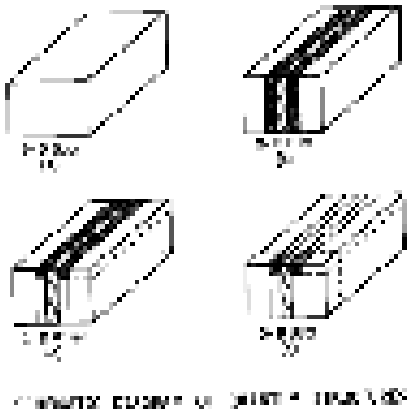
# 15. NANOTECHNOLOGY

## Introduction

In 1959, Richard Feynman made a statement 'there is plenty of room at the bottom'. Based on his study he manipulated smaller units of matter. He prophesied that "we can arrange the atoms the way we want, the very atoms, all the way down". The term 'nanotechnology' was coined by Norio Taniguchi at the University of Tokyo. Nano means $10^{-9.}$ A nano metre is one thousand millionth of a metre (i.e. $10^{-9}$ m).
Nanomaterials could be defined as those materials which have structured components with size less than 100nm at least in one dimension. Any bulk material we take, its size can express in 3-dimensions. Any planer material, its area can be expressed in 2-dimension. Any linear material, its length can be expressed in 1-dimension.



Materials that are nano scale in 1-dimension or layers, such as thin films or surface coatings.
Materials that are nano scale in 2-dimensions include nanowires and nanotubes.
Materials that are nano scale in 3- dimensions are particles like precipitates, colloids and quantum dots.

**Nanoscience:** it can be defined as the study of phenomena and manipulation of materials at atomic, molecular and macromolecular scales, where properties differ significantly from those at a larger scale.

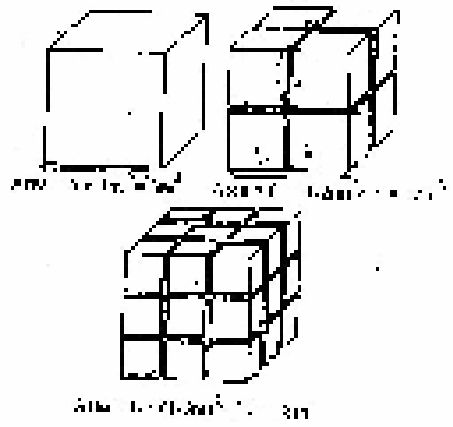
**Nanotechnology:** It can be defined as the design, characterization, production and application of structures, devices and systems by controlling shape and size at the nano metre scale. It is also defined as "A branch of engineering that deals with the design and manufacture of extremely small electronic circuits and mechanical devices built at molecular level of matter. Now nanotechnology crosses and unites academic fields such as Physics, Chemistry and Computer science.

### Properties of nano particles:

The properties of nano scale materials are very much different from those at a larger scale. Two principal factors that cause that the properties to differ significantly are increased relative surface area and quantum effects. These can enhance or change properties such as reactivity, strength and electrical characteristics.

## 1. Increase in surface area to volume ratio

Nano materials have relatively larger surface area when compared to the volume of the bulk material.



Consider a sphere of radius r
Its surface area $=4\Pi r^2$
Its volume $= 4\Pi r^3/3$

$$\frac{\text{Surface area}}{\text{Volume}} = \frac{4\Pi r^2}{4\Pi r^3/3} = \frac{3}{r}$$

Thus when the radius of sphere decreases, its surface area to volume ratio increases.

EX: For a cubic volume,

Surface area $= 6x1m^2 = 6m^2$

When it is divided it 8 pieces
It surface area $= 6x\ (1/2m)^{2x8} = 12m^2$
When the sane volume id divided into 27 pieces,

It surface area $= 6x\ (1/3m)^{2x27} = 18m^2$
Therefore, when the given volume is divided into smaller pieces, the surface area increases. Hence as particle size decreases, greater proportions of atoms are found at the surface compared to those inside. Thus nano particles have much greater surface to volume ratio. It makes material more chemically reactive.

As growth and catalytic chemical reaction occur at surfaces, then given mass of material in nano particulate form will be much more reactive than the same mass of bulk material. This affects there strength or electrical properties.

## 2. Quantum confinement effects

When atoms are isolated, energy levels are discrete or discontinuous. When very large number of atoms is closely packed to form a solid, the energy levels split and form bands. Nan materials represent intermediate stage.

When dimensions of potential well and potential box are of the order of deBroglie wave length of electrons or mean free path of electrons, then energy levels of electrons changes. This effect is called Quantum confinement effect.

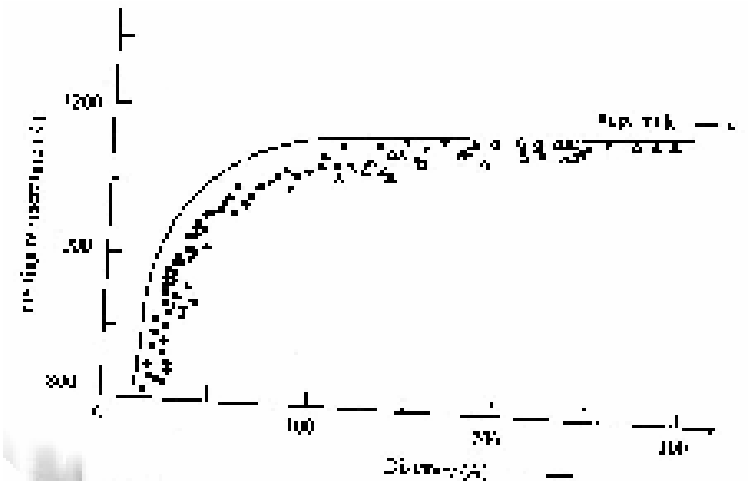
When the material is in sufficiently small size, organization of energy levels into which electrons can climb of or fall changes. Specifically, the phenomenon results from electrons and holes being squeezed into a dimension that approaches a critical quantum measurement called the exciton Bohr radius. These can affect the optical, electrical and magnetic behaviour of materials.

## Variations of properties of nano materials

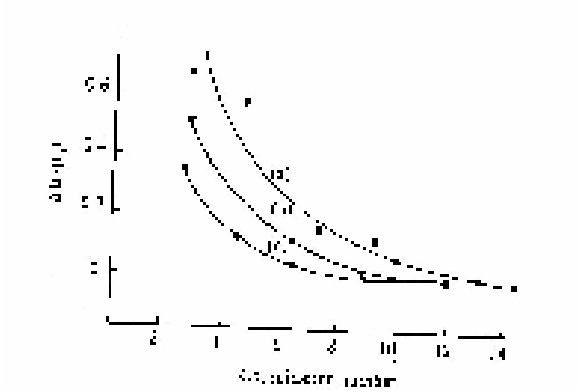
The physical, electronic, magnetic and chemical properties of materials depend on size. Small particles behave differently from those of individual atoms or bulk.

***Physical properties:*** The effect of reducing the bulk into particle size is to create more surface sites i.e. to increase the surface to volume ratio. This changes the surface pressure and results in a change in the inter particle spacing. Thus the inter atomic spacing decreases with size.

The change in the inter particle spacing and the large surface to volume ratio in particle have a combined effect on material properties. Variation in the surface free energy changes the chemical potential. This affects the thermodynamic properties like melting point. The melting point decreases with size and at very small sizes the decrease is faster.



***Chemical properties:*** the large surface to volume ratio, the variations in geometry and electronic structure has a strong effect on catalytic properties. The reactivity of small clusters increases rapidly even when the magnitude of the cluster size is changed only by a few atoms.



Another important application is hydrogen storage in metals. Most metals do not absorb, hydrogen is typically absorbed dissociatively on surfaces with hydrogen- to- metal atom ratio of one. This limit is significantly enhanced in small sizes. The small positively charged clusters of Ni, Pd and Pt and containing between 2 and 60 atoms decreases with increasing cluster size. This shows that small particles may be very useful in hydrogen storage devices in metals.

***Electrical properties*:** The ionization potential at small sizes is higher than that for the bulk and show marked fluctuations as function of size. Due to quantum confinement the electronic bands in metals become narrower. The delocalized electronic states are transformed to more localized molecular bands and these bands can be altered by the passage of current through these materials or by the application of an electric field.

In nano ceramics and magnetic nano composites the electrical conductivity increases with reduction in particle size where as in metals, electrical conductivity decreases.

***Optical properties:*** Depending on the particle size, different colours are same. Gold nano spheres of 100nm appear orange in colour while 50nm nano spheres appear green in colour. If semiconductor particles are made small enough, quantum effects come into play, which limits the energies at which electrons and holes can exist in the particles. As energy is related to wavelength or colour, the optical properties of the particles can be finely tuned depending on its size. Thus particles can be made to emit or absorb specific wavelength of light, merely by controlling their size.

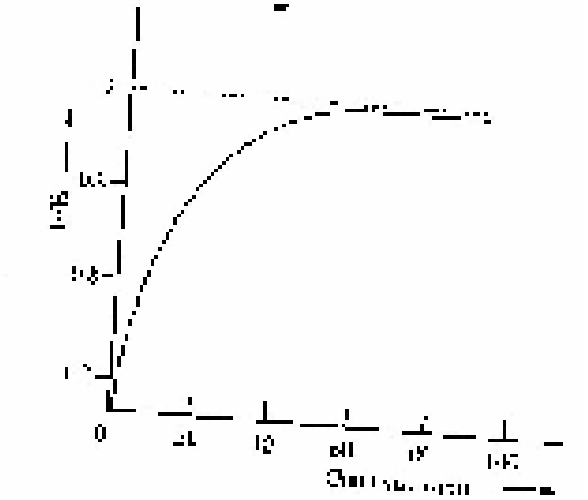
An electro chromic device consist of materials in which an optical absorption band can be introduced or existing band can be altered by the passage of current through the materials, or by the application of an electric field. They are similar to liquid crystal displays (LCD) commonly used in calculator and watches. The resolution, brightness and contrast of these devices depend on tungstic acid gel's grain size.

***Magnetic properties:*** The strength of a magnet is measured in terms of coercivity and saturation magnetization values. These values increase with a decrease in the grain size and an increase in the specific surface area (surface area per unit volume) of the grains.

In small particle a large number or fraction of the atoms reside at the surface. These atoms have lower coordination number than the interior atoms. As the coordination number decreases, the moment increases towards the atomic value there is small particles are more magnetic than the bulk material.

Nano particle of even non magnetic solids are found to be magnetic. It has been found theoretically and experimentally that the magnetism special to small sizes and disappears in clusters. At small sizes, the clusters become spontaneously magnetic.

***Mechanical properties:*** If the grains are nano scale in size, the interface area with in the material greatly increases, which enhances its strength. Because of the nano size many mechanical properties like hardness, elastic modulus, fracture toughness, scratch resistance, fatigue strength are modified.



