7. Define a one-dimensional potential box. Using Schrodinger's equation, calculate the energy eigenvalue and the normalized wave functions for a particle in a box. Explain zero-point energy for the particle in a one-dimensional box. 15

SECTION – IV

8. Discuss the origin of energy bands in solids on the basis of Kronig Penney model. 15

9. Writes a short note on the following : $3 \times 5 = 15$

   (a) Carrier generation and recombination

   (b) Carrier transport : diffusion and drift

   (c) Fermi level

Roll No. .....

3002

B. Tech. 1st Semester (EE) Examination – December, 2022

WAVES AND OPTICS & QUANTUM MECHANICS

Paper : BSC-PHY-102-G

Time : Three hours] *[Maximum Marks : 75*

Before answering the questions, candidates should ensure that they have been supplied the correct and complete question paper. No complaint in this regard, will be entertained after examination.

Note : Attempt ***five*** questions in all, selecting ***one*** from each Section. Question No. **1** ***compulsory***. All questions carry equal marks.

1. (a) How the evanescent wave is generated ? Explain with a suitable diagram.

   (b) What is the highest order spectrum which may be seen with monochromatic light of wavelength 6000 A° by means of a diffraction grating with 5000 lines/cm ?

(c) Define transverse and longitudinal waves. Give *two* examples for each type of wave.

(d) What is Max Born interpretation of the wave function ?

(e) Distinguish between insulators, metals and semiconductors on the basis of energy level diagram. $5 \times 3 = 15$

SECTION – I

2. (a) What is a driven harmonic oscillator ? Discuss the steady-state of a driven harmonic oscillator subjected to an external periodic force $F = F_0 \cos \omega t$. Also, explain the dependence of the amplitude as a function of the driving frequency. 13

(b) What is the impedance matching ? Why it is needed ? 2

3. (a) Derive the wave equation for the transverse vibrations of a stretched string and show that speed of the transverse wave is given by $v = \sqrt{T/\rho}$. 10

(b) Explain the terms : 5

(i) Brewster angle

(ii) Total internal reflection

SECTION – II

4. (a) Distinguish between interference by division of amplitude and division of wavefront.

(b) Explain Rayleigh's criterion for the limit of resolution.

(c) Derive the expression for resolving power of grating.

(d) Explain the terms with appropriate diagrams : Spontaneous emission and Stimulated emission.

(e) Explain the terms : Population inversion and pumping in lasers. $5 \times 3 = 15$

5. (a) Describe the construction, theory and working of Newton's ring experiment. Derive the expression for the diameter of the n^{th} dark ring by reflected light. How this experiment is used to determine the wavelength of light ? 12

(b) Explain the concept of directionality and monochromaticity as applied to the lasers. 3

SECTION – III

6. (a) Derive time-dependent Schrodinger wave equation in three dimensions. 12

(b) Calculate the uncertainty in the measurement of momentum of an electron if the uncertainty in locating it is 1 A°. 3