Question Bank

Unit-I **Bonding in solids**
Crystal Structure and Crystallography

1. Explain with suitable examples the ionic, covalent, metallic and molecular type of bonding in solids.

2. Explain the forces between the two interacting atoms when they are brought nearer to form a molecule.

3. What is cohesive energy. Assuming a suitable model for interatomic forces derive an expression for the cohesive energy.

4. Derive an expression for the cohesive energy of an ionic crystal.

5. Illustrate graphically the variation of (i) interatomic forces (ii) potential energy with the spacing between two atoms.

6. Explain the terms (i) basis (ii) space lattice (iii) unit cell

7. Describe the seven crystal systems with diagrams.

8. Show that FCC is the most closely packed of the three cubic structures by working out the packing factors.

9. Illustrate Bravais Lattices.

10. What are Miller indices. How are they obtained.

11. Deduce the expression for the inter-planar distance in terms of Miller indices for a cubic structure.

12. Sketch the following planes of a cubic unit cell: (001),(120) and (211).

13. Find the packing factors for diamond and HCP.

14. Describe the structures of NaCl,CsCl and ZnS.

Unit-II **X-Ray Diffraction**
Defects in crystals

1. (a). Why X-ray are used for crystal diffraction studies.
   (b). State and Prove Bragg's law.

2. Describe Laue's method of determination of crystal structure.

3. Describe with suitable diagram, the powder method of determination of crystal structure.

4. What are the applications of X-ray diffraction studies.

5. What are the three experimental methods of X-ray diffraction.

6. Briefy explain the Defects in crystals.

7. (a). Write notes on edge dislocation and screw dislocation.
   (b). Explain the significance of Burgers vector.

8. Write notes on surface imperfections.

9. Explain different types of volume defects.

10. What are grain boundaries. What are different types of grain boundaries.

11. Discuss Schottky Defects. Calculate the concentration for schotty defects.

12. Write a note on point defects.

Unit-III **Elements of Statistical Mechanics**
Principal of Quantum Mechanics

1. Briefly give an comparative study of three types of statistics.

2. Derive an expression for Maxwell-boltzmann energy distribution function.

3. Derive an expression for Bose-Einstein distribution function.

4. Derive an expression for Fermi-Dirac distribution function.

5. Explain Rayleigh-Jean's law of radiation. Derive the expression for radian energy of a blackbody on the basis of Rayleigh-Jeans.

6. What is Photon gas. What are its characteristics.

7. Write short nots on Fermi energy of metal and Wien's displacement law.

8. What is an electron gas.

9. Discuss the executed feature of Plank's theory of black body radiation.

10. What are matter waves. Explain their properties.

11. Derive time independent Schrodinger's wave equation for a free particle.

12. Explain de-Broglie hypothesis. Explain G.P. Thomson's experiment in support of this hypothesis.

13. Describe Davisson and Germer's experiment and explain how it enabled the verification of wave nature of matter.

14. Assuming the time independent Schrodinger's wave equation. Discuss the solution for a particle in a one-dimensional potential well of infinite height.

15. Explain the physical significance of wavefunction.

Unit-IV **Band Theory of Solids**

1. Explain the origin of energy bands in solids.

2. Discuss the Kronig penny model for the motion of an electron in a periodic potential.

3. Explain the concept of effective mass of an electron.

4. Explain the classification of metals, semiconductors and insulators based on band theory.

5. Explain the following:
   (a). Drift velocity, Mobility and Relaxation time.
   (b). Effective mass (c). Bloch theorem.

6. Explain the effective mass of Hole.

7. Explain about Brillouin Zone.

8. Explain about Bloch theorem.

Unit-V **Semiconductor Physics**
Physics of Semiconductor Devices

1. Distinguish between intrinsic and extrinsic impurity semiconductors with suitable examples.

2. Derive an expression for the carrier concentration of an intrinsic semiconductor.

3. Distinguish between metals, Semiconductors and Insulators.

4. Describe the drift and diffusion currents in a semiconductor and Deduce Einstein relation.

5. Explain Hall effect and its importance.

6. Sketch the energy band diagrams of (a). an intrinsic (b). N-type (c). P-type semiconductors. Indicate Fermi, Donar and acceptor levels wherever present.