The presence of extrinsic defects such as pores and cracks may be responsible for low values of E (young's modulus) in nano crystalline materials. The intrinsic elastic modulli of nano structured materials are essentially the same as those for conventional grain size material until the grain size becomes very small. At lower grain size, the no. of atoms associated with the grain boundaries and triple junctions become very large. The hardness, strength and deformation behaviour of nano crystalline materials is unique and not yet well understood.

Super plasticity is the capability of some polycrystalline materials to exhibit very large texture deformations without fracture. Super plasticity has been observed occurs at somewhat low temperatures and at higher strain rates in nano crystalline material.

*PRODUCTION OF NANOMATETIALS*:

Material can be produced that are nanoscale in one dimension like thin surface coatings in two dimensions like nanowires and nanotubes or in 3 dimensions like nanoparticles

Nano materials can be synthesized by' top down' techniques producing very small structures from larger pieces of material. One way is to mechanical crushing of solid into fine nano powder by ball milling.

Nanomaterials may also be synthesized by 'bottom up' techniques, atom by atom or molecule by molecule. One way of doing this is to allow the atoms or molecules arranges themselves into a structure due to their natural properties

Ex: - Crystals growth

## PERPARATION:

There are many methods to produce nanomaterials. They are

***1). PLASMA ARCING:***

Plasma is an ionized gas. To produce plasma, potential difference is applied across two electrodes. The gas yields up its electrons and gets ionized .Ionized gas (plasma) conducts electricity. A plasma arcing device consists of two electrodes. An arc passes from one electrode to the other. From the anode electrode due to the potential difference electrons are emitted. Positively charged ions pass to the other electrode (cathode), pick up the electron and are deposited to form nanoparticles. As a surface deposit the depth of the coating must be only a few atoms. Each particle must be nanosized and independent. The interaction among them must be by hydrogen bonding or Vander Waals forces. Plasma arcing is used to produced carbon nanotubes.

***2). CHEMICAL VAPOUR DEPOSITION:***

In this method, nanoparticles are deposited from the gas phase. Material is heated to from a gas and then allowed to deposit on solid surface, usually under vacuum condition. The deposition may be either physical or chemical. In deposition by chemical reaction new product is formed. Nanopowder or oxides and carbides of metals can be formed, if vapours of carbon or oxygen are present with the metal.

Production of pure metal powders is also possible using this method. The metal is meted exciting with microwave frequency and vapourised to produce plasma at $1500^0$c . This plasma then enters the reaction column cooled by water where nanosized particles are formed.

CVD can also be used to grow surfaces. If the object to be coated is introduced inside the chemical vapour, the atoms/molecules coated may react with the substrate atoms/molecules. The way the atoms /molecules grow on the surface of the substrate depends on the alignment of the atoms /molecules of the substrate. Surfaces with unique characteristics can be grown with these techniques.

## 3. Sol – Gels:

Sol: - A material which when reacts with liquid converts in to a gelly or viscous fluid.

Colloid:- A substance which converts liquid to semisolid or viscous or cloudy.

Gel : Amore thicky substance.

Soot :- When a compound is brunt, it given black fumes called soot.

In solutions molecules of nanometer size are dispersed and move around randomly and hence the solutions are clear. In colloids, the molecules of size ranging from 20µm to100µm are suspended in a solvent. When mixed with a liquid colloids look cloudy or even milky. A colloid that is suspended in a liquid is called as sol. A suspension that keeps its

shape is called a gel. Thus sol-gels are suspensions of colloids in liquids that keep their shape. Sol -gels formation occurs in different stages.

1) Hydrolysis
2) Condensation and polymerization of monomers to form particles
3) Agglomeration of particles. This is followed by formation of networks which extends throughout the liquid medium and forms a gel.

The rate of hydrolysis and condensation reactions are governed by various factors such as $P_H$, temperature, $H_2O$/Si molar ratio, nature and concentration of catalyst and process of drying. Under proper conditions spherical nanoparticles are produced.

## 3. *ELECTRODEPOSITION*:

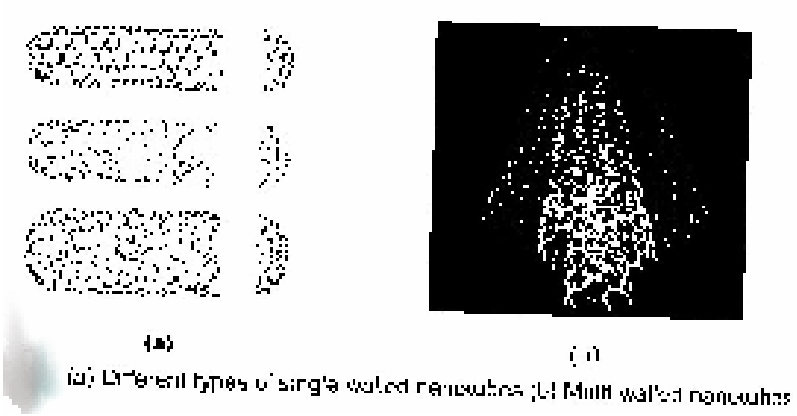
This method is used to electroplate a material. In many liquids called electrolytes (aqueous solutions of salts , acids etc) when current is passed through two electrodes immersed inside the electrolyte, certain mass of the substance liberated at one electrode gets deposited on the surface of the other. By controlling the current and other parameters, it is possible to deposit even a single layer of atoms. The films thus obtained are mechanically robust, highly flat and uniform. These films have very wide range of application like in batteries, fuel cells, solar cells, magnetic read heads etc.

## 5. BALL MILLING (MECHANICAL CRUSHING):

In this method, small balls are allowed to rotate around the inside of a drum and then fall on a solid with gravity force and crush the solid into nanocrystallites. Ball milling can be used to prepare a wide range of elemental and oxide powders. Ball milling is the preferred method for preparing metal oxides.

## CARBON NANOTUBES (CNT'S):

We know three forms of carbon namely diamond graphite and amorphous carbon. There is a whole family of other forms of carbon known as carbon nanotubes, which are related to graphite. In conventional graphite, the sheets of carbon are stacked on top of one another .They can easily slide over each other. That's why graphite is not hard and can be used as a lubricant. When graphite sheets are rolled into a cylinder and their edges joined, they form carbon nanotubes i.e. carbon nanotubes are extended tubes of rolled graphite sheets.



(a) (b)

(a) Different types of single walled nanotubes (b) Multi walled nanotubes

**TYPES OF CNT'S:** A nanotube may consist of one tube of graphite, a one atom thick single wall nanotube or number of concentric tubes called multiwalled nanotubes.

There are different types of CNT'S because the graphite sheets can be rolled in different ways .The 3 types of CNT'S are ZigZag, Armchair and chiral. It is possible to recognize type by analyzing their cross sectional structures.

Multiwalled nanotubes come in even more complex array of forms. Each concentric single – walled nanotube can have different structures, and hence there are a variety of sequential arrangements. There can have either regular layering or random layering .The structure of the nanotubes influences its properties .Both type and diameter are important .The wider the diameter of the nanotube, the more it behaves like graphite. The narrower the diameters of nanotube, the more its intrinsic properties depends upon its specific type. Nanotubes are mechanically very strong, flexible and can conduct electricity extremely well.

The helicity of the graphite sheet determines whether the CNT is a semiconductor of metallic.

**PRODUCTION OF CNT'S:** There are a number of methods of making CNT'S few method adopted for the production of CNT'S.

**ARC MRTHOD:** This method creates CNT'S through arc- vapourisation of two carbon rods placed end to end, separated by 1mm , in an enclosure filled with inert gas at low pressure .It is also possible to create CNT'S with arc method in liquid nitrogen. A direct current of 50-100A, driven by a potential difference of 20V apprx, creates a high temperature discharge between the two electrodes .The discharges vapourizes the surface of one of the carbon electrodes, and forms a small rod shaped deposit on the other electrode. Producing CNT'S in high yield depends on the uniformity of the plasma arc, and the temperatures of deposits forming on the carbon electrode.

**LASER METHOD:** CNT'S were first synthesized using a dual-pulsed laser. Samples were prepared by laser vapourizations of graphite rods with a 50:50 catalyst mixture of Cobalt & Nickel at $1200^0$c in flowing argon. The initial layer vapourization pulse was followed by a second pulse, to vapourize the target more uniformly. The use of two successive laser pulses minimizes the amount of carbon deposited as soot. The second laser pulse breaks up the larger particles ablated by the first one and feeds then into growing nanotube structure. The CNT'S produced by this method are 10-20nm in diameter and upto 100m or more in length. By varying the growth temperatures, the

catalyst composition and other process parameters the average nanotube diameter and size distribution can be varied.

**CHEMICAL VAPOUR DEPOSITION** (CVD)**:** Large amount of CNT"S can be formed by catalytic CVD of acetylene over Cobalt and Iron catalysts supported on silica or zeolite. The carbon deposition activity seems to relate to the cobalt content of the catalyst; where as the CNT'S selectivity seems to be a function of the $P_H$ in catalyst preparation. CNT'S can be formed from ethylene. Supported catalysts such as iron cobalt and Nickel containing either a single metal or a mixture of metals, seem to induce the growth of isolated single walled nanotubes or single walled nanotubes, bundles in the ethylene atmosphere. The production of single walled nanotubes as well as double walled CNT'S, molybdenum and molylodenum-iron catalysts has also been demonstrated.

**PROPERTIES OF CNT;S :** Few unique properties of CNT"S are

**1) ELECTRICAL CONDUCTIVITY:** CNT'S can be highly conducting , and hence can be said to be metallic. Their conductivity will be a function of chirality, the degree of twist and diameter. CNT'S can be either metallic or semi conducting in their electrical behaviour. Conductivity in multi walled CNT'S is more complex .The resistivity of single walled nanotubes ropes is of the order of $10^{-4}$ ohm –cm at $27^0$c .This means that single walled nanotube ropes are most conductive carbon fibers. Individual single walled nanotubes may contain defects. These defects allow the single walled nanotubes to act as transistors. Similarly by joining CNT"S together forms transistor - like devices. A nanotube with natural junctions behaves as a rectifying diode.

2) Strength and elasticity: Because of the strong carbon bonds, the basal plane elastic modules of graphite, it is one of the largest of any known material. For this reason, CNT"S are the ultimate high strength fibers. Single walled nanotubes are stiffer than Steel, and are very resistant to damage from physical forces.

**3)THERMAL CONDUCTIVITY AND EXPANSION**: The strong in- plane graphite carbon- carbon bonds make them exceptionally strong and stiff against axial strains. The almost zero- in -plane thermal expansion but large inter - plane expansion of single walled nanotubes implies strong in plane coupling and high flexibility against non-axial strains. CNT'S show very high thermal conductivity. The nanotube reinforcements in polymeric materials may also significantly improve the thermal and thermo mechanical properties of composites.

**4) HIGHLY ABSORBENT:** The large surface area and high absorbency of CNT"S make them ideal for use in air, gas and water filteration. A lot of research is being done in replacing activated charcoal with CNT'S in certain ultra high purity application.

