SIMULTANEOUS DIFFERENTIAL EQUATIONS

1. Solve $\frac{dx}{dt} + y = \sin t$, $x + \frac{dy}{dt} = \cos t$ given x=2 and y=0 at t=0 **(M/J 2009) (N/D 2015)**
2. Solve $\frac{dx}{dt} + 2y = \sin 2t$, $\frac{dy}{dt} - 2x = \cos 2t$ **(M/J 2012),(N/D 2009)**
3. Solve $\frac{dx}{dt} + 2y = -\sin t$, $\frac{dy}{dt} - 2x = \cos t$ **(M/J 2014)**
4. Solve $\frac{dx}{dt} + 2y = -\sin t$, $\frac{dy}{dt} - 2x = \cos t$ given x=1 y=0 at t=0 **(N/D 2010)**
5. Solve $\frac{dx}{dt} - y = t$, $\frac{dy}{dt} + x = t^2$ **(A/M 2011) (MAY/JUNE-2016)**
6. Solve $\frac{dx}{dt} - y = t$, $\frac{dy}{dt} + x = t^2$ given x(0)=y(0)=2 **(N/D 2011)**
7. Solve $\frac{dx}{dt} + y = e^t$, $x - \frac{dy}{dt} = t$ **(N/D 2012),(N/D 2014)**
8. Solve $\frac{dx}{dt} + 2x + 3y = 2e^{2t}$, $\frac{dy}{dt} + 3x + 2y = 0$ **(M/J 2010)**
9. Solve $\frac{dx}{dt} + 5x - 2y = t$, $\frac{dy}{dt} + 2x + y = 0$ **(M/J 2013)**
10. Solve $\frac{dx}{dt} + 2x - 3y = t$, $\frac{dy}{dt} - 3x + 2y = e^{2t}$ **(N/D 2011)**
11. Solve $\frac{dx}{dt} + 4x + 3y = t$, $\frac{dy}{dt} + 2x + 5y = e^{2t}$ **(N/D 2013)**
12. Solve the simultaneous equations $\frac{dx}{dt} + \frac{dy}{dt} + 3x = \sin t$, $\frac{dx}{dt} - x + y = \cos t$ **(M/J 2015)**
13. Solve for x from the equations $D^2x + y = 3e^{2t}$, $Dx - Dy = 3e^{2t}$ **(M/J 2011)**

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Department of Physics

2 MARKS QUESTION WITH ANSWERS

UNIT I- PROPERTIES OF MATTER

1. What is elasticity?

The property of the body to regain its original shape and size, after the removal of deforming force is called elasticity.

2. Define stress and strain.

Stress: The force of resistance per unit area, offered by a body against deformation is known as stress.

Strain: The ratio of change in dimension to the original dimension when subjected to an external load is termed as strain and is denoted by e. It has no unit.

3. Identify tensile stress and tensile strain.

The stress induced in a body, when subjected to two equal and opposite pulls, as a result of which there is an increase in length, is known as tensile stress. The ratio of increase in length to the original length is known as tensile strain.

4. Define compressive stress and compressive strain.

The stress induced in a body, when subjected to two equal and opposite pushes, as a result of which there is a decrease in length, is known as compressive stress. The ratio of increase in length to the original length is known as compressive strain.

5. Define shear stress and shear strain.

The stress induced in a body, when subjected to two equal and opposite forces, which are acting tangentially across the resisting section as a result of which the body tends to shear off across the section is known as shear stress and corresponding strain is known as shear strain.

6. Define Poisson‘s ratio.

The ratio of lateral strain to the linear strain is a constant for a given material, when the material is stressed within the elastic limit. This ratio is Poisson‘s ratio.

7. State Hooke‘s law.

Hooke‘s law is stated as when a material is loaded within elastic limit, the stress is proportional to the strain produced by stress, or Stress/strain=constant. This constant is termed as modulus of elasticity.

8. Define modulus of rigidity.

The ratio of shear stress to the corresponding shear strain when the stress is within the elastic limit is known as modulus of rigidity or shear modulus and is denoted by N.

9. Define modulus of elasticity.

The ratio of tensile stress or compressive stress to the corresponding strain is known as modulus of elasticity or young‘s modulus and is denoted by E.

10. Define Bulk modulus.

When a body is subjected to an uniform direct stress in all the three mutually perpendicular directions, the ratio of the direct stress to the corresponding volumetric strain is found to be a constant is called as the bulk modulus of the material and is denoted by K.

11. Define factor of safety.

Factors of safety, also known as safety factor, is a term describing the load carrying capacity of a system beyond the expected or actual loads. Essentially, the factor of safety is how much stronger the system is than it usually needs to be for an intended load. Safety factors are often calculated using detailed analysis because comprehensive testing is impractical on many projects, such as bridges and buildings, but the structure's ability to carry load must be determined to a reasonable accuracy.

12. What is stability?

The stability may be defined as an ability of a material to withstand high load without deformation.

