Q. 1 **Distinguish between crystalline, amorphous and polymeric solids.**

Ans. **Crystalline solids**:

Solids which have a regular arrangement of molecules are called crystalline solids. Due to their regular structure they have fixed melting point. All metals like copper, iron, aluminum etc. are crystalline solids.

Amorphous solids:

Solids having a random arrangement of particles are called amorphous or glassy solids. Due to their random structure they donot have a fixed melting point. They are like liquids which are suddenly frozen. Examples are wood, glasss etc.

Polymeric solids:

Solids whose structure is in between crystalline and amorphous solids are called pollymeric solids. They consist of long chain carbon molecules due chemical reaction called polymerization. Examples are ceramics and polymers

Q. 2 **Define stress and strain. What are their SI units? Differentiate between tensile, compressive and shear modes of stress and strain.**

Ans. **Stress**:

The applied force per unit area to change the length volume or shape of the object is called stress.

$\sigma = F/A$ S.I units of stress are N/m^2 or pascal.

Strain:

The change produced in the length, volume or shape of a body due to applied stress is called strain.

$\varepsilon = \Delta L / L$ It is dimensionless and has no units.

Tensile stress:

The stress applied on a body to change its length is called tensile stress.

Volumetric stress:

It is appled stress which changes the volume of the object.

Shear stress:

It is a stress which changes the shpae of the object.

Tensile strain:

It is the change in length divided by the original length of an object.

$\varepsilon = \Delta L / L$

Volumetric strain:

The strain produced as a result of volumetic stress is called volumetric strain. It is equal to change in volume per unit original volume.

Compressive Strain = $\Delta V/V$

Shear strain:

The strain produced in the body due shear stress is called shear strain.

Shear Strain = $\Delta a/a$

Q. 3 **Define modulus of elasticity. Show that the units of modulus of elasticity and stress are the same. Also discuss its three kinds.**

Ans. **Modulus of elasticity**:

The ratio of the stress on a body to the strain produced in it is called modulus of elasticity. Mathematically it can be written as

Modulus of elasticity = Stress / Strain

Units of stress and modulus of elasticity

Since $\sigma = F/A$ so its units are N/m^2

As the strain is dimensionless quantity and it has no units. Hence the units of modulus of elasticity is also N/m^2 which are same as units of stress.

Three Kinds of Modulus of Elasticity

i. **Young's Modulus**

The ratio of tensile stress to the tensile strain is called Young's modulus. Mathematically, $Y = (F/A)/(\Delta L/L)$

ii. Bulk Modulus

The ratio of volumetic stress to the volumetic strain is callled Bulk modulus. Mathematically, $K = (F/A)/(\Delta V/V)$

iii. Shear Modulus

The ratio of shear stress to the shear strain is callled Shear modulus. Mathematically,

$K = (F/A)/\tan\theta$

Q. 4 **Draw a stress-strain curve for a ductile material, and then define the terms: Elastic limit, Yield point and Ultimate tensile stress.**

Ans. See the long article in book for stress strain curve.

Elastic Limit: It is the greatest stress that a material can endure without any permanent change in its shape or dimension.

Yield Point: It is the point on the stress strain curve beyond which a material is permanently de-shaped.

Ultimate Tensile Stress: It is the maximum stress which a material can withstand without breaking.

Q. 5 **What ismeant by strain energy? How can it be determined from force-extension graph?**

Ans. See long article in book

Q.6 **Describe the formation of energy bands in solids. Explain difference amongst electrical behaviour of conductors, insulators and semiconductors in terms of energy band theory.**

Ans. See long article in book

Q. 7 **Distinguish between intrinsic and extrinsic semi-conductors. How would you obtain n-type and p-type material from pure silicon? Illustrate it by schematic diagram**.

Ans. **Intrinsic semiconductor**

A Pure semiconductor material is called intrinsic semicondutor. In it the concentrations of negative charge carriers (electrons) and positive charge carriers (holes) are the same. e.g. pure silicon, germanium etc.

Extrinsic semiconductor

The semiconductor material in which certain impurities are added is called extrinsic semiconductor. This addition of impurities is called doping. In pure silicon if we add pentavalent impurities like phosphorus it becomes n-type semiconductor material. In pure silicon if we add trivalent impurities like aluminum then it becomes p-type semiconductor material.

Q. 8 **Discuss the mechanism of electrical conduction by holes and electrons in a pure semi- conductor element.**

Ans. A pure semiconductor element consists of holes (+ve charge carriers) and free electrons (-ve charge carriers; electrons). They are equal in number and move at random but in opposite direction. When some voltage is applied across the ends of the semiconductor, then free electrons move towards the positive end and the holes move towards the negative end of the semiconductor.

Q. 9 **Write a note on superconductors**.

Ans. **Superconductors**

The substances whose resistivity becomes zero at certain low temperature are called superconductors. The temperature at which resistivity of material becomes zero is called critical temperature represented by Tc. The first superconductor was discovered in 1911 by Kmaerlingh Ornes. He observed that electrical resistance of mercury disappears at 4.2 K. Some other metals such as Al, Sn and Pb also become superconductor at very low temperatures. In 1986 a new class of ceramic materials was discovered that become superconductors at 125 K. Recently Yttrium barium copper oxide (Yba2 Cu3 O7) have been reported to become superconductor at 163 K. Superconductors have many applications., e.g.magnetic resonance imaging (MRI), magnetic levitation trains and faster computer chips.

Q.10 **What is meant by para, dia and ferromagnetic substances? Give examples for each.**

Ans. **Paramagnetic substances**:

The substances in which, the orbits and the spin axes of the electrons in the atom are so oriented that their fields support each other and the atoms behave like a tiny magnet. They are feebly attracted by a strong magnet e.g. Na and K.

Diamagnetic substances: The substances in whose atoms, there is no resultant field as the magnetic fields produced by both orbital and spin motions of the electrons might add up to zero. They are feebly repelled by a strong magnet, e.g. Cu, Bi & Sb.

Ferromagnetic substances: The substances in which domains cooperate with each other in such a way so as to exhibit a strong magnetic effect on the application of external magnetic field or passing current through the ferromagnetic substances. They are strongly attracted by a magnet, e.g. Fe, Co & Ni.

Q.11 **What is meant by hysteresis loss? How is it used in the construction of a transformer?**

Ans. **Hysteresis loss**:

The dissipation of energy that occurs due to magnetic hysteresis (The lagging behind of magnetization of ferromagnetic material behind the magnetizing current), when the magnetic material is subjected to cyclic changes of magnetization is called hysteresis loss. The magnetic materials for which the area of hysteresis loop is small the dissipation of energy will also be small. These are called soft magnetic materials like soft iron. That is why soft iron is very useful material for making the core of transformer.