**APPLICATION OF NANOMATERIALS:**

1. **Engineering:** i).Wear protection for tools and machines (anti blocking coatings, scratch resistant coatings on plastic parts). ii) Lubricant – free bearings.
2. **Electronic industry:** Data memory(MRAM,GMR-HD), Displays(OLED,FED), Laser diodes, Glass fibres
3. **Automotive industry:** Light weight construction, Painting (fillers, base coat, clear coat), Sensors, Coating for wind screen and car bodies.
4. **Construction:** Construction materials, Thermal insulation, Flame retardants.

5. **Chemical industry:** Fillers for painting systems, Coating systems based on nano composites. Impregnation of papers, Magnetic Fluids.
6. **Medicine:** Drug delivery systems, Agents in cancer therapy, Anti microbial agents and coatings, Medical rapid tests Active agents.
7. **Energy:** Fuel cells, Solar cells, batteries, Capacitors.
8. **Cosmetics:** Sun protection, Skin creams, Tooth paste, Lipsticks.

## Questions:

1. What are Nanomaterials? Why do they exhibit different properties?
2. How are optical, physical and chemical properties of nano particles vary with their size.
3. How are electrical, magnetic and mechanical properties of nano particles vary with their size?
4. How are nano materials produced?
5. What are carbon nano tubes? How are they produced?
6. What are the different types of carbon nano tubes? What are their properties?
7. What are the important applications of nano materials?

## 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.

**Objective Type Question**

**UNIT -1** **Bonding in Solids**

**Crystallography and Crystal Structures**

## Choose the correct Answer

1. At equilibrium condition the atoms possess [ ]
   a) Maximum kinetic energy b) minimum potential energy
   c) Maximum potential energy d) maximum total energy

2. Primary bondings have bond energies in the range of [ ]
   a) 0.01 - 0.5 eV b) 10 -100 eV
   c) 0 - 0.01 eV d) 0.1 - 10 eV

3. Secondary bondings have bond energies in the range of [ ]
   a) 0.01 – 0.5 eV b) 10 – 100 Ev
   c) 0 – 0.01 eV d) 0.1 – 10 Ev

4. Among the following the strongest bond is [ ]
   a) hydrogen bond b) metallic bond
   c) covalent bond d) ionic bond

5. Primary bonds are formed by [ ]
   a) inter molecular forces b) inter atomic forces
   c) van der waal's forces d) none of the above

6. Bonding in diamond is [ ]
   a) covalent b) ionic
   c) dipole d) metallic

7. There are _____ basic crystal systems [ ]

   a) four b) five c) six d) seven

8. The only element exhibiting simple cubic structure is [ ]
   a) silver B) polonium c) zinc d) diamond

9. The relation between atomic radius r and lattice constant a in the case of simple cubic structure is [ ]
   a) a=2r b) a=r/2 c) a=4r/3 d) a=2 2r

10. Effective number of atoms belonging to the unit cell of BCC structure is

    a) 8 b) 1 c) 2 d) 9 [ ]

## Fill in the blanks

11. The primary bonds are

    1) _____ 2) _____ 3) _____ 4) _____

12. A melt of a solid consists of _____ order that is not stable.

13. The repulsive forces between atoms become significant only if atoms are _____ from each other.

14. Born' s exponent is evaluated from the _____ studies in ionic crystals.

15. The compressibility of crystal is _____ proportional to the repulsive exponent.

16. The units of the lattice energy is _____

17. The alkali halides show absorption bonds in _____ region of the Electromagnetic spectrum.

18. Amorphous substances are formed by _____ cooling of the melts Of organic compounds.

19. A glass is _____ liquid.

20. A substance in amorphous state possesses _____ viscosity.

## UNIT -2 X-Ray Diffraction
## Defects in Crystals

## Choose the correct Answer

1. X-ray are used for crystal diffraction studies because [ ]
   a) they have higher penetrating power
   b) crystals are transparent to x- rays
   c) the inter atomic spacing is of the order of x – ray wavelength
   d) they have high resolving power

2. According to Bragg ‘s law [ ]
   a) $2\lambda \sin\theta = nd$ b) $2 \sin \theta = nd \lambda$
   c) $2d \sin\theta = n \lambda$ d) $\sin \theta = nN \lambda$

3. Burgers vector is to indicate the magnitude of [ ]
   a) point defects b) line defects
   c) surface defects d) volume defect

4. If a foreign atom replaces a parent atom in the crystal, it is called
   a) Frenkel defect B) Schottky defect [ ]
   c) Substitutional impurity d) Electronic defect

5. In ionic crystals, an ion displaced from a regular site to an interstitial site is
   Called [ ]
   a) Frenkel defect b) schottky defect
   c) substitutional defect d) electronic defect

6. A pair of cation and anion missing from an ionic crystal leaving vacant ion
   Sites is called [ ]
   a) Frenkel defect b) schottky defect
   c) substitutional defect d) electronic defect

7. Twin boundary is a [ ]
   a) point defects b) line defects
   c) surface defects d) volume defect

8. When the composition of an ionic crystal does not corresponds to the exact
   stoichiometric formula, the _____ arise. [ ]
   a) Frenkel defect b) schottky defect
   c) substitutional defect d) electronic defect

9. Stacking fault is a [ ]

a) Frenkel defect b) schottky defect

c) substitutional defect d) electronic defect

10. Edge dislocation is a [ ]

a) Frenkel defect b) schottky defect

c) substitutional defect d) electronic defect

## True/False

11. The defects like point defects or line defects are charged defects in ionic crystals [True/ False]

12. In a Laue method, mono chromatic X-ray are used for X-ray diffraction. [True/ False]

13. Laue method deals with a single crystal diffraction. [True/ False]

14. A nickel crystal gives X-ray diffraction pattern that is charactertic of bcc. [True/ False]

## Fill in the blanks

15. A Schotlky defects is also called _____.

16. Impurities added deliberately to a metal crystal alter the _____ of the crystal.

17. The Frenkel defects do not change the _____ of a metal crystal.

18. Vacancies in ionic crystal are formed in _____.

19. In ionic crystals, the defects are _____ defects.

20. The Burgers vector of an edge dislocation is _____ to it.

## Unit –III Elements of Statistical Mechanics
## Principles of Quantum Mechanics

### Choose the correct Answer

1. If a system has n distinguishable particles, total number of macrostates possible is [ ]
   (a). n (b) (n+1)
   (c) (n-1) (d) 2n

2. If a system has n distinguishable particles, total number of microstates possible is [ ]
   (a). n (b) (n+1)
   (c) (n-1) (d) None

3. The statistics which deals with identical particle which are distinguishable
   Is [ ]
   (a) Fermi – Dirac (b) Bose – Einstein
   (c) Maxwell – Boltzmann (d) Fermi – Boltzmann

4. Statistics dealing with particle with half integral spin is [ ]
   (a) Fermi – Dirac (b) Bose – Einstein
   (c) Maxwell – Boltzmann (d) None

5. Example for Bose – Eintein statistics is [ ]
   (a) gas molecule (b) electrons
   (c) protons (d) photons

6. Velocity of matter wave is always [ ]
   (a) lesser than velocity of light (b) equal to velocity of light
   (c) greater than velocity of light (d) none of these

7. Existence of matter wave was experimental first demonstratd by
   (a) Newton (b) Planck [ ]
   (c) Davisson and Gerner (d) de Broglie

8. When an electron is accelerated, if de Broglie wavelength is 1 A, then the wavelength associated with electron is [ ]

(a) 15 volts (b) 12 volts
(c) 500 volts (d) 150 volts

9. In G.P. Thomson experiment for diffraction, the sample used for diffraction is [ ]
   (a) NaCl crystal (b) any one crystal
   (c) thin film of matter such as gold (d) none
10. Wave nature and particle nature called dual nature is exhibiting by
    (a) particles only (b) waves only [ ]
    (c) photons only (d) by particle and waves

## Fill in the blanks

11. The MB distribution function is Expressed as _____.
12. Particles with intergral spin are called _____.
13. particles with odd half-integral spins are called _____.
14. Phonons are the particles that follow _____ statistics.
15. Wien's displacements law is given as _____.
16. Electrical conduction in metals is explained by _____ theory.
17. Conduction electrons in a simple metal are known as ____ electrons.
18. The wavelength of the waves associated with particles is given by the relation _____.
19. The diffraction of electrons was demonstrated for the first time by _____.
20. The eigen values of the particle are also called _____ states.

## Unit-IV Band theory of Solids

### Choose the correct Answer

1. Drude and Lorentz developed [ ]
   (a) classical free electron theory (b) quantum free electron theory
   (c) zone theory (d) corpuscular theory
2. Sommerfeld developed [ ]
   (a) classical free electron theory (b) quantum free electron theory
   (c) zone theory (d) corpuscular theory

3. Zone theory of metals was developed by [ ]
   (a) Drude and Lorentz (b) Sommerfeld
   (c) Bloch (d) Newton

4. The steady drift velocity per unit electric field is called [ ]
   (a) mobility of the electron (b) random velocity
   (c) mean free path (d) none of these

5. The classical free electron theory was developed by [ ]
   (a) Sommerfeld (b) Bloch
   (c) Drude and Lorentz (d) Planck

6. The quantum free electron theory was developed by [ ]
   (a) Sommerfeld (b) Bloch
   (c) Drude and Lorentz (d) Planck

7. The zone theory of electron was developed by [ ]
   (a) Sommerfeld (b) Bloch
   (c) Drude and Lorentz (d) Planck

8. The periodicity of the lattice is given by [ ]
   (a) Bloch theorem (b) planck theorem
   (c) Drude and Lorentz (d) None of these

9. When the band gap is in the order of 1eV in a solid, it behaves as a
   (a) conductor (b) semiconductor [ ]
   (c) insulator (d) metal

10. When the scattering power of the potential barrier is zero, the electron is
    (a) Completely bound (b) partly bound and partly free [ ]
    (c) Completely free (d) lost due to recombination

### Fill in the blanks

11. The nature and quantity of conductivity differences between insulators and
Conductors can be explained by _____ theory.

