Assignment Questions

Module -1
Modern Physics and Quantum physics

1. Explain the energy distribution in the spectrum of a black body. Give an account of the attempts made through various laws to explain the spectrum.
2. Explain Wien's law and Rayleigh-Jeans law and Mention their drawbacks.
3. What are the basic assumptions of quantum theory of radiation? Explain how Planck's overcome the drawback of Wein's law and Ray-Jeans law
4. State and explain Planck's law of radiation. Show that it reduces to Wien's law and Rayleigh-Jeans law under certain conditions?
5. Give a qualitative account of Compton effect
6. State de-Broglie hypothesis. Show that the de Broglie wavelength for an electron accelerated by potential difference V volts is $\lambda = \frac{1.226}{\sqrt{V}}$ nm for non-relativistic case.
7. Explain the characteristics of matter wave.
8. Discuss Phase velocity and Group velocity? Obtain the expressions for both.
9. Explain group velocity and phase velocity. Derive the relation between them.
10. Derive expressions for group velocity on the basis of superposition of waves.
11. Show that the group velocity of de Broglie waves is equal to the velocity of the particle with which the waves are associated.
12. State and explain the Heisenberg uncertainty principle. Using this principle, show that the electrons cannot reside in an atomic nucleus.
13. Derive time-independent Schrödinger wave equation. What is the physical significance of state function 'ψ' used in this equation?
13. What is a wave function? Explain the properties of wave function?
14. Write down the Schrödinger equation for a particle in one-dimensional box. Obtain the eigen functions and eigen values for this particle.
15. Discuss the wave functions, probability densities and energy levels for a particle in a box.
16. Describe zero-point energy.

Module– 2
Electrical properties of materials

1. Define drift velocity, mean collision time, mean free path and relaxation time.

2.Explain the three failures of classical free electron theory.

3. What are the assumptions made in quantum free electron theory? Explain success of this theory.

4. Explain density of states?

5. What is Fermi- Dirac statistics? Explain.
6. Define Fermi energy, Fermi factor and Fermi level. Describe the variation of Fermi factor with energy and temperatures.
7. Explain the laws of mass action and derive the conductivity expression of a semiconductor.
8. Explain Fermi level in an intrinsic semiconductor.

9. What is Hall effect? Derive an expression for the Hall coefficient in an n-type the material semiconductor. Discuss what information can be obtained from Hall measurement regarding the material parameter.

10. Discuss BCS theory of superconductors.

11. Distinguish between type-I and type-II superconductors.

12.Write a brief note on high temperature superconductivity.

13. Explain the Meissner effect and Write a short note on Maglev vehicle.

Module-3

Laser and Optical Fibres

1. Mention the Characteristics of laser beam. Derive the expression for energy density of radiation using Einstein's coefficients. Compare the expression with Planck's equation?
2. Explain the requisites and conditions of a laser system.
3. Explain the construction and working of CO_2 laser with the help of energy level diagram.
4. What are semiconductor diode lasers? Describe the construction and working of Semiconductor laser with the help of energy band diagram. Mention the uses and advantages of diode lasers?
5. Describe the recording and reconstruction processes in Holography with the help of suitable diagrams. Mention the applications of holography.
6. Describe briefly the application of lasers in welding, cutting, drilling.
7. Describe the principle and working of LIDAR used to measure pollutant in atmosphere .

8. What is meant by acceptance angle for an optical fiber? Show how it is related to

numerical aperture.
9. Obtain an expression for numerical aperture and arrive the condition for propagation

10. Discuss types of optical fibers and modes of propagation using suitable diagram.

11. What is attenuation? Discuss the contributing factors for the same.

14. Describe the point to point communication system, with the help of a block diagram?

Module- 4
Crystal Structure

1. Define lattice points, Bravais lattice, unit cell and primitive cell.
2. Explain briefly the seven crystal systems with neat diagrams.
3. What are miller indices? Explain how axial intercepts in a crystal plane are converted into miller indices.
4. Define planes and directions of crystals and mark the $(\bar{1}02)$ & $(1\bar{1}\bar{2})$ planes in the cubic unit cell.
5. Derive an expression for inter planar spacing of a crystal in terms of Miller indices.
6. Define coordination number and atomic packing fraction. Calculate packing fraction for SC, BCC and FCC structures.
7. Determine the coordination number, number of lattice points per unit cell.
8. Sketch and explain the structure of diamond crystal.
9. Define allotropy and discuss allotropy of carbon with reference to diamond & graphite.
10. Define polymorphism and discuss it by taking the example of iron.
11. Discuss about the structure of Perovskite qualitatively.
12. Describe with suitable diagrams, how a liquid crystal display works.
13. List the differences between LED and LCD devices.
14. Derive Bragg's law.
15. Describe how Bragg's spectrometer is used for determination of crystal structure.

Module-5
Shock Waves and Science of Nano materials

1. Define Mach number and distinguish ultrasonic, subsonic and supersonic waves.

2. Distinguish between subsonic and supersonic flights of a body with the help of a diagram.

3. Explain sonic boom and a shock wave.

4. Explain the construction and working of Reddy tube with the help of a diagram.

5. Write a brief note on Rankine-Hugoniot equations.

6. State different methods of creating shock waves in the laboratory using shock tubes.

7. Discuss the applications of shock waves.

8. Explain the experiment to find M, p_2, T_2, P_5 & T_5 using Reddy tube.

9. What is mesoscopic state? Explain the special features of matter in mesoscopic state.

10. Discuss the density of the states for various quantum structures.

11. Expain construction and working of ball milling method.

12. Write a note on Sol –gel method.

13. Describe Arc discharge method of obtaining carbon nano tubes with the help of diagram.

14. Write a note on Pyrolysis method of obtaining carbon nanotubes.
15. Write a note on carbon nanotubes.
16. Write the structures and applications of carbon nanotubes.
17. Describe the principle, construction and working of Scanning electron microscope.