13. What are the factors that affect the tensile strength?

i) Specimen length ii) Rate of loading and time to break iii) Capacity of machine iv) Effect of humidity and temperature v) Clamping problem

14. What are the factors that affect the elastic modulus?

i) Stress ii) Strain iii) Change of length iv) Elongation

15. What is a twisting moment? Is it same as torque?

Torque is a very simple concept, and has the units of force x distance. For example newton.metre. Torque is therefore a moment. It is typically used to describe mechanical phenomenon (ie mechanisms can have a torque applied or can apply a torque). Such as the moment in a motor shaft or a bolt. Whilst torque is a moment, not all moments are torques. For example a beam is said to undergo a bending moment, but not a torque.

16. Give example for gradually applied load and suddenly applied load.

Gradually applied load

When we lower a body with the help of a crane, the body first touches the platform on which it is to be placed. On further releasing the chain, the platform goes on loading till it is fully loaded by the body. This is the case of gradually applied load.

Suddenly applied load

When we lower a body with the help of a crane, the body is first of all, just above the platform on which it is to be placed. If the chain breaks at once at this moment the whole load of the body begins to act on the platform. This is the case of suddenly applied load.

17. What is resilience?

The strain energy stored by the body within elastic limit, when loaded externally is called resilience.

18. Define strain energy.

Strain energy is the energy absorbed or stored by a member when work is done on it to deform it.

19. Distinguish between suddenly applied and impact load.

When the load is applied all of a sudden and not step wise is called is suddenly applied load. The load which falls from a height or strike and body with certain momentum is called falling or impact load.

20. Define proof resilience?

The maximum strain energy stored in a body up to elastic limit is known as proof resilience.

21. Define strain energy density.

Strain energy density as the maximum strain energy stored in a material within the elastic limit per unit volume. It is also known as modulus of resilience.

22. What are the different types of beams?

1. Cantilever beam: A beam which is fixed at one end and at the other end is known as cantilever beam.
2. Simply supported beam: A beam supported or resting freely on the supports at its both end is known as simply supported beam.
3. Fixed beam: A beam whose both end are fixed or built-in walls is known as fixed beam.
4. Overhanging beam: if the end portion of a beam is extended beyond the support is known as overhanging beam.
5. Continuous beam: A beam which is having more than two supports is known as continuous beam.

23. Name the various types of load.

1. concentrated load or point load
2. Uniformly load
3. Uniformly distributed load

24. Define shear force at a section of a beam.

The algebraic sum of the vertical force at any section of a beam to the right or left of the section is known as shear force.

25. Define bending moment at a section of a beam.

The algebraic sum of the moments of all the force acting to the right or left of the section is known as bending of the beam.

26. What is meant by point of contra flexure?

It is the point where the bending moment is zero where it change sign from positive to negative or vice – versa.

27. State the relationship between the load and shear force.

The rate of the change of shear force is equal to the loading= -W

28. Define clear span and effective span.

The horizontal distance between the supporting walls is called the clear span of the beam. The horizontal distance between the lines of action of end reaction is called effective span.

29. State the theory of simple bending?

If a length of a beam is subjected to a constant bending moment and no share force (i.e. zero shear force) then the stresses will be set up in that length of the beam due to bending moment only and that length of the beam is said to be in pure bending or simple bending. The stresses set up in that length of beam are known as bending stress

30. What are the assumptions made in the theory of simple bending?

1. The material of the beam is perfectly homogeneous and isotropic.
2. The beam material is stressed, within its elastic limit and thus obeys Hooke‘s law.
3. The transverse sections, which were plane before bending, remain plane after bending.
4. Each layer of the beam is free to expand or contract, independently, of the layer, above or below it.

31. Define torsion.

A shaft is said to be in torsion, when equal and opposite torques are applied at the two ends of the shaft. The torque is equal to the product of the force applied (tangentially to the ends of a shaft) and radius of the shaft.

32. What are the assumptions made in the theory of torsion?

(i) The material of the shaft is uniform throughout.(ii) The twist along the shaft is uniform.(iii) Normal cross sections of the shaft, which were plane and circular before twist, remain plane and circular after twist.(iv) All diameters of the normal cross section which were straight before twist, remain straight with their magnitude unchanged, after twist.

33. Why girders are given l shaped?

I beams have very high moment of inertia for the same volume of the given material. So they have high stability in case of bending moments. The two horizontal parts (called flanges) of the I

beam can bear high bending and shearing stress. That means they do not get twisted and tilted easily. That is why they are used in girders, and as rails on the railway tracks.

34. Recall elastic fatigue.

If a body is continuously subjected to stress (or) strain , it gets fatigued (weak) which is called elastic fatigue.

35. How to impurity in a material affect the elasticity of the material? Give an example

The addition of impurities produces variation in the elastic property of the materials. The increase and decrease of elasticity depends on the type of impurity added to it.