12. In metals, there is an over lapping of _____ and _____ bands.

13. The band theory of solids deals with electron motion in a _____ field of a crystal.

14. Near the bottom of band, the effective mass of the electron is _____ in sign.

15. Semi metals posses_____ bands.

16. The number of energy states in a band is equal to the _____ of states.

17. The upper most band is filled with _____ electrons.

18. If an element has odd number of electrons, the upper most band will be _____ filled.

19. The width of the allowed band _____ with increasing binding energy of the electrons.

20. A hole near the top of an allowed band has _____ effective mass.

## Unit-VI Dielectric Properties
## Magnetic Properties
### Choose the correct Answer

1. Electronic polarization [ ]
   (a) decreases with increase of temperature
   (b) increase of temperature
   (c) may decreases or increase of temperature
   (d) is independent of temperature

2. Ionic polarization [ ]
   (a) decreases with increase of temperature
   (b) increase of temperature
   (c) may decreases or increase of temperature
   (d) is independent of temperature

3. Orientational polarization [ ]
   (a) decreases with increase of temperature
   (b) increase of temperature
   (c) may decreases or increase of temperature
   (d) is independent of temperature

4. At normal temperatures, the polarizations which are independent of temperature are [ ]
   (a) electronic and ionic (b) ionic and orientational
   (c) orientational and space charge (d) space charge and electronic

5. Dielectrics are [ ]
   (a) solids (b) metals
   (c) semiconductors (d) insulators

6. Diamagnetic materials possess [ ]
   (a) permanent magnetic dipoles (b) no permanent magnetic dipoles
   (c) induced dipoles along field direction
   (d) no induced diploes even when external field is applied

7. Materials do not having permanent magnetic dipoles are [ ]
   (a) paramagnetic (b) ferromagnetic
   (c) ferrimagnetic (d) diamagnetic

8. Diamagnetic susceptibility is [ ]
   (a) large , negative (b) small , positive
   (b) small , negative (d) large , positive

9. The magnetization of a superconductor is [ ]
   (a) 0 (b) H (c) 1 (d) –H

10. Theory which explains superconductivity is [ ]
   (a) lattice theory (b) Lorentz theory
   (c) BCS theory (d) sommerfeld theory

## Fill in the blanks

11. The polarization density P in a dielectric medium is proportional directly to
   The _____.

12. The polarizability of a dielectric is the ratio of ____ and the _____.
13. The units of D, the electric displacement, are _____.
14. Gauss law in electrostatics is _____.
15. The ionic polarization in an ionic solid is unaffected by the variations in ___.
16. In case of diamagnectic substances, the susceptibility is _____.
17. The SI unit of magnetic moment is _____.
18. The ratio of magnetic moment to the angular momentum of an electron is Called _____.
19. The exchange integral is positive for _____ substance.
20. The exchange integral is negative for _____.

## Unit-VII Laser
## Fiber Optics

### Choose the correct Answer

1. The population of the various energy levels of a system in thermal equilibrium is given by [ ]
(a) Boltzmann distribution law (b) Einstein relations
(c) Planck's law (d) Beer's law

2. T.Maiman invented [ ]
(a) He-Ne laser (b) CO2 laser
(c) Ruby laser (d) Nd: YAG laser

3. The colour of the laser output from a Ruby laser is [ ]
(a) green (b) blue (c) red (d) violet

4. In He-Ne lasers, the ratio of He-Ne is in the order [ ]
(a) 1:10 (b) 1:1 (c) 100:1 (d) 10:1

5. Laser radiation is [ ]
(a) monochromatic (b) highly directional
(c) coherent and stimulated
(d) highly directional, monochromatic , coherent and stimulated

6. Propagation of light through fiber core is due to [ ]
(a) diffraction (b) interference (c) refraction
(d) total internal reflection

7. Step index fiber can be a [ ]
(a) monomode fiber only (b) multimode fiber only
(c) monomode as well as multimode fiber
(d) either monomode or multimode

8. The process of mixing the signal with the carrier is called [ ]
(a) dispersion (b) attenuation (c) modulation
(d) demodulation

9. To overcome the problem of inter model dispersion one has to use
(a) multimode fiber (b) step index fiber [ ]
(c) graded index fiber (d) plastic fiber

10. The attenuation in an optical fiber is a function of [ ]
(a) fiber material only (b) wavelength of light pnly
(c) length of the fiber only (d) all the above

## Fill in the blanks

11. A laser source is a quantum _____.

12. Generally, the laser that are used in holography are _____ laser.

13. The pumping process that is used in He-Ne lasers source is _____.

14. In He-Ne laser system, _____ ions give metastable levels.

15. Semi conductor diode gives out radiation as a results of ____ emission.

16. In a single mode fiber, there is _____.

17. In multi mode fibers, the core diameter is _____.

18. _____ fiber is a multimode fiber.

19. A glass fiber consists of a _____ glass surrounded by a _____ made Of slightly of lower refractive index.

20. Single mode fibers transmit single ray _____ the axis of the fiber.

## Unit-VIII Acoustics of Buildings and Acoustic Quieting Nanotechnology

### Choose the correct Answer

1. Optomum reverberation time for music is [ ]
   (a) 0.5 to 1 second (b) 0 to 1 second
   (c) 1 to 2 second (d) above 5 second

2. Two square meter of a fiber board absorbs sound energy as that of unit area of an open window. The absorption coefficient of fiber board is [ ]
   (a) 0.50 (b) 0.2 (c) 2 (d) 0.0825

3. The wall of a halls built for music concerns should [ ]
   (a) amplify sound (b) reflect sound
   (c) transmit sound (d) absorb sound

4. Which one of the following has maximum absorbtion coefficient.
   (a) marble (b) carpet (c) human body (d) glass [ ]

5. Which one of the following has minimum absorbtion coefficient.[ ]
   (a) glass (b) felt (c) open window (d) wooden floor

6. Diameter of one carbon atom is [ ]
   (a) 0.5nm (b) 0.05 nm (c) 0.15 nm (d) 5 nm

7. In nanomaterials with decrease of size the interatomic spacing
   (a) Increase (b) Decreases [ ]
   (c) remains constant (d) first increase and then decrease

8. In nanomaterials with decrease of size, the melting point
   (a) Increase (b) remains constant [ ]
   (b) Decreases (d) first decrease and then increase

9. Gold nanospheres of 100nm appear [ ]
   (a) red in colour (b) blue in colour
   (c) orange in colour (d) violet in colour

10. Young's modulus value of single walled nonatubes is about
    (a) 1 Kilopascal (b) 1 Millpascal [ ]
    (c) 1 Terapascal (d) 1 Gigapascal

### Fill in the blanks

11. The unit of absorption coefficient is _____-.

12. The audible sounds have a frequency range ____ Hz to ____ Hz.

13. Erying formula for reverberation tine T is _____.
14. The unit of sound noise is _____.

15. The total absorption in a room is expressed in _____.

16. Fabric panels in a hall reflecting walls, cause _____ in a hall.

17. Nano materials are catalysts, because their enhanced _____ activity.

18. Aerogel is _____ nano crystalline.

19. Quantum dots are _____ materials.

20. The lifetime of a satellites increase by using _____ materials.

## Unit-V: Semiconductor Physics, Physics of Semiconductor Devices

**I. Fill in the blanks.**

1. In semiconductors, the valance band is---------- and the Conduction band is ---------- at low temperatures.
2. The conductivity of p- type silicon is 4 $ohm^{-1}$, the mobility of holes is 0.05$m^2$/V-S. Then the density of impurities is (atoms / $m^3$) ----------
3. Fermi energy is the ---------- energy that can be possessed by an electron at 0 K
4. When forward biased, the forward current increases ---------- with forward bias.
5. The concentration of charge carriers in an intrinsic semiconductor is proportional to ----------.
6. p-n junction diode, when forward biased behaves likes a ----------
7. The mobility of electron is ---------- than that of a hole.
8. In an intrinsic semiconductor at a temperature T, the product electron and hole densities is given by the relation ----------, where $E_g$, is the forbidden gap, and A, is a constant.
9. The position of the Fermi- level in an impurity doped semiconductor depend on ---- ---------- and the concentration of ----------.
10. The diffusion hole current (Jp) in a semiconductor is proportional to the ----------.

**II. Choose correct one**

11. At 0K pure silicon is

    (a) an intrinsic semiconductor (b) extrinsic semiconductor

    (C) insulator (d) superconductor.

12. the majority carriers in p- type Ge are

    (a) free electrons (b) holes

    ( c) ions (d) conductions electrons

13. The electric current in a pure semiconductor when voltage is applied is due to

    (a) electrons (b) holes

    (c) ions (d) holes and electrons

14. In an intrinsic semiconductor at 0 K, the Fermi level lies

(a) at the centre of top of the valence band and bottom of the conduction band

(b) at the centre of donor level and intrinsic Fermi level

(c ) at the centre of donor level and bottom of the conduction band

(d) at the centre of acceptor level and top of the valence band

15. The density of charge cxarriers in a pure semiconductor is proportional to

(a) $\exp(-E_g / kT)$ (b) $\exp(-2E_g / kT)$

(c ) $\exp(-E_g / kT^2)$ (d) $\exp(-E_g / 2kT)$

16. The thickness of depletion region is in the order of

(a) $6 \times 10^{-3}$ cm (b) $6 \times 10^{-9}$ cm

(c ) $6 \times 10^{-6}$ cm (d) $6 \times 10^{-12}$ cm

17. In a LED, if $E_g$ is the band gap, the wavelength of emission is given by

(a) $\lambda = E_g / h\upsilon$ (b) $\lambda = h\upsilon / E_g$

(c ) $\lambda = E_g / hc$ (d) $\lambda = hc / E_g$

18. Response time of LEDs in the order of

(a) $10^{-3}$ s (b) $10^{-6}$ s

(c ) $10^{-9}$ s (d) $10^{-12}$ s

19. Life time of LEDs is about

(a) $10^2$ hours (b) $10^3$ hours

(c ) $10^4$ hours (d) $10^5$ hours

20. LCD stands for

(a) light cavity display (b) light control display

(c ) liquid crystal diode (d) liquid crystal display

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD**
**I B.Tech. I Mid Examinations, November – 2009**
**ENGINEERING PHYSICS**

**Objective Exam**

**Name: _____ Hall Ticket No. A**

**Answer All Questions. All Questions Carry Equal Marks. Time: 20 Min. Marks: 10.**

**I. Choose the correct alternative:**

1. The atomic packing factor of a simple cubic structure, is [ ]
(a) 68% (b) 74% (c) 52% (d) 24%

2. The crystal planes (1 1 2) and (2 2 4) are [ ]
(a) perpendicular to each other (b) intersecting at an angle other than 90°
(c) parallel to each other (d) intersecting at an angle 45°

3. The Laue spots close to the centre of the Laue photograph correspond to [ ]
(a) high Bragg angles (b) low Bragg angles
(c) lesser interplanar separation of the crystal (d) larger wavelength of X-rays

4. NaCl crystal possess [ ]
(a) FCC structure (b) HPC structure (c) SC structure (d) BCC structure

5. The diffraction of X-rays by crystal planes [ ]
(a) reveals the nature of X-rays
(b) helps to know the characteristics of X-rays
(c) reveals the internal arrangement of atoms in the crystal
(d) helps to know the properties of the crystals

6. Burger's vector gives [ ]
(a) length of Burger's circuit (b) magnitude and direction of dislocation
(c) magnitude and direction of point defect (d) magnitude and direction of surface defect

7. The amount of energy required to separate the atoms completely [ ]
from the structure, is called
(a) cohesive energy (b) potential energy (c) attractive energy (d) repulsive energy

8. The number of atoms belonging to a unit cell is one, for [ ]
(a) body centered cubic structure (b) face centered cubic structure
(c) base centered cubic structure (d) simple cubic structure