7. What is equation of continuity for semiconductors. What physical law leads to the equation of continuity.

8. Explain how a PN junction is formed. Draw I-V characteristic curve of a PN junction diode and explain.

9. With theory explain the working of a PN junction diode and derive diode equation.

10. Explain the rectifying action of a PN diode. Explain the construction and working of a wave rectifier.

11. Explain the construction and working of LED. What are the advantages and disadvantages of LEDs in electronic display.

12. Explian the characteristics of liquid crystal materials. How are they used in the construction of liquid crystal display devices.

13. Explain the construction of a Junction photodiode. Discuss the factors which limits the speed of response of photodiode.

Unit-VI **Dielectric Properties**
Magnetic Properties

1. Explain the following:
   (a). Dielectric constant (b). Electirc susceptibility
   (c). Electric polarization (d). Polarizability

2. Explain Electric polarization, polarization vector and Electirc displacement.

3. Explain Clausius-Mosotti relation in dielectrics subjected to static fields.

4. Explain the electronic polarizability in atoms and obtain an expression for electronic polarizability in terms of the radius of the atom.

5. Explain ionic polarizability of a molecule and its frequency dependence. And define piezoelectric effect.

6. What is orientation polarization. Derive an expression for the mean dipole moment when a polar material is subjected to an external field.

7. Write notes on Piezoelectricity.

8. Explain clearly the phenomenon of ferro electricity.

9. What is pyroelectircity. Give some examples.

10. Define the terms Permeability, Susceptibility, Magnetic induction, Magnetic field and magnetization with reference to magnetism.

11. Define magnetic moment. Explain the origin of magnetic moment at the atomic level. What is a Bohr magneton.

12. Explain the classification of magnetic materials.

13. Explain the hysterisis loop observed in Ferromagnetic material. What are hysterisis losses.

14. Explain clearly difference between hard and soft magnetic material.
15. Show the nature of magnetic dipole moments in ferro-ferri and Antiferro magnetic material.

16. What is superconductivity. Explain effect of temperature and strength of magnetic field on a superconducting material.

17. Write a notes on Meissner effect relating to superconductivity.
18. Write applications of superconductivity.

UNIT -7 LASERS –FIBRE OPTICS

1. a) Explain the characteristics of a laser beam.
   b) Mention any two applications of laser each in the field of scientific research. engineering and medicine.
   c) Describe the construction and working of a Ruby laser.
2. a) What do you understand by population inversion? How it is achieved?
   b) Derive the relation between the probabilities of spontaneous emission and stimulated emission in terms of Einstein's coefficient.
3. a) Explain the purpose of an active medium in a gas laser.
   b) With the help of suitable diagrams, explain the principle, construction and working of a helium-neon laser.
4. Distinguish between spontaneous and stimulated emission process of light.
5. Explain the terms
   a) Absorption
   b) Spontaneous emission
   c) Stimulated emission
   d) pumping mechanism
   e) Population inversion
   f) Optical cavity
6. Describe a semiconductor laser. Give the applications of lasers.
7. Give the energy level diagram of co2 Laser and explain the working of co2 laser.
8. a) Explain the principle of an optical fiber.
   b) Explain how the optical fibers are classified.
9. Define numerical aperture and acceptance angle. Derive a relation between the two.
10. Describe different types of fibers by giving the refractive index and propagation details.
11. Draw the block diagram of fiber optic communication system and explain the function of each block.
12. What are the losses in optical fibers? Write brief note on each.

Unit-VIII **Nanotecchnology**
Acoustics of Buildings and Acoustic Quieting

1. Define Reverberation, reverberation time and Absorption coefficient of a material.
2. Derive Sabine's formula for reverberation time.
3. What are the basic requirements of acoustically good hall.
4. Explain the various factors affecting architectural acoustics and their remedies.
5. Write a short notes on Optimum reverberation and Acoustic noise.
6. What do you mean by 'acousting quieting'.
7. What is sound proofing.
8. What are nanomaterials. Why do they exhibit different properties.
9. What are Carbon Nanotubes. How are they produced.
10. What are the different types of carbon nanotubes. What are their properties.
11. What is the principle and advantages of TEM. And explain the transmission electron microscopy.
12. What is Nanotechnology. How is it useful to society and discuss the properties of Nanomaterials.
13. List a few methods of synthesis of Nanomaterials and mention the applications of Nanomaterials.