

2017

PHYSICS

( Major )

Paper : 4.2

Full Marks : 60

Time : 3 hours

*The figures in the margin indicate full marks  
for the questions*

GROUP—A

( Wave Optics )

( Marks : 40 )

1. Answer the following questions : 1×4=4

(a) In Young's double-slit experiment, if one of the slits is closed, what happens to the interference pattern?

(b) Define specific rotation for an optically active solution.

- (c) A diffraction grating has 5000 lines per cm. What is its grating constant?
- (d) What is double refraction?
2. (a) Two identical coherent waves, each of intensity  $I$ , are producing an interference pattern. Find the value of the resultant intensity at a point of  
 (i) constructive interference and  
 (ii) destructive interference. 2
- (b) What is a quarter-wave plate? Give the use of a quarter-wave plate. 1+1=2
- (c) Distinguish between unpolarized light and linearly polarized light. 2
3. Answer any *two* questions of the following : 5×2=10
- (a) In a biprism arrangement, show that the distance between the virtual images of the source is  $d = 2a(\mu - 1)\alpha$ , where  $a$  is the distance of the source from the biprism,  $\alpha$  is the refracting angle of the prism and  $\mu$  is the refractive index of the prism material. 5

(b) Discuss the intensity distribution in the diffraction pattern due to a straight edge.

5

(c) What are plane of polarization and plane of vibration? How can circularly and elliptically polarized light be produced with the help of retarding plate?

1+1+3=5

4. (a) (i) Explain the formation of colours in thin films. Show that condition of bright and dark fringe for reflected light is just opposite to condition for transmitted light.

6

(ii) The diameter of the 10th dark fringe in Newton's ring experiment is 0.50 cm in the reflected system. Calculate the thickness of the air film at the position and also radius of curvature of the lens. ( $\lambda = 5900 \times 10^{-10}$  meter)

4

Or

- (b) (i) What is a zone plate? Deduce the relation

$$\frac{1}{u} + \frac{1}{v} = \frac{m\lambda}{r_m^r}$$

for a zone plate. Give one dissimilarity of a zone plate and convex lens. 1+3+1=5

- (ii) Explain the construction and working of Laurent half-shade polarimeter. 5

5. (a) (i) Discuss theoretically, the distribution of intensity in the diffraction pattern due to a single slit. 8

- (ii) What is the condition for missing order in double-slit diffraction pattern? 2

Or

- (b) (i) What do you understand by the term resolving power of a grating? Obtain an expression for the resolving power of a plane transmission grating in terms of grating constant and wavelength of light. 1+5=6

( 5 )

- (ii) The specific rotation of the quartz for  $\lambda = 508.6 \text{ nm}$  is  $29.73 \text{ deg/mm}$ . Calculate the difference between the refractive indices for left and right circularly polarized light for quartz.

4

GROUP—B

( Special Theory of Relativity )

( Marks : 20 )

6. Answer the following questions :  $1 \times 3 = 3$

(a) What do you understand by relativistic length contraction?

(b) Find the effective mass of a photon of energy  $E$ .

(c) Define proper time interval.

7. (a) Explain why a moving clock appears to go slow to a stationary observer. 2

(b) Use the transformation equation involving rest mass and moving mass to derive an expression for the total mass energy of a moving body. 5

8. (a) (i) Discuss the concept of space and time in special theory of relativity. Prove that the physical laws retain their validity under Lorentz transformation.  $2+3=5$

(ii) Write the expression of relativistic kinetic energy. Explain its limiting value mathematically.  $1+4=5$

Or

(b) (i) How many times will the half-life of an unstable particle increase if the particle moves with a velocity of  $0.99 c$ ? 3

( 7 )

- (ii) Describe the Michelson-Morley experiment and show how it supports Einstein's postulates of special relativity. 5+2=7

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