9. CsCl crystal possess [ ]
(a) FCC structure (b) HPC structure (c) SC structure (d) BCC structure

10. Twin boundary in a crystal, is called [ ]
(a) zero dimensional defect (b) one dimensional defect
(c) two dimensional defect (d) three dimensional defect

**Cont…..2**

**Set No. 1**

**II. Fill in the Blanks:**

11. KBr is an example for _____ bond.

12. The number of basic crystal systems, is _____

13. The number of atoms belonging to the unit cell of BCC structure, is _____.

14. The number of Frenkel defects increase exponentially with _____ of temperature.

15. In an _____ crystal system a . b . c and $\alpha = \beta = 90° . \gamma$

16. The angle at which reflection is maximum in X-ray diffraction by crystal planes, is called _____ angle.

17. In the powder method of X-ray diffraction, the camera used is _____ camera.

18. In ionic crystals, an ion displaced from a regular site to an interstitial site, is called _____
imperfection.

19. Silver is an example for _____ bond.

20. The Miller Indices of the plane parallel to Y and Z axes are _____

**-oOo-**

**Set No. 2**

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD**
**I B.Tech. I Mid Examinations, November – 2009**
**ENGINEERING PHYSICS**

**Objective Exam**
**Name: _____ Hall Ticket No.**

**Answer All Questions. All Questions Carry Equal Marks. Time: 20 Min. Marks: 10.**
**I. Choose the correct alternative:**

1. NaCl crystal possess [ ]
(a) FCC structure (b) HPC structure (c) SC structure (d) BCC structure

2. The diffraction of X-rays by crystal planes [ ]
(a) reveals the nature of X-rays
(b) helps to know the characteristics of X-rays
(c) reveals the internal arrangement of atoms in the crystal
(d) helps to know the properties of the crystals

3. Burger's vector gives [ ]
(a) length of Burger's circuit (b) magnitude and direction of dislocation
(c) magnitude and direction of point defect (d) magnitude and direction of surface defect

4. The amount of energy required to separate the atoms completely [ ]
from the structure, is called
(a) cohesive energy (b) potential energy (c) attractive energy (d) repulsive energy

5. The number of atoms belonging to a unit cell is one, for [ ]
(a) body centered cubic structure (b) face centered cubic structure
(c) base centered cubic structure (d) simple cubic structure

6. CsCl crystal possess [ ]
(a) FCC structure (b) HPC structure (c) SC structure (d) BCC structure

7. Twin boundary in a crystal, is called [ ]
(a) zero dimensional defect (b) one dimensional defect
(c) two dimensional defect (d) three dimensional defect

8. The atomic packing factor of a simple cubic structure, is [ ]
(a) 68% (b) 74% (c) 52% (d) 24%

9. The crystal planes (1 1 2) and (2 2 4) are [ ]
(a) perpendicular to each other (b) intersecting at an angle other than 90°
(c) parallel to each other (d) intersecting at an angle 45°

10. The Laue spots close to the centre of the Laue photograph correspond to [ ]
(a) high Bragg angles (b) low Bragg angles
(c) lesser interplanar separation of the crystal (d) larger wavelength of X-rays

**Cont…..2**
**Set No. 2**
**II. Fill in the Blanks:**

11. The number of Frenkel defects increase exponentially with _____ of temperature.

12. In an _____ crystal system a . b . c and $\alpha = \beta = 90° . \gamma$

13. The angle at which reflection is maximum in X-ray diffraction by crystal planes, is called _____ angle.

14. In the powder method of X-ray diffraction, the camera used is _____ camera.

15. In ionic crystals, an ion displaced from a regular site to an interstitial site, is called _____
imperfection.

16. Silver is an example for _____ bond.

17. The Miller Indices of the plane parallel to Y and Z axes are _____

18. KBr is an example for _____ bond.

19. The number of basic crystal systems, is _____

20. The number of atoms belonging to the unit cell of BCC structure, is _____.

**-oOo-**

**Set No. 3**

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD**
**I B.Tech. I Mid Examinations, November – 2009**
**ENGINEERING PHYSICS**

**Objective Exam**
**Name: _____ Hall Ticket No.**

**Answer All Questions. All Questions Carry Equal Marks. Time: 20 Min. Marks: 10.**
**I. Choose the correct alternative:**

1. Burger's vector gives [ ]
(a) length of Burger's circuit (b) magnitude and direction of dislocation
(c) magnitude and direction of point defect (d) magnitude and direction of surface defect

2. The amount of energy required to separate the atoms completely [ ]
from the structure, is called
(a) cohesive energy (b) potential energy (c) attractive energy (d) repulsive energy

3. The number of atoms belonging to a unit cell is one, for [ ]
(a) body centered cubic structure (b) face centered cubic structure
(c) base centered cubic structure (d) simple cubic structure

4. CsCl crystal possess [ ]
(a) FCC structure (b) HPC structure (c) SC structure (d) BCC structure

5. Twin boundary in a crystal, is called [ ]
(a) zero dimensional defect (b) one dimensional defect
(c) two dimensional defect (d) three dimensional defect

6. The atomic packing factor of a simple cubic structure, is [ ]
(a) 68% (b) 74% (c) 52% (d) 24%

7. The crystal planes (1 1 2) and (2 2 4) are [ ]
(a) perpendicular to each other (b) intersecting at an angle other than 90°
(c) parallel to each other (d) intersecting at an angle 45°

8. The Laue spots close to the centre of the Laue photograph correspond to [ ]
(a) high Bragg angles (b) low Bragg angles
(c) lesser interplanar separation of the crystal (d) larger wavelength of X-rays

9. NaCl crystal possess [ ]
(a) FCC structure (b) HPC structure (c) SC structure (d) BCC structure

10. The diffraction of X-rays by crystal planes [ ]
(a) reveals the nature of X-rays
(b) helps to know the characteristics of X-rays
(c) reveals the internal arrangement of atoms in the crystal

(d) helps to know the properties of the crystals

**Set No. 3**

**II. Fill in the Blanks:**

11. The angle at which reflection is maximum in X-ray diffraction by crystal planes, is called _____ angle.

12. In the powder method of X-ray diffraction, the camera used is _____ camera.

13. In ionic crystals, an ion displaced from a regular site to an interstitial site, is called _____
imperfection.

14. Silver is an example for _____ bond.

15. The Miller Indices of the plane parallel to Y and Z axes are _____

16. KBr is an example for _____ bond.

17. The number of basic crystal systems, is _____

18. The number of atoms belonging to the unit cell of BCC structure, is _____.

19. The number of Frenkel defects increase exponentially with _____ of temperature.

20. In an _____ crystal system a . b . c and $\alpha = \beta = 90° . \gamma$.

**-oOo-**

**Set No. 4**

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD**
**I B.Tech. I Mid Examinations, November – 2009**
**ENGINEERING PHYSICS**

**Objective Exam**

**Name: _____ Hall Ticket No. A**

**Answer All Questions. All Questions Carry Equal Marks. Time: 20 Min. Marks: 10.**

**I. Choose the correct alternative:**

1. The number of atoms belonging to a unit cell is one, for [ ]
(a) body centered cubic structure (b) face centered cubic structure
(c) base centered cubic structure (d) simple cubic structure

2. CsCl crystal possess [ ]
(a) FCC structure (b) HPC structure (c) SC structure (d) BCC structure

3. Twin boundary in a crystal, is called [ ]
(a) zero dimensional defect (b) one dimensional defect
(c) two dimensional defect (d) three dimensional defect

4. The atomic packing factor of a simple cubic structure, is [ ]
(a) 68% (b) 74% (c) 52% (d) 24%

5. The crystal planes (1 1 2) and (2 2 4) are [ ]
(a) perpendicular to each other (b) intersecting at an angle other than 90°
(c) parallel to each other (d) intersecting at an angle 45°

6. The Laue spots close to the centre of the Laue photograph correspond to [ ]
(a) high Bragg angles (b) low Bragg angles
(c) lesser interplanar separation of the crystal (d) larger wavelength of X-rays

7. NaCl crystal possess [ ]
(a) FCC structure (b) HPC structure (c) SC structure (d) BCC structure

8. The diffraction of X-rays by crystal planes [ ]
(a) reveals the nature of X-rays
(b) helps to know the characteristics of X-rays
(c) reveals the internal arrangement of atoms in the crystal
(d) helps to know the properties of the crystals

9. Burger's vector gives [ ]
(a) length of Burger's circuit (b) magnitude and direction of dislocation
(c) magnitude and direction of point defect (d) magnitude and direction of surface defect

10. The amount of energy required to separate the atoms completely [ ]
from the structure, is called
(a) cohesive energy (b) potential energy (c) attractive energy (d) repulsive energy

**Set No. 4**

**II. Fill in the Blanks:**

11. In ionic crystals, an ion displaced from a regular site to an interstitial site, is called _____
imperfection.

12. Silver is an example for _____ bond.

13. The Miller Indices of the plane parallel to Y and Z axes are _____

14. KBr is an example for _____ bond.

15. The number of basic crystal systems, is _____

16. The number of atoms belonging to the unit cell of BCC structure, is _____.

17. The number of Frenkel defects increase exponentially with _____ of temperature.

18. In an _____ crystal system a . b . c and $\alpha = \beta = 90° . \gamma$.

19. The angle at which reflection is maximum in X-ray diffraction by crystal planes, is called _____ angle.

20. In the powder method of X-ray diffraction, the camera used is _____ camera.

**-oOo-**

**Code No: 09A1BS02 Set No. 1**

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD**

**I B.Tech. II Mid Examinations, March – 2010**

# ENGINEERING PHYSICS

**Objective Exam**

**Name: _____ Hall Ticket No.**

**Answer All Questions. All Questions Carry Equal Marks. Time: 20 Min. Marks: 10.**

**I. Choose the correct alternative:**

1. The Maxwell-Boltzmann statistics deals with particles having [ ]
(A) integral spin (B) half integral spin
(C) no spin (D) any value of spin

2. According to Planck's quantum theory of radiation [ ]
(A) energy is emitted in the form of waves
(B) energy is emitted in the form of mechanical waves
(C) energy is emitted in the form of a continuous stream
(D) energy is emitted in the form of packets called photons

3. If $E_1$ is the energy value for the ground state of an electron in a one-dimensional potential well of
length L, the energy of the first excited state is equal to [ ]
(A) $E_1$ (B) 2 $E_1$ (C) 4 $E_1$ (D) 9 $E_1$

4. The zone theory of electrons was developed by [ ]
(A) Sommerfeld (B) Planck
(C) Drude and Lorentz (D) Bloch

5. In an allowed energy band, the velocity of an electron is zero, at [ ]
(A) top of the band (B) any where in the band
(C) top and bottom of the band (D) bottom of the band

6. An example for direct band gap semiconductor is [ ]
(A) Ge (B) GaAs (C) Si (D) SiO

7. If the Hall coefficient is negative, then the semiconductor is [ ]
(A) intrinsic (B) p-type (C) n-type (D) extrinsic

8. The Fermi level of intrinsic semiconductor raises slightly with increase of temperature, because
[ ]
(A) the effect mass of electron is greater than the effective mass hole
(B) the mass of hole is greater than the mass electron
(C) the effect mass of hole is greater than the effective mass electron
(D) the mass of electron is greater than the mass hole

9. Application of forward bias to a junction diode reduces [ ]
(A) the minority carrier current to zero (B) the majority carrier current to zero
(C) the potential barrier (D) the current to zero

10. Infra-red LED finds application in [ ]
(A) test instruments (B) burglar's alarm
(C) pocket calculators (D) display boards

**II Fill in the Blanks**

11. The number of quantum states present in a metal between the energies E and E+dE per unit volume
is called _____

12. In the spectrum of black body radiation, the wavelength maximum _____ with increase in
temperature.

13. When a potential difference of 400 volts is applied in accelerating an electron, the wavelength
attained by the electron, is _____ A.U.