- Ex: when potassium is added to gold, the elastic property of gold increase.
- when carbon is added to molten iron, the elastic property of iron decreases, provided the carbon content should be more than 1% in iron.

36. Define moment of a force about a point.

It is defined as a product of a force and perpendicular distance of the line of action of the force from a point.

37. Define center of gravity.

The center of gravity of a body may be defined as the point through which the entire weight of the body is assumed to be concentrated.

38. Define parallel axis theorem

This theorem states that the moment of inertia of a plane area about any axis is the sum of moment of inertia of the area about the passing through the centroidal axis and the product of the area of the plane and square of the perpendicular distance of its centroid from the axis.

$$I_m=I+ah^2$$

39. If the material is in the form of hollow cylinder of inner radius r1 and outer radius r2 then what is the torque per unit twist?

If the material is in the form of hollow cylinder of inner radius r1 and outer radius r2 then the torque per unit twist is $C= n\frac{n\pi}{2L}(r_2 4 - r_1 4)$

40. When a wire is bent back and forth, it becomes hot. Why?

When a wire is bent back and forth, heat is generated due to the area of the elastic hysteresis and frictional force. Hence it becomes hot.

41. What is difference between grain size and particle size?

Particle size is a notation for the comparative dimension of solid particles. But when we are talking about the metal, the crystal contains the internal boundaries. Any of the enclosed part by these boundaries, called as grain and its size is called as a grain size. Generally inside the particle, we can get grains.

42. How size of grains affect the elastic property of the materials?

The elastic nature of material is linked up with its grain size. The metal of smaller grains has better elasticity then the same metal of larger grains.

43. What is meant by thermal stress?

Thermal stress is stress created by any change in temperature to a material. These stresses can lead to fracture or plastic deformation depending on the other variables of heating, which include material types and constraints.

44 . On heating an object, how does thermal stress occur?

As a solid material experiences an increase in temperature, the volume of the structure is ultimately impacted by increasing, a phenomenon known as thermal expansion. This process results from heat's ability to increase a material's kinetic energy.Within solids, molecules are typically located in close proximity to one another, contributing to the defined shape of the structure. As the temperature rises, molecules begin to vibrate at a more rapid speed and push away from one another. This increased separation between the individual atoms causes the solid to expand, thus increasing the volume of the structure.

45. Why an I-section preferred for beams?

I-Section is preferred to rectangular section for resisting Bending Moment (BM) because; in I-Section more than 80% of the bending moment is resisted by the flanges itself. I-Section has higher moment of resistance (MoR) because the areas of flanges is away from the neutral axis (N.A.). In a beam of I-Section, more material is positioned near the outer fibres representing the regions of greatest stress and hence is stronger than a beam of rectangular cross section

46. Write the relation connecting the three modulii of Elasticity.

Young's modules of elasticity Y characterize the ability of the material to resist the change in length.

- Rigidity modulus of elasticity n determines the ability of a material to resist a change in shape while maintaining it volume.
- Bulk modulus K of elasticity characterizes the ability of a material to resist change in its volume not accompanied by a change in shape.
- These elastic constants of the materials are dependent on each other. The expression can be derived by showing the inter-relations between them.
- Three moduli of elasticity Y, n and K are related as $\frac{9}{Y} = \frac{3}{n} + \frac{1}{K}$

47. Mention the factors affecting the Elasticity of Materials.

Effect of stress, Effect of change in temperature, Effect of impurities, Effect of hammering, rolling and annealing, Effect of crystalline nature.

48. What is the importance of safety factor in designing engineering structures?

The good values of safety factor are always adopted to keep the structure for long life.

49. What are the Young's modulus values of the following materials?

Name of the material	GPa Values
Aluminum	69
Brass	100 - 125
Bronze	96 - 120
Copper (Cu)	117
Glass	50 - 90
Rubber	0.01 – 0.1
Steel	200
Wood	11

50. What are the applications of Young's modulus?

- The Young's modulus enables the calculation of the change in the dimension of a bar made of an isotropic elastic material under tensile or compressive loads.
- For instance, it predicts how much a material sample extends under tension or shortens under compression.
- The Young's modulus directly applies to cases of uniaxial stress, that is tensile or compressive stress in one direction and no stress in the other directions.
- Young's modulus is also used in order to predict the deflection that will occur in a statically determinate beam when a load is applied at a point in between the beam's supports.

51. Which is more elastic steel or rubber and why?

Steel. Elasticity is measured as ratio of stress to strain. For a given stress (stretching force per unit area) strain is much smaller in steel than in rubber.

UNIT II- WAVES AND OPTICS

1. Expand LASER.

LASER stands for **L**ight **A**mplification and **S**timulated **E**mission and **R**adiation.

2. Define LASER.

LASER is an artificial light source which emits a powerful,monochromatic Collimated beam of light. The emitted light waves from a LASER source are coherent innature.

