PART - A

Answer all questions. Each question carries 2 marks.

1. Distinguish between free and forced vibrations.

2. Explain the term “wave motion”. Distinguish between transverse and longitudinal wave motions.

3. Define crystal lattice and crystal structure.

4. Explain inertial and non inertial frames of reference.

5. Distinguish between Fresnel and Fraunhofer class of diffractions.

6. Explain the phenomenon of double refraction.

7. Explain important properties of ultrasonic waves.

8. Explain what is meant by “expectation value”.

9. Explain the concept of “phase space”.

10. Explain the mechanism of light emission in a laser source.
PART - B

Answer **one full** question from **each** Module. **Each** question carries **20** marks.

**MODULE - I**

11. a) Derive an expression for velocity and acceleration of a particle executing SHM.  
    b) Explain the characteristics of a wave motion. Obtain the 3 dimensional differential equation for a wave motion.  
    c) A particle executes SHM of period 10 seconds and amplitude 1.5 metre. Calculate its maximum acceleration and velocity.

12. a) State and explain ‘poynting’ theorem for the flow of energy in e.m. wave.  
    b) Prove that the velocity of plane e.m. wave in vacuum is given by \( \sqrt{\frac{\mu_0 \varepsilon_0}{2}} \).  
    c) State Maxwell’s equations in differential form.

**MODULE - II**

13. a) What is co-ordination number ? Calculate the co-ordination number for simple cubic, b.c.c. and f.c.c. lattices.  
    b) A particle is moving with a speed of 0.5C. Calculate the ratio of the rest mass and the mass while in motion.  
    c) Explain Type I and Type II super conductors with suitable examples and then applications.

14. a) Define ‘packing factor’. Calculate the packing factor in the case of simple cubic, b.c.c. and f.c.c.  
    b) Explain the time dilation and realistic variation of mass of an object.  
    c) Describe qualitatively the B.C.S. theory of super conductivity. Explain some potential applications of superconductivity.
MODULE – III

15. a) Give the theory of formation of fringes in wedge shaped air film. How this can be used to find the wave length of light?  
   b) Explain the construction and working of a Nicol Prism.  
   c) Explain the Fraunhofer diffraction at a single slit.  

16. a) Account for the colours observed when a little oil spreads over water. Give the theory of the formation of these colours.  
   b) A parallel beam of monochromatic light is allowed to be incident on a grating having 5000 lines/cm and the second order spectral line is found to be diffracted through 30°, calculate the wavelength of the light used.  
   c) Discuss with necessary theory, how can Elliptically polarized and circularly polarized light be produced and detected.

MODULE – IV

17. a) Deduce the Time Independent Schrodinger equation from Time Dependent Schrodinger equation.  
   b) What is a photon gas? Derive the Planck's distribution law.  
   c) Explain population inversion and how it is achieved.

18. a) Obtain the expressions for wave functions and energy for a free particle confined in an one dimensional box.  
   b) Compare the postulates of M-B, B-E and F-D statistics.  
   c) With necessary diagram, explain the construction and working of He-Ne laser. List potential applications of laser.