14. One-dimensional time-independent Schrodinger's wave equation is _____

15. Pure semiconductor behaves as an insulator at _____ K

16. The electrons in a periodic potential move with _____ mass.

17. For Ge at room temperature, the intrinsic concentration is $2.5 \times 10^{13}$ $cm^{-3}$. The donor impurity
concentration is $5 \times 10^{15}$ $cm^{-3}$. Then the hole concentration in the semiconductor is
_____ $cm^{-3}$.

18. Under equilibrium conditions, the rate of generation of holes in a semiconductor, is equal to the
rate of loss due to recombination. The equation relating the generation rate and loss rate is known
as _____

19. The recombination produces a layer, at P-N junction, is called _____

20. The rectification efficiency of a half-wave rectifier is _____.

**-oOo-**

**Code No: 09A1BS02 Set No. 2**

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD**

**I B.Tech. II Mid Examinations, March – 2010**

# ENGINEERING PHYSICS

**Objective Exam**

**Name: _____ Hall Ticket No.**

**Answer All Questions. All Questions Carry Equal Marks. Time: 20 Min. Marks: 10.**

**I. Choose the correct alternative:**

1. The zone theory of electrons was developed by [ ]
(A) Sommerfeld (B) Planck (C) Drude and Lorentz (D) Bloch
2. In an allowed energy band, the velocity of an electron is zero, at [ ]
(A) top of the band (B) any where in the band
(C) top and bottom of the band (D) bottom of the band
3. An example for direct band gap semiconductor is [ ]
(A) Ge (B) GaAs (C) Si (D) SiO
4. If the Hall coefficient is negative, then the semiconductor is [ ]
(A) intrinsic (B) p-type (C) n-type (D) extrinsic
5. The Fermi level of intrinsic semiconductor raises slightly with increase of temperature, because
[ ]
(A) the effect mass of electron is greater than the effective mass hole
(B) the mass of hole is greater than the mass electron
(C) the effect mass of hole is greater than the effective mass electron
(D) the mass of electron is greater than the mass hole
6. Application of forward bias to a junction diode reduces [ ]
(A) the minority carrier current to zero (B) the majority carrier current to zero
(C) the potential barrier (D) the current to zero
7. Infra-red LED finds application in [ ]
(A) test instruments (B) burglar's alarm (C) pocket calculators (D) display boards
8. The Maxwell-Boltzmann statistics deals with particles having [ ]
(A) integral spin (B) half integral spin (C) no spin (D) any value of spin
9. According to Planck's quantum theory of radiation [ ]
(A) energy is emitted in the form of waves
(B) energy is emitted in the form of mechanical waves
(C) energy is emitted in the form of a continuous stream
(D) energy is emitted in the form of packets called photons

**Cont…2**



10. If $E_1$ is the energy value for the ground state of an electron in a one-dimensional potential well of
length L, the energy of the first excited state is equal to [ ]
(A) $E_1$ (B) 2 $E_1$ (C) 4 $E_1$ (D) 9 $E_1$

**II Fill in the Blanks**

11. One-dimensional time-independent Schrodinger's wave equation is _____
12. Pure semiconductor behaves as an insulator at _____ K
13. The electrons in a periodic potential move with _____ mass.
14. For Ge at room temperature, the intrinsic concentration is $2.5 \times 10^{13}$ $cm^{-3}$. The donor impurity
concentration is $5 \times 10^{15}$ $cm^{-3}$. Then the hole concentration in the semiconductor is
_____ $cm^{-3}$.

15. Under equilibrium conditions, the rate of generation of holes in a semiconductor, is equal to the
rate of loss due to recombination. The equation relating the generation rate and loss rate is known
as _____
16. The recombination produces a layer, at P-N junction, is called _____
17. The rectification efficiency of a half-wave rectifier is _____.
18. The number of quantum states present in a metal between the energies E and E+dE per unit volume
is called _____
19. In the spectrum of black body radiation, the wavelength maximum _____ with increase
in temperature.
20. When a potential difference of 400 volts is applied in accelerating an electron, the wavelength
attained by the electron, is _____ A.U.

**-oOo-**

**Code No: 09A1BS02 Set No. 3**

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD**

**I B.Tech. II Mid Examinations, March – 2010**

# ENGINEERING PHYSICS

**Objective Exam**

**Name: _____ Hall Ticket No. A**

**Answer All Questions. All Questions Carry Equal Marks. Time: 20 Min. Marks: 10.**

**I. Choose the correct alternative:**

1 An example for direct band gap semiconductor is [ ]
(A) Ge (B) GaAs (C) Si (D) SiO
2 If the Hall coefficient is negative, then the semiconductor is [ ]
(A) intrinsic (B) p-type (C) n-type (D) extrinsic
3 The Fermi level of intrinsic semiconductor raises slightly with increase of temperature, because
[ ]
(A) the effect mass of electron is greater than the effective mass hole
(B) the mass of hole is greater than the mass electron
(C) the effect mass of hole is greater than the effective mass electron
(D) the mass of electron is greater than the mass hole
4 Application of forward bias to a junction diode reduces [ ]
(A) the minority carrier current to zero (B) the majority carrier current to zero
(C) the potential barrier (D) the current to zero
5 Infra-red LED finds application in [ ]
(A) test instruments (B) burglar's alarm (C) pocket calculators (D) display boards
6 The Maxwell-Boltzmann statistics deals with particles having [ ]
(A) integral spin (B) half integral spin
(C) no spin (D) any value of spin
7. cording to Planck's quantum theory of radiation [ ]
(A) energy is emitted in the form of waves
(B) energy is emitted in the form of mechanical waves
(C) energy is emitted in the form of a continuous stream
(D) energy is emitted in the form of packets called photons
8. f $E_1$ is the energy value for the ground state of an electron in a one-dimensional potential well of
length L, the energy of the first excited state is equal to [ ]
(A) $E_1$ (B) 2 $E_1$ (C) 4 $E_1$ (D) 9 $E_1$
9. The zone theory of electrons was developed by [ ]
(A) Sommerfeld (B) Planck (C) Drude and Lorentz (D) Bloch

**Cont….2**



10. In an allowed energy band, the velocity of an electron is zero, at [ ]
(A) top of the band (B) any where in the band
(C) top and bottom of the band (D) bottom of the band

**II Fill in the Blanks**

11. The electrons in a periodic potential move with _____ mass.
12. For Ge at room temperature, the intrinsic concentration is $2.5 \times 10^{13}$ $cm^{-3}$. The donor impurity
concentration is $5 \times 10^{15}$ $cm^{-3}$. Then the hole concentration in the semiconductor is _____ $cm^{-3}$.
13. Under equilibrium conditions, the rate of generation of holes in a semiconductor, is equal to the

rate of loss due to recombination. The equation relating the generation rate and loss rate is known
as _____
14. The recombination produces a layer, at P-N junction, is called _____
15. The rectification efficiency of a half-wave rectifier is _____.
16. The number of quantum states present in a metal between the energies E and E+dE per unit volume
is called _____
17. In the spectrum of black body radiation, the wavelength maximum _____ with increase in
temperature.
18. When a potential difference of 400 volts is applied in accelerating an electron, the wavelength
attained by the electron, is _____ A.U.
19. One-dimensional time-independent Schrodinger's wave equation is _____
20. Pure semiconductor behaves as an insulator at _____ K

**-oOo-**

**Code No: 09A1BS02 Set No. 4**

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD**

**I B.Tech. II Mid Examinations, March – 2010**

# ENGINEERING PHYSICS

**Objective Exam**

**Name: _____ Hall Ticket No. A**

**Answer All Questions. All Questions Carry Equal Marks. Time: 20 Min. Marks: 10.**

**I. Choose the correct alternative:**

1. The Fermi level of intrinsic semiconductor raises slightly with increase of temperature, because
[ ]
(A) the effect mass of electron is greater than the effective mass hole
(B) the mass of hole is greater than the mass electron
(C) the effect mass of hole is greater than the effective mass electron
(D) the mass of electron is greater than the mass hole

2. Application of forward bias to a junction diode reduces [ ]
(A) the minority carrier current to zero (B) the majority carrier current to zero
(C) the potential barrier (D) the current to zero

3. Infra-red LED finds application in [ ]
(A) test instruments (B) burglar's alarm
(C) pocket calculators (D) display boards

4. The Maxwell-Boltzmann statistics deals with particles having [ ]
(A) integral spin (B) half integral spin
(C) no spin (D) any value of spin

5. According to Planck's quantum theory of radiation [ ]
(A) energy is emitted in the form of waves
(B) energy is emitted in the form of mechanical waves
(C) energy is emitted in the form of a continuous stream
(D) energy is emitted in the form of packets called photons

6. If $E_1$ is the energy value for the ground state of an electron in a one-dimensional potential well of
length L, the energy of the first excited state is equal to [ ]
(A) $E_1$ (B) 2 $E_1$ (C) 4 $E_1$ (D) 9 $E_1$

7. The zone theory of electrons was developed by [ ]
(A) Sommerfeld (B) Planck
(C) Drude and Lorentz (D) Bloch

8. In an allowed energy band, the velocity of an electron is zero, at [ ]
(A) top of the band (B) any where in the band
(C) top and bottom of the band (D) bottom of the band

**Cont..2**



9. An example for direct band gap semiconductor is [ ]
(A) Ge (B) GaAs (C) Si (D) SiO

10. If the Hall coefficient is negative, then the semiconductor is [ ]
(A) intrinsic (B) p-type (C) n-type (D) extrinsic

**II Fill in the Blanks**

11. Under equilibrium conditions, the rate of generation of holes in a semiconductor, is equal to the
rate of loss due to recombination. The equation relating the generation rate and loss rate is known
as _____

12. The recombination produces a layer, at P-N junction, is called _____
13. The rectification efficiency of a half-wave rectifier is _____.
14. The number of quantum states present in a metal between the energies E and E+dE per unit volume
is called _____
15. In the spectrum of black body radiation, the wavelength maximum _____ with
increase in temperature.
16. When a potential difference of 400 volts is applied in accelerating an electron, the wavelength
attained by the electron, is _____ A.U.
17. One-dimensional time-independent Schrodinger's wave equation is _____
18. Pure semiconductor behaves as an insulator at _____ K
19. The electrons in a periodic potential move with _____ mass.
20. For Ge at room temperature, the intrinsic concentration is $2.5 \times 10^{13}$ $cm^{-3}$. The donor impurity
concentration is $5 \times 10^{15}$ $cm^{-3}$. Then the hole concentration in the semiconductor is
_____ $cm^{-3}$.