3. What are the three process in LASER ?

The three process in LASER are (i) Absorption (ii) Spontanoeous (iii) Stimulated Emission.

4. What is stimulated emission?

The process of induces emissions and photons caused by the incident photons is called as stimulated emission. This process is a key factor to the process of LASER.

5. Define Population Inversion and how it is achieved?

The establishment of condition in which the number of atoms in which the number of atom in higher energy level is more than that in lower energy level is called as population inversion. It is an essential requirement for producing a LASER beam. It is achieved by population inversion.

6. Differentiate between Spontaneous and stimulated emission?

Spontaneous Emission	Stimulated Emission
Emission of light radiation is not triggered by external forces.	Induced Emission of radiations caused by incident Photons.
Emitted Photon travels in random direction	Emitted Photon travels in particular direction
Emitted Photon Cannot be controlled	Emitted Photon Can be controlled.
It is the key factor for light	It is for LASER operation.

7. Define the term upward transition.

The number of stimulated absorptions transistions occurring per unit time is given by Nab = $B_{12}N_1Q$ where B_{12} is a proportionality constant. This process is called as upward transition.

8. Define the term downward transition.

The number of stimulated absorptions transitions occurring per unit time is given by Nsp = $A_{21}N_2$ where A_{21} is a proportionality constant. This process is called as downward transition.

9. What is the usage of pumping action?

The process of creating a population inversion in the Atomic states is known as pumping action, which is essential for producing Laser beam.

10. Define the term population inversion.

It is a situation in which the number of atoms in the higher energy state is more than that of the lower energy states.

11. State the necessary condition for Population inversion.

(i) There must be at least two energy levels.
(ii) There must be a source to supply the energy to the medium.
(iii)The atoms must be continously raised to the excited state.

12. Write the four methods for pumping action.

(i) Optical Pumping

(ii) Electrical discharge.
(iii)Direct conversion.
(iv)In-Elastic collision between atoms.

13. What are the four characteristics of LASER source?

(i) High directionality.
(ii) High intensity
(iii)Highly mono-chromatic.
(iv)Highly coherent.

14. What are the two types of semi-conductor LASER?

1. Homo-Junction semi-conductor diode LASER.
2. Hetero-Junction semi-conductor diode LASER.

15. What are the applications of Homo-Junction LASER?

1. It is used in fiber–optic communication.
2. It is used in LASER printers and CD players.
3. It is used to heal wounds by infra-red radiations.
4. It is also used as pain killer.

16. What are the applications of Hetero-Junction LASER?

1. It is used in optic communication.
2. It is used in computers and CD ROMs.

17. Name any four industrial applications of LASER.

1. Material Processing
2. LASER Annealing
3. LASER Hardening
4. LASER Cladding

18. Name any four medical applications of LASER. (OR) Mention the medical application of LASER.

1. Opthamology
2. Neuro-surgery
3. Dermotology
4. Gyneocolgy Treatment of detached retina.
5. Performing micro-surgery and blood-less operation.
6. Treatment of human and animal cancer and skin tumours.

19. Define Acceptance angle of the fiber.

The maximum angle at which a ray of light can enter through one end of the fibre and still be totally internally reflected is called as acceptance angle of the fibre.

20. What do you mean by optical fiber optical communication?

For an efficient optical communication system light waves should be transmitted through some guiding mechanism. This type of mechanism is called as optical fiber and the communication through it is called as optical fiber communication.

21. What are the main applications of optical fibre communication?

The main applications of optical fibre communications are to transmit data, voice, video signals, digital data signals using light wave signals.

22. Define numerical aperture.

The sine of the acceptance angle of the fibre is known as numerical aperture (NA). It denotes the light waves gathering capability of the optical fibre. $NA = \sqrt{(n12\text{-}n22)}$.

23. What are applications of Step-index Single – mode fibers?

(i) This type of fiber is used in under-sea cable for long distance communication.
(ii) It is used in submarine cable system.

24. Define attenuation.

It is defined as the logarthmic value of ratio of the optical power output (Pout) from a fibre to the power input(Pin). $\alpha = -10\log[Pout/Pin]$.

25. What do you mean by Fiber-Optic sensors?

One of the applications of optical fibres is called as fibre – optic sensors. A sensor is a transducer which converts one form of energy into another form of energy. There are three type of sensors (i) Intrinsic sensors (or) Active sensors (ii) Extrinsic sensors (Passive sensors).

26. What do you meant by free oscillations?

The oscillation of a body or system with its own natural frequency and under no external influence other than the impulse that initiated the motion is called free oscillation.

27. Define damping coefficient.

A damping coefficient is a material property that indicates whether a material will bounce back or return energy to a system. For example, a basketball has a low damping coefficient.

28. How does quantum mechanics differ from Newtonian mechanics?

Newtonian mechanics is valid only for large objects, whereas quantum mechanics is valid only for very small objects. In Newtonian mechanics the position and velocity of an object can be predicted at a particular time, whereas quantum mechanics can only give probabilities.

