

i) Double refraction

ii) Optics axis

iii) Positive and negative crystals

iv) Principal section of crystal

v) *E* rays and *O* rays.

b) Calculate the thickness of a half wave plate of quartz for a light of wavelength 500 Å (the R.I.s for ordinary ray and extraordinary ray are 1·544 and 1·533 respectively). 3