**-oOo-**

**Code No: A109100104 Set No. 1**
**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD**
**I B.Tech. III Mid Examinations, May– 2010**
**ENGINEERING PHYSICS**

**Objective Exam**

**Name: _____ Hall Ticket No. A**

**Answer All Questions. All Questions Carry Equal Marks. Time: 20 Min. Marks: 10.**

**I. Choose the correct alternative:**

1. The material in which spontaneous polarization changes with temperature, is called [ ]
(A) ferroelectric (B) pyroelectric (C) piezoelectric (D) anti-ferromagnetic
2. Nickel zinc ferrites are used as cores in [ ]
(A) radios (B) TV transformers (C) transmitters (D) electromagnets
3. In multimode graded index fiber, light rays travel in different parts of the fiber [ ]
(A) with different speeds (B) with same speed
(C) with minimum speed (D) with maximum speed
4. In fiber optic communication system, the preferable source of light is [ ]
(A) LED (B) sodium lamp (C) mercury lamp (D) laser
5. The residential soundproofing aims to eliminate the effects of [ ]
(A) internal noise (B) reverberation (C) absorption (D) external noise
6. The magnetic susceptibility (÷) of a magnetic material is given by [ ]
(A) ÷ = (îr -1) (B) ÷ = (îr +1) (C) ÷ = (1 - ìr) (D) ÷ = (îo -1)
7. The condition for lasing action is [ ]
(A) excitation (B) meta-stable state (C) population inversion (D) emission
8. The reverberation time for an auditorium is the time required for the intensity of sound to drop to
[ ]
(A) $10^{-9}$ times its initial value (B) $10^{-6}$ times its initial value
(C) $10^{-3}$ times its initial value (D) $10^{-8}$ times its initial value
9. Which of the following is not a stage of sol-gel formation? [ ]
(A) Agglomeration (B) Condensation (C) Hydrolysis (D) Sputtering
10. The relation between magnetic induction (B), magnetic field strength (H) and magnetization (M) is
[ ]

a. B = H + M (B) B = M + ìoH (C) B = ìo (H + M) (D) M = B + ìoH
b.

**II Fill in the blanks**

11. The unit for measurement of displacement vector is _____.
12. Above Curie temperature, the shape of B-H curve of a ferromagnetic material is in the form of a
_____.
13. The phenomenon of expulsion of magnetic lines from a super-conductor is known as _____.
14. The unit of Einstein's coefficient is _____.
15. The synthesizing of nanomaterials from larger pieces of material, is called _____ technique.
16. Ionic Polarization is _____ temperature.
17. The active element in ruby laser is _____.
18. The acceptance angle of a fiber of numerical aperture 0.22, is _____º.
19. A _____ is a device for reducing the amount of noise emitted by a machine.

20. When the radius of a sphere is reduced to 2.0 nm, the surface area to volume ratio becomes
_____ per meter.

**-oOo-**

**Code No: A109100104 Set No. 2**
**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD**
**I B.Tech. III Mid Examinations, May – 2010**
**ENGINEERING PHYSICS**

**Objective Exam**
**Name: _____ Hall Ticket No. A**

**Answer All Questions. All Questions Carry Equal Marks. Time: 20 Min. Marks: 10.**

**I. Choose the correct alternative:**

1. In fiber optic communication system, the preferable source of light is [ ]
(A) LED (B) sodium lamp (C) mercury lamp (D) laser
2. The residential soundproofing aims to eliminate the effects of [ ]
(A) internal noise (B) reverberation (C) absorption (D) external noise
3. The magnetic susceptibility (÷) of a magnetic material is given by [ ]
(A) ÷ = (ìr -1) (B) ÷ = (ìr +1) (C) ÷ = (1 - ìr) (D) ÷ = (ìo -1)
4. The condition for lasing action is [ ]
(A) excitation (B) meta-stable state (C) population inversion (D) emission
5. The reverberation time for an auditorium is the time required for the intensity of sound to drop to
[ ]
(A) $10^{-9}$ times its initial value (B) $10^{-6}$ times its initial value
(C) $10^{-3}$ times its initial value (D) $10^{-8}$ times its initial value
6. Which of the following is not a stage of sol-gel formation? [ ]
(A) Agglomeration (B) Condensation (C) Hydrolysis (D) Sputtering
7. The relation between magnetic induction (B), magnetic field strength (H) and magnetization (M) is
[ ]
(A) B = H + M (B) B = M + ìoH (C) B = ìo (H + M) (D) M = B + ìoH
8. The material in which spontaneous polarization changes with temperature, is called [ ]
(A) ferroelectric (B) pyroelectric (C) piezoelectric (D) anti-ferromagnetic
9. Nickel zinc ferrites are used as cores in [ ]
(A) radios (B) TV transformers (C) transmitters (D) electromagnets
10. In multimode graded index fiber, light rays travel in different parts of the fiber [ ]
(A) with different speeds (B) with same speed
(C) with minimum speed (D) with maximum speed

**II Fill in the blanks**

11. The unit of Einstein's coefficient is _____.
12. The synthesizing of nanomaterials from larger pieces of material, is called _____ technique.
13. Ionic Polarization is _____ temperature.
14. The active element in ruby laser is _____.
15. The acceptance angle of a fiber of numerical aperture 0.22, is _____º.
16. A _____ is a device for reducing the amount of noise emitted by a machine.
17. When the radius of a sphere is reduced to 2.0 nm, the surface area to volume ratio becomes
_____ per meter.
18. The unit for measurement of displacement vector is _____.
19. Above Curie temperature, the shape of B-H curve of a ferromagnetic material is in the form of a
_____.

20. The phenomenon of expulsion of magnetic lines from a super-conductor is known as _____.

**-oOo-**

**Code No: A109100104 Set No. 3**
**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD**
**I B.Tech. III Mid Examinations, May – 2010**
**ENGINEERING PHYSICS**

**Objective Exam**
**Name: _____ Hall Ticket No. A**

**Answer All Questions. All Questions Carry Equal Marks. Time: 20 Min. Marks: 10.**

**I. Choose the correct alternative:**

1. The magnetic susceptibility (÷) of a magnetic material is given by [ ]
(A) ÷ = (ìr -1) (B) ÷ = (ìr +1) (C) ÷ = (1 - ìr) (D) ÷ = (ìo -1)
2. The condition for lasing action is [ ]
(A) excitation (B) meta-stable state (C) population inversion (D) emission
3. The reverberation time for an auditorium is the time required for the intensity of sound to drop to
[ ]
(A) $10^{-9}$ times its initial value (B) $10^{-6}$ times its initial value
(C) $10^{-3}$ times its initial value (D) $10^{-8}$ times its initial value
4. Which of the following is not a stage of sol-gel formation? [ ]
(A) Agglomeration (B) Condensation (C) Hydrolysis (D) Sputtering
5. The relation between magnetic induction (B), magnetic field strength (H) and magnetization (M) is
[ ]
(A) B = H + M (B) B = M + ìoH (C) B = ìo (H + M) (D) M = B + ìoH
6. The material in which spontaneous polarization changes with temperature, is called [ ]
(A) ferroelectric (B) pyroelectric (C) piezoelectric (D) anti-ferromagnetic
7. Nickel zinc ferrites are used as cores in [ ]
(A) radios (B) TV transformers (C) transmitters (D) electromagnets
8. In multimode graded index fiber, light rays travel in different parts of the fiber [ ]
(A) with different speeds (B) with same speed
(C) with minimum speed (D) with maximum speed
9. In fiber optic communication system, the preferable source of light is [ ]
(A) LED (B) sodium lamp (C) mercury lamp (D) laser
10. The residential soundproofing aims to eliminate the effects of [ ]
(A) internal noise (B) reverberation (C) absorption (D) external noise

**II Fill in the blanks**

11. Ionic Polarization is _____ temperature.
12. The active element in ruby laser is _____.
13. The acceptance angle of a fiber of numerical aperture 0.22, is _____º.
14. A _____ is a device for reducing the amount of noise emitted by a machine.
15. When the radius of a sphere is reduced to 2.0 nm, the surface area to volume ratio becomes
_____ per meter.
16. The unit for measurement of displacement vector is _____.
17. Above Curie temperature, the shape of B-H curve of a ferromagnetic material is in the form of a
_____.
18. The phenomenon of expulsion of magnetic lines from a super-conductor is known as
_____.

19. The unit of Einstein’s coefficient is _____.
20. The synthesizing of nanomaterials from larger pieces of material, is called _____ technique.

**-oOo-**

**Code No: A109100104 Set No. 4**
**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD**
**I B.Tech. III Mid Examinations, May – 2010**
**ENGINEERING PHYSICS**

**Objective Exam**
**Name: _____ Hall Ticket No. A**

**Answer All Questions. All Questions Carry Equal Marks. Time: 20 Min. Marks: 10.**

**I. Choose the correct alternative:**

1. The reverberation time for an auditorium is the time required for the intensity of sound to drop to
[ ]
(A) $10^{-9}$ times its initial value (B) $10^{-6}$ times its initial value
(C) $10^{-3}$ times its initial value (D) $10^{-8}$ times its initial value

2. Which of the following is not a stage of sol-gel formation? [ ]
(A) Agglomeration (B) Condensation (C) Hydrolysis (D) Sputtering

3. The relation between magnetic induction (B), magnetic field strength (H) and magnetization (M) is
[ ]
(A) B = H + M (B) B = M + $ì_o$H (C) B = $ì_o$ (H + M) (D) M = B + $ì_o$H

4. The material in which spontaneous polarization changes with temperature, is called [ ]
(A) ferroelectric (B) pyroelectric (C) piezoelectric (D) anti-ferromagnetic

5. Nickel zinc ferrites are used as cores in [ ]
(A) radios (B) TV transformers (C) transmitters (D) electromagnets

6. In multimode graded index fiber, light rays travel in different parts of the fiber [ ]
(A) with different speeds (B) with same speed
(C) with minimum speed (D) with maximum speed

7. In fiber optic communication system, the preferable source of light is [ ]
(A) LED (B) sodium lamp (C) mercury lamp (D) laser

8. The residential soundproofing aims to eliminate the effects of [ ]
(A) internal noise (B) reverberation (C) absorption (D) external noise

9. The magnetic susceptibility (÷) of a magnetic material is given by [ ]
(A) ÷ = ($ì_r$ -1) (B) ÷ = ($ì_r$ +1) (C) ÷ = (1 - $ì_r$) (D) ÷ = ($ì_o$ -1)

10. The condition for lasing action is [ ]
(A) excitation (B) meta-stable state (C) population inversion (D) emission

**II Fill in the blanks**

11. The acceptance angle of a fiber of numerical aperture 0.22, is _____º.
12. A _____ is a device for reducing the amount of noise emitted by a machine.
13. When the radius of a sphere is reduced to 2.0 nm, the surface area to volume ratio becomes
_____ per meter.
14. The unit for measurement of displacement vector is _____.
15. Above Curie temperature, the shape of B-H curve of a ferromagnetic material is in the form of a
_____.
16. The phenomenon of expulsion of magnetic lines from a super-conductor is known as

_____.
17. The unit of Einstein's coefficient is _____.
18. The synthesizing of nanomaterials from larger pieces of material, is called _____ technique.
19. Ionic Polarization is _____ temperature.
20. The active element in ruby laser is _____.