29. What is the Schrodinger wave function?

The Schrödinger equation is the fundamental equation of physics for describing quantum mechanical behavior. It is also often called the Schrödinger wave equation, and is a partial differential equation that describes how the wavefunction of a physical system evolves over time.

30. What is the potential well?

A potential well is the region surrounding a local minimum of potential energy. Energy captured in a potential well is unable to convert to another type of energy (kinetic energy in the case of a gravitational potential well) because it is captured in the local minimum of a potential well.

31. What is a particle in a box?

In quantum mechanics, the particle in a box model (also known as the infinite potential well or the infinite square well) describes a particle free to move in a small space surrounded by impenetrable barriers. Likewise, it can never have zero energy,

32. How is depletion region formed in pn junction?

Depletion Region. When a p-n junction is formed, some of the free electrons in the n-region diffuse across the junction and combine with holes to form negative ions. In so doing they leave behind positive ions at the donor impurity sites.

33. What is the potential barrier in pn junction?

As more electrons and holes flow in the depletion region the number of positive and negative ions is reduced, causing the depletion region to narrow. The energy loss in overcoming the barrier potential results in a voltage drop across the PN junction equal to the barrier potential. (0.7V for Si, 0.3V for Ge.)

34. Define zero external voltage.

No external voltage potential is applied to the PN junction diode. In the zero bias junction, potential provides higher potential energy to the holes on the P and N side terminals. When the terminals of the junction diode are shorted, few majority charge carriers in the P-side with plenty

energy to overcome the potential barrier to travel across the depletion region. Therefore, with the help of majority charge carriers, the current starts to flow in the diode and it is denoted to as forward current. In the same way, minority charge carriers in the N-side move across the depletion region in reverse direction and it is referred to as reverse current.

35. Define the term of Knee voltage.

Knee voltage is also known as cut in voltage. The minimum amount of voltage threshold inspections required for conducting the diode is known as knee voltage or cut in voltage. And also said as. The forward voltage at which the current through PN junction starts increasing rapidly is known as knee voltage.

36. Define the terms (a) Maximum power current and (b) Peak Inverse Voltage (PIV).

Maximum power current: maximum power point (MPP): The point on a power (I-V) curve that has the highest value of the product of its corresponding voltage and current, or the highest power output. Maximum power point tracker (MPPT): A device that continually finds the MPP of a solar panel or array.

Peak Inverse Voltage (PIV): The maximum value of the reverse voltage that a PN junction or diode can withstand without damaging itself is known as its Peak Inverse Voltage. This rating of Peak Inverse Voltage (PIV) is given and described in the data sheet provided by the manufacturer.

37. Why a junction diode offers very high resistance in reverse biased mode?

Hence, a large amount of electric current is blocked by the depletion region. Thus, reverse biased diode offer large resistance to the electric current. The resistance offered by the reverse biased p-n junction diode is very large compared to the forward biased diode.

38. Define optical pumping

It is the process of establishing population inversion by light energy.

39. Define electrical pumping

It is the process of establishing population inversion by electrical energy.

40. Define chemical pumping

It is the process of establishing population inversion by exothermal chemical reactions.

41. Mention the essential components of laser devices.

Active medium, Pumping source, Optical resonator

42. How can population inversion be achieved in a semiconductor laser?

Population inversion can be achieved in a semiconductor laser by doping, irradiation by light or an electron beam.

43. What is laser communication?

Laser communications systems are wireless connections through the atmosphere. They work similarly to fiber optic links, except the beam is transmitted through free space. The carrier used for the transmission signal is typically generated by a laser diode.

44. What are the performance characteristics of glass fibers?

- Lowest losses
- Smallest intermodal pulse spreading
- Useful at moderately high information rates
- Useful at fairly long range
- Low numerical aperture

45. What are the performance characteristics of plastic fibers?

- High propagation losses
- Limited to very short paths
- Higher coupling effiency
- Large numerical aperture

46. Advantages of fiber optic communication system

- Large information carrying capacity
- Small size and weight
- Electrical isolation
- Immunity to interference and cross talk
- Signal security
- Low transmission loss
- Easy maintenance
- Low cost

47. Types of fiber manufacturing technique.

- Double crucible method (or) crucible-crucible method
- Vapour deposition method

48. What are the conditions for total internal reflections?

Two important conditions for total internal reflection are:

Angle of incidence (i) should be greater than critical angle (ic).

Ray should travel from denser medium to rarer medium.

49. What is the role of a metastable state in lasers?

A large number of excited atoms are accumulated in the metastable state. The population of metastable state can exceed the population at a lower level there by establishing population inversion in a lasing medium. Population inversion could not be created without a metastable state.

50. What are the life times of excited state and metastable state?

Metastable state is an excited state of an atom or other system with a longer lifetime than the other excited states. However, it has a shorter lifetime than the stable ground state. Atoms in the metastable state remain excited for a considerable time in the order of 10^{-6} to 10^{-3}.

