

3002

(Graph Paper)

B.Tech. (EE) 2nd Semester (G-Scheme)

Examination, May-2023

WAVES AND OPTICS & QUANTUM MECHANICS

Paper - BSC-PHY-102-G

Time allowed : 3 hours]

[Maximum marks : 75

Note : Attempt five questions in all. Attempt one question from each Section. All questions carry equal marks.

1. (a) What are evanescent waves? 1.5
- (b) State and explain the phenomenon of Total Internal Reflection. 1.5
- (c) Define resolving power of grating. 1.5
- (d) Discuss the phenomena of population inversion. 1.5
- (e) What is Poynting vector for an electromagnetic wave? What does it represent? 1.5
- (f) State Heisenberg Uncertainty principle. 1.5
- (g) Distinguish between stimulated emission and spontaneous emission. 1.5
- (h) What is impedance matching? Why it is needed? 1.5

3002-P-3-Q-9(23)

[P.T.O.]



(2)

3002

- (i) Define Brewster angle and Brewster's Law. 1.5
(j) What are coherent sources? How coherent sources can be obtained? 1.5

Section-I

2. Deduce expression for the velocity of transverse wave along stretched string. 15
3. Derive laws of reflection and reflection when an electromagnetic wave is incident obliquely on a boundary separating two different media. 15

Section-II

4. (a) What are Newton's Rings? Discuss formation of Newton's ring in reflected light. How it can be used to determine refractive index of a liquid? 12
(b) In Newton's Rings experiment diameter of 5th and 25th dark rings are 0.3 cm and 0.8 cm respectively. Find wavelength of light, $R=100$ cm. 3
5. (a) What are three level and four level lasers? Give construction and working of Ruby laser with necessary diagrams. 12
(b) Discuss necessary conditions for lasing action. 3

3002

(3)

3002

Section-III

6. (a) Derive expression for Schrodinger time independent wave equation in three dimensions. 10
(b) An electron is within a nucleus of radius 10^{-15} m. Using Uncertainty principle, the kinetic energy of electron in eV. 5
7. Solve Schrodinger equation for one-dimensional motion of particle in a box of side L and show that its Eigen values are inversely proportional to square of side L . 15

Section-IV

8. (a) Derive expression for Density of States (DOS) for 3-D bulk system. 10
(b) How does 3-D density of states differ from 2-D and 1-D density of states? Explain graphically. 5
9. (a) What do you mean by effective mass of an electron in an energy band? How do you account for negative mass of electron in an energy band? 10
(b) Explain why Fermi level of an *intrinsic* semiconductor lies near the middle of forbidden gap, whereas it is closer to conduction band in n-type semi conductors. 5

3002

[Encl. Graph Paper]