**-oOo-**

Code No: 09A1BS02 R09 Set No. 2
I B.Tech Regular Examinations,June 2010
ENGINEERING PHYSICS
Common to CE, ME, CHEM, BME, IT, MECT, MEP, AE, BT, AME, ICE, E.COMP.E, MMT, ETM, EIE, CSE, ECE, EEE

Time: 3 hours Max Marks: 75
Answer any FIVE Questions
All Questions carry equal marks

1. (a) What is statistical mechanics? Write notes on Bose-Einstein statistics.
(b) Write notes on black body radiation.
(c) Calculate the energies that can be possessed by a particle of mass 8.50 _ 10_31kg which is placed in an in_nite potential box of width 10_9cm. [6+5+4]

2.(a) What is the meaning of nanotechnology? Explain.
(b) Describe the processes of \sol-gel" and \precipitation" in the fabrication Of nano- structures.
(c) Write the applications of nanotechnology in Electronic Industry. [4+7+4]

3. (a) Write notes on volume defects in crystals.
(b) What is Burger's vector? What is Burger's circuit? Explain.
(c) If the average energy required to create a Frenkel defect in an ionic crystal is 1.35 eV, calculate the ratio of Frenkel defects at 250C and 3500C. [5+6+4]

4. (a) Discuss the band theory of solids and explain the formation of bands and concept of holes.
(b) What is effective mass of an electron? Derive an expression for the e_ective mass of an electron. [9+6]

5. (a) Explain the formation and properties of an ionic crystal, with a suitable ex-
ample.
(b) Derive an expression for the cohesive energy of an ionic crystal. [7+8]

6. (a) What is Meissner e_ect? Explain, in detail.
(b) Distinguish a super-conductor and a normal metal, both maintained at same temperature.
(c) Write notes on magnetic levitation. [5+5+5]

7. (a) Explain the characteristics of a laser beam.

(b) Describe the construction of He-Ne laser and discuss with relevant ELD, the working of He-Ne laser.
(c) What are the di_erences between a laser diode and an LED? [4+7+4]
1
8. (a) Derive an expression for carrier concentration of p-type semiconductors.
(b) Explain Hall e_ect and its importance.
(c) For a semiconductor, the Hall coe_cient is -6.85 _ 10_5 m3/coulomb, and electrical conductivity is 250 m_1_1. Calculate the density and mobility of the charge carriers. [7+4+4]

R09 Set No. 4
I B.Tech Regular Examinations,June 2010
ENGINEERING PHYSICS
Common to CE, ME, CHEM, BME, IT, MECT, MEP, AE, BT, AME, ICE, E.COMP.E, MMT, ETM, EIE, CSE, ECE, EEE
Time: 3 hours Max Marks: 75
Answer any FIVE Questions
All Questions carry equal marks

1. (a) Obtain an expression for Fermi energy at T > 0 K.
(b) Derive an expression for density of states of electrons.
(c) Write short notes on:
i. De Broglie wavelength and
ii. Heisenberg's uncertainty principle. [4+7+4]

2. (a) Derive Bragg's law of crystal di_raction.
(b) Describe, in detail, Debye-Scherrer method for the determination of crystal parameter.
(c) A certain crystal reects monochromatic X-rays strongly when Bragg's angle is 210 for the second order di_raction. Calculate the glancing angle for third order spectrum. [4+7+4]

3. (a) What is bonding in solids? Write the list of di_erent types of bonding in solids.
(b) Describe with suitable examples, the formation of covalent and Vander-Waal's
bonds in solids.
(c) What is bonding energy of a molecule? Explain. [4+7+4]

4. (a) Describe the top-down methods by which nanomaterials are fabricated.
(b) Explain how X-ray di_raction can be used to characterize nanoparticles.[9+6]

5. (a) Discuss the propagation mechanism of light waves in optical _bers.
(b) Derive the expression for the numerical aperture of an optical _ber.
(c) A step index _ber has a numerical aperture of 0.16, and core refractive index of 1.45. Calculate the acceptance angle of the _ber and the refractive index of the cladding. [5+6+4]

6. (a) Using Kronig-Penney model show that the energy spectrum of an electron contains a number of allowed energy bands separated by forbidden bands.
(b) De_ne e_ective mass of an electron. Explain its physical signi_cance. [9+6]

7. (a) Show that the application of forward bias voltage across p-n junction causes
an exponential increase in number of charge carriers in opposite regions.
(b) Write notes on \Liquid Crystal Display".
(c) The current in a p-n junction at 270C, is 0.18 _A when a large reverse bias voltage is applied. Calculate the current when a forward bias of 0.98 V is applied. [7+4+4]

8. (a) De_ne the terms magnetic induction (B), magnetization (M) and magnetic _eld (H). Obtain an expression relating to these quantities.
(b) What are ferrites? Prove that ferrites are superior to ferro-magnetic materils. Write the applications of ferrites.
(c) The magnetic susceptibility of aluminum is 2.3 _ 10_5. Find its permeability and relative permeability. [6+5+4]

Code No: 09A1BS02 R09 Set No. 1
I B.Tech Regular Examinations,June 2010
ENGINEERING PHYSICS
Common to CE, ME, CHEM, BME, IT, MECT, MEP, AE, BT, AME, ICE, E.COMP.E, MMT, ETM, EIE, CSE, ECE, EEE
Time: 3 hours Max Marks: 75
Answer any FIVE Questions
All Questions carry equal marks

1. (a) Explain the principle behind the functioning of an optical _bre.
(b) Derive an expression for numerical aperture of an optical _bre.
(c) Write any three applications of optical _bres. [4+7+4]

2. (a) Distinguish between intrinsic and extrinsic semicondutors.
(b) Derive an expression for the density of holes in the valence band of an intrinsic
semiconductor. [7+8]

3. (a) What is bonding in solids? Write the list of di_erent types of bonding in solids.
(b) Describe with suitable examples, the formation of ionic and covalent bonds in
solids.
(c) What is cohesive energy of a molecule? Explain. [4+7+4]

4. (a) What is Bloch theorem? Explain.
(b) Write the conclusions given by Kronig-Penney model.
(c) For an electron under motion in a periodic potential, plot the curve between the e_ective mass of the electron and wave number, and explain. [5+5+5]

5. (a) Describe any three processes by which nanomaterials are fabricated.
(b) Describe the important applications of nanotechnology. [9+6]

6. (a) De_ne magnetic moment. What is Bohr magneton? Explain.
(b) What are the characteristics of diamagnetic, paramagnetic and ferromagnetic substances? Explain their behavior with the help of examples.
(c) If a magnetic _eld of strength 300 amp/metre produces a magnetization of 4200 A/m in a ferromagnetic material, _nd the relative permeability of the material. [3+9+3]

7. (a) Explain the concept of dual nature of the light.
(b) Describe the experimental veri_cation of matter waves using Davisson-Germer
experiment.
(c) Calculate the wavelength of matter wave associated with a neutron whose kinetic energy is 1.5 times the rest mass of electron.
(Given that Mass of neutron = 1.676 _ 10_27 kg, Mass of electron = 9.1 _ 10_31 kg, Planck's constant = 6.62 _ 10_34 J-sec, Velocity of light = 3 _ 108 m/s). [4+7+4]

8. (a) Write notes on Bragg's law.
(b) Describe Bragg's X-ray spectrometer method in the determination crystal structure.
(c) Calculate the glancing angle of (1 1 1) plane of a cubic crystal having axial length 0.19 nm corresponding to the second order di_raction maximum for the X-rays of wavelength 0.058 nm. [4+7+4]

Code No: 09A1BS02 R09 Set No. 3
I B.Tech Regular Examinations,June 2010
ENGINEERING PHYSICS
Common to CE, ME, CHEM, BME, IT, MECT, MEP, AE, BT, AME, ICE, E.COMP.E, MMT, ETM, EIE, CSE, ECE, EEE
Time: 3 hours Max Marks: 75
Answer any FIVE Questions
All Questions carry equal marks

1. (a) Explain Fermi-Dirac distribution function. Illustrate the e_ect of temperature
on the distribution.
(b) Derive an expression for density of states of an atom. [8+7]

2. (a) Derive the expressions for:
i. Acceptance angle and
ii. Numerical aperture of an optical _ber.
(b) Describe the di_erent types of _bers by giving the refractive index pro_les and
propagation details. [8+7]

3. (a) What are Brillouin zones? Explain using E-K diagram.

(b) De_ne e_ective mass of an electron. Explain its physical signi_cance.
(c) What is a hole? List out the properties of a hole. [5+5+5]

4. (a) Write notes on `point defects' in crystals..
(b) Derive the expression for the density of Frenkel defects in a metallic crystal.
(c) What is Burgers vector? Explain. [5+5+5]

5. (a) Describe the di_erent methods of acoustic quieting.
(b) Describe various method to achieve soundproo_ng. [7+8]

6. (a) Explain the terms:
i. Magnetic induction,
ii. Magnetic susceptibility,
iii. Permeability of a medium and
iv. Intensity of magnetization.
(b) What are hard and soft magnetic materials? Give their characteristic properties and applications.
(c) A paramagnetic material has a magnetic _eld intensity of 104 amp/m. If the susceptibility of the material at room temperature is 3.7 _ 10_3. Calculate the magnetization and ux density of the material. [6+5+4]

7. (a) What do you understand by Miller indices of a crystal plane?
(b) Show that in a cubic crystal the spacing (d) between consecutive parallel planes of Miller indices (h k l) is given by d = a (h2 + k2 + l2)_1=2.
(c) NaCl crystals have FCC structure. The density of NaCl is 2.18 gm/cm2. Calculate the distance between two adjacent atoms. (Molecular weight of NaCl = 58.5). [4+7+4]

8. (a) Derive an expression for density of electrons in intrinsic semiconductors.
(b) Explain the variation of Fermi level with temperature in the case of p-type semiconductors.
(c) If the e_ective mass of holes in a semiconductor is 5 times that of electrons, at
what temperature would the Fermi level be shifted by 15% from the middle of the forbidden energy gap? [Given that the energy gap for the semiconductor is 1.20 eV]. [7+4+4]

*ALL*

*THE*

*BEST…..*

*Dept of physics*

www.jntuworld.com