51. In Lasers, What does the word 'population' mean?

The number of atoms per unit volume in an energy level is known as population of that energy level.

52. Why laser action is called "inverted absorption"?

If the system is to act as a laser, an incident photon must have a higher probability of causing stimulated emission than of being absorbed i.e. the rate of stimulated emission must exceed that of absorption. In other words, the laser action is possible only when N2 > N1.

53. What are the reasons to believe that light is a wave motion?

Light undergoes interference, diffraction and polarization. These phenomena establish that light is a wave motion.

54. A light wave enters from air into glass. How will the following be affected?

(i) Energy of the wave (ii) Frequency of the wave?

Energy of the wave decreases because a part of the light wave is reflected back into air. (ii) Frequency of the wave remains unchanged.

55. If a wave undergoes refraction, what will be the phase change?

Zero. No phase change occurs during refraction.

56. When monochromatic light travels from one medium to another its wavelength changes but frequency remains the same. Explain.

Frequency is the characteristic of the source while wavelength is the characteristic of the medium. When monochromatic light travels from one medium to another, its speed changes, so its wavelength ($\lambda=c/v$) changes but frequency v remains unchanged.

57. State the essential conditions for two light waves to be coherent.

1. The two waves must be continuous. 2. The two waves should be of same frequency or wavelength. 3. They should have a constant or zero phase difference. 4. Preferably, they should have equal amplitude.

58. Two independent light sources cannot act as coherent sources'. Why?

Two independent sources of light cannot be coherent. This is because light is emitted by individual atoms, when they return to ground state. Even the smallest source of light contains billions of atoms which obviously cannot emit light waves in the same phase.

UNIT III – THERMAL PHYSICS

1. **Differentiate heat and temperature.**

S.No	Heat	Temperature

1.	Heat is energy that is transferred from one body to another as the result of a difference in temperature.	Temperature is a measure of hotness or coldness expressed in terms of any of several arbitrary scales like Celsius and Fahrenheit.
2.	Heat is a measure of how many atoms there are in a substance multiplied by how much energy each atom possesses.	Temperature is related to how fast the atoms within a substance are moving.
3.	Unit: Joules	Kelvin, Celsius or Fahrenheit

2. Define thermal conductivity.

Thermal conductivity refers to the amount/speed of heat transmitted through a material. Heat transfer occurs at a higher rate across materials of high thermal conductivity than those of low thermal conductivity. Materials of high thermal conductivity are widely used in heat sink applications and materials of low thermal conductivity are used as thermal insulation.

3. Define conduction.

Conduction is how heat transfers through direct contact with objects that are touching. Any time that two objects or substances touch, the hotter object passes heat to the cooler object.

4. What is the first law of thermodynamics?

The first law of thermodynamics, also known as Law of Conservation of Energy, states that energy can neither be created nor destroyed; energy can only be transferred or changed from one form to another. For example, turning on a light would seem to produce energy; however, it is electrical energy that is converted.

5. Define convection.

Convection is how heat passes through fluids. A fluid is anything that has loosely moving molecules that can move easily from one place to another. Liquids and gases are fluids. One important property of fluids is that they rise when heated. That's because the molecules spread out and move apart when they get hot. The hot fluid becomes less dense and rises up. Cooler fluid is less dense and so it sinks down. This up-and-down motion creates what are called convection.

6. What is adiabatic condition?

Adiabatic conditions refer to conditions under which overall heat transfer across the boundary between the thermodynamic system and the surroundings is absent.

7. Define radiation.

Radiation is how heat moves through places where there are no molecules. Radiation is actually a form of electromagnetic energy.

8. What are bimetallic strips?

A bimetallic strip is used to convert a temperature change into mechanical displacement. The strip consists of two strips of different metals which expand at different rates as they are heated, usually steel and copper, or in some cases steel and brass.

9. How the circuit breakers are expands for temperature?

Bimetal strips are used in miniature circuit breakers to protect circuits from excess current. A coil of wire is used to heat a bimetal strip, which bends and operates a linkage that unlatches a spring-operated contact. This interrupts the circuit and can be reset when the bimetal strip has cooled down.

10. Can you give any two differences of muffle and reverberatory furnace?

Muffle Furnace	Reverberatory Furnace
A muffle furnace (sometimes retort furnace in historical usage) is a furnace in which the subject material is isolated from the fuel and all of the products of combustion, including gases and flying ash	In this the material to be heated is insulated from the fuel but not with its combustion gases. To make it easier consider this example.
200◦C -1200◦C	Above 1500◦C

11. What is solar power?

Solar power is the conversion of energy from sunlight into electricity, either directly using photovoltaic (PV), indirectly using concentrated solar power, or a combination. Concentrated solar power systems use lenses or mirrors and tracking systems to focus a large area of sunlight into a small beam. Photovoltaic cells convert light into an electric current using the photovoltaic effect.

