

(Set-R₁)

B.Tech - 2nd
Physics

Full Marks : 70

Time : 3 hours

Answer Q. No. 1 which is compulsory and
five questions from the rest

The figures in the right-hand margin indicate marks

1. Answer *all* questions : 2 × 10

(a) Why the fringes in the Newton's ring interference are circular and concentric ?

(b) A thin plate of mica ($RI = 1.58$) is used to cover one of the slit of a double-slit arrangement. The central point on the screen is occupied by what used to be the seventh bright fringe. If $\lambda = 5,500 \text{ \AA}$, what is the thickness of the mica ?

(Turn Over)

(2)

- (c) A plane grating has 15000 lines/inch. Find the angle of separation of the 5048 Å and 5016 Å lines of helium in the second order spectrum.
- (d) Distinguish (in brief) between circular and elliptically polarized light.
- (e) Define Divergence and curl of a vector field. Express it in Cartesian-coordinates.
- (f) Write the differential form of the following operators (i) momentum (ii) energy (iii) Position (iv) Hamiltonian.
- (g) Write the general form of an eigenvalue equation. Show that $\sin 2x$ is an eigen function of the operator $\frac{d^2}{dx^2}$. What is the eigenvalue?
- (h) What are the characteristics of Laser? How laser beam is different from all other conventional light sources?

(3)

- (i) What do you mean by numerical aperture and acceptance angle of an optical fibre?
- (j) Explain quantum confinement (quantum dot and quantum wire) in nanomaterials.
2. (a) Distinguish between coherent and incoherent superposition. 3
- (b) Write the condition for the maxima and minima in the interference due to reflected and transmitted waves in the interference due to division of amplitude. 4
- (c) In the Newton's ring experiment, the diameter of 10th dark ring due to wavelength 6000 Å in air is 0.5 cm. Find the radius of curvature of the ring. 3
3. (a) Distinguish between Fresnel's and Fraunhofer diffraction. 3
- (b) A narrow slit, illuminated by monochromatic light produces Fraunhofer diffraction. Graphically show the intensity distribution

(4)

pattern. Write the expression for intensity distribution. 4

(c) What is resolving power? When you say that the two lines of wavelengths λ and $\lambda + d\lambda$ are just resolved? 3

4. (a) State and explain Malu's law. 3

(b) Explain the construction of Nicol's prism. How it is used as a polarizer and analyzer. 4

(c) State Brewster's law. The refractive index of the material of lead glass plate is 1.96. Find the Brewster's angle for which the reflected light will be plane polarized. 3

5. (a) Write mathematical form of 3

(i) Gauss divergence theorem

(ii) Stokes theorem

(iii) Green's theorem. 3

(b) Derive Maxwell's theorem in differential form. 4

(5)

(c) Explain in brief 3

(i) Pyonting theorem

(ii) Waveguides.

6. (a) The inadequacy of classical mechanics led to the development of quantum mechanics. Justify this statement briefly with reference to any one experiment. 3

(b) Establish the time-dependent Schrödinger equation in one dimension for a particle of mass m moving in a constant potential V . 4

(c) Draw the levelled neat sketch of (i) particle in a box (ii) potential step (no description and mathematical derivation). 3

7. (a) Write Einstein's coefficients of different emissions in laser (no derivation). 3

(b) Draw the neat sketch of Ruby laser and explain its principle and working. Mention any two industrial applications of laser. 4

(6)

(c) With neat sketch show three and four level pumping (no description). 3

8. (a) Distinguish between step index fiber and graded index fiber. 3

(b) Discuss the principle of fiber optic communication using ray approach. 4

(c) Discuss nanomaterials with reference to (i) size dependent property (ii) surface to volume ration. 3