12. What are heat exchangers?

A heat exchanger is a device used to transfer heat between a solid object and a fluid, or between two or more fluids. The fluids may be separated by a solid wall to prevent mixing or they may be in direct contact. They are widely used in space heating, refrigeration, air conditioning, power stations, chemical plants,petrochemical plants, petroleum refineries, natural-gas processing, and sewage treatment.

13. Define green house effect.

The greenhouse effect is the process by which radiation from a planet's atmosphere warms the planet's surface to a temperature above what it would be without its atmosphere. If a planet's atmosphere contains radioactively active gases they will radiate energy in all directions.

14. Give the principle of solar water heaters?

The working of solar water heaters is very simple to understand. The solar water heaters use two common principles for its functioning. a black surface heats up when left in the sun, by

absorption of solar radiation; The good absorption property of black surfaces is used to improve solar energy absorption in a solar heater. The inside of car/ bus parked in sun for a long time becomes hot. This is because solar radiation can pass through the glass windows of the bus but cannot come out. It is trapped inside and thus heats up the bus. Similarly water passing through insulated pipes kept in the sun becomes hot.

15. How the heat conducts through solid?

Generally conduct heat better than other solids do. In metals, some of the electrons (often one per atom) are not stuck to individual atoms but flow freely among the atoms. Of course, that's why metals are such good conductors of electricity. Now if one end of a bar is hot, and the other is cold, the electrons on the hot end have a little more thermal energy- random jiggling- than the ones on the cold end. So as the electrons wander around, they carry energy from the hot end to the cold end, which is another way of saying they conduct heat.

16. Mention the properties of thermal insulation materials should have?

1. Thermal conductivity of the material should be low.
2. Specific heat capacity should be low.
3. They should have high fire resistance.

17. Write the thermal coefficient equation for the bad conductor using lee's disc method.

The thermal coefficient equation for the bad conductor using lee's disc method is,

$$K=\frac{msrd(r+2h)}{A(\theta_1-\theta_2)(2r+2h)}$$

18. How do solar water heaters work?

The working of solar water heaters is very simple to understand. The solar water heaters use two common principles for its functioning. a black surface heats up when left in the sun, by absorption of solar radiation; The good absorption property of black surfaces is used to improve solar energy absorption in a solar heater. The inside of car/ bus parked in sun for a long time becomes hot. This is because solar radiation can pass through the glass windows of the bus but cannot come out. It is trapped inside and thus heats up the bus. Similarly water passing through insulated pipes kept in the sun becomes hot.

19. Write the thermal conductivity equation for the good conductor using Forbe's disc method.

The thermal conductivity equation for the good conductor using Forbe's disc method is,

$$\mathbf{K}=\frac{\rho S\int_p^{end}\left(\frac{d\theta}{dt}\right)}{\left(\frac{d\theta}{dt}\right)p}dt$$

20. Suppose that your body is covered with a "perfect" blanket where the heat you release is 100 percent reflected back to you, it does not leak any temperature outside the environment and the blanket is indestructible and can not be deformed in any way. If your body continues to generate heat at 37 degree, and just like the blanket you are indestructible and no matter what will continue to radiate 37 degrees of heat, with enough time, can the temperature inside the blanket match that of the sun why or why not?

Temperature would rise to 41 or 42 degrees at most. Then it leads to death.

21. Does the material molded in a mold with low and high thermal diffusivity freeze faster?

We have a mold material with low thermal diffusivity (plastic) vs a mold material with high thermal diffusivity (silver). So easily freeze the same material in the same freezer.

22. Explain how the water and air can be at the same temperature.

A closed bottle contains water at the bottom and air above it in equilibrium at the same temperature.

23. A 1-kg block of ice at 0ºC is placed into a perfectly insulated, sealed container that has 2 kg of water also at 0ºC. The water and ice completely fill the container, but the container is flexible. After some time one can except that,

The ice will melt so that the mass of the ice will decrease. In accordance to second law of thermodynamics, if an irreversible process occurs in a closed system, the entropy of that system always increases; it never decreases. Entropy measures the state of disorder. As the ice is more order than water, therefore the ice will melt so that the mass of the ice will decrease.

24. Consider an ideal heat pump and a perfect electric heater. The electric heater converts 100% of the electrical energy into heat energy; the heat pump converts 100% of the electrical energy into work, which is the more "efficient" way to heat a home?

The heat pump is more efficient if the outside temperature is not too cold. The value of coefficient of performance **K** becomes larger as the temperature of the two reservoirs becomes more nearly the same. Thus heat pumps are more efficient in temperate climates than in climates where the outside temperature fluctuates between wide limits. From the above observation we conclude that, the heat pump is more efficient if the outside temperature is not too warm.

25. How heat passes through fluids?

Convection is how heat passes through fluids. A fluid is anything that has loosely moving molecules that can move easily from one place to another. Liquids and gases are fluids. One important property of fluids is that they rise when heated. That's because the molecules spread out

and move apart when they get hot. The hot fluid becomes less dense and rises up. Cooler fluid is less dense and so it sinks down. This up-and-down motion creates what are called convection.

26. How the heat transfers through direct contact with objects?

Conduction is how heat transfers through direct contact with objects that are touching. Any time that two objects or substances touch, the hotter object passes heat to the cooler object

27. How the electromagnetic energy converted to heat?

Radiation is how heat moves through places where there are no molecules. Radiation is actually a form of electromagnetic energy.

28. What are green house gases?

Many greenhouse gases occur naturally in the atmosphere, such as carbon dioxide, methane, water vapor, and nitrous oxide, while others are synthetic. Those that are man-made include the chlorofluorocarbons (CFCs), hydrofluorocarbons (HFCs) and Perfluorocarbons (PFCs), as well as sulfur hexafluoride (SF_6).

29. What is the thermal expansion of two different metals combined?

The strip consists of two strips of different metals which expand at different rates as they are heated, usually steel and copper, or in some cases steel and brass known as bimetallic strip. A bimetallic strip is used to convert a temperature change into mechanical displacement.

30. How that heat exchangers works in every day home equipments?

They are widely used in space heating, refrigeration, air conditioning, power stations, chemical plants, petrochemical plants, petroleum refineries, natural-gas processing, and sewage treatment.

31. Define the term temperature?

A measure of the warmth or coldness of an object or substance with reference to some standard value. The temperature of two systems is the same when the systems are in thermal equilibrium. The degree of heat in a living body, normally about 98.6°F (37°C) in humans. What are different temperature scales?

32. What the temperature Scales used?

There are three temperature scales in use today, Fahrenheit, Celsius and Kelvin.

33. State various temperature measurement methods.

Thermocouples. Thermistors. Resistance temperature detector (RTD) Pyrometer. Langmuir probes (for electron temperature of a plasma) Infrared.

34. What is positive temperature coefficient of resistance?

This factor is represented by the Greek lower-case letter "alpha" (α). A positive coefficient for a material means that its resistance increases with an increase in temperature. Pure metals typically have positive temperature coefficients of resistance.

35. What is negative temperature coefficient of resistance?

Negative coefficient for a material means that its resistance decreases with an increase in temperature. Semiconductor materials (carbon, silicon, germanium) typically have negative temperature coefficients of resistance.

36. Temperature measurement Electrical methods What are they?

i) Resistance wire
ii) Thermocouple
iii) Thermistor

37. What is thermistor? What kind of material is used for thermistor?

The thermistor is a kind of resistor whose resistivity depends on surrounding temperature. It is a temperature sensitive device. The word thermistor is derived from the word, thermally sensitive resistor. The thermistor is made of the semiconductor material that means their resistance lies between the conductor and the insulator. The most common materials to be used for these thermistors are Manganese oxide, nickel oxide, cobalt oxide, copper oxide and ferric oxide. Semiconductor thermistors are used for much lower temperatures.

38. State the Seebeck effect.

The Seebeck effect is a phenomenon in which a temperature difference between two dissimilar electrical conductors or semiconductors produces a voltage difference between the two substances.

39. What is meant by renewable energy source?

Resource which are renewed by nature again and again and their supply is not affected by the arte of their consumption are called renewable. E.g., solar, wind, biomass, ocean, geothermal, hydro, etc.

40. Define solar constant.

Solar constant is defined as the amount of energy received in unit time on a unit area perpendicular to the sun's direction at the mean distance of the earth from the sun.

41. Define the term thermal Physics.

Thermal Physics is the science that deals with the energy transfer to practical applications such as energy transfer power generation, refrigeration, gas compression and its effect on the properties of working substance.

42. Define Heat.

Heat is the energy crossing the boundary due to the temperature difference between the system and surroundings.

43. State the law of conservation of energy.

Energy can neither be created nor destroyed, but it can be transferred from one form to another.

44. Define free expansion process.

When a gas expands suddenly into a vacuum through a large orifice is known as free expansion process.

45. What is the difference between a heat pump and a refrigerator?

Heat pump is a device which operating in cyclic process, maintains the temperature of a hot body at a temperature higher than the temperature of surroundings.

A refrigerator is a device which operating in a cyclic process, maintains the temperature of a cold body at a temperature lower than the temperature of the surroundings.

46. Name four important properties of a good refrigerant

- Low boiling point
- High critical temperature & pressure
- Low sp.heat of liquid
- Non – flammable and non explosive.

47. Name any four commonly used refrigerants

- Ammonia (NH_3)
- Carbon di oxide (CO_2)
- Sulphur di oxide (SO_2)
- Freon – 12.

48.Given two examples of heat transfer with internal heat generation.

Chemical Reaction

Nuclear Reaction

Combustion Reaction.

49.Name the law which governs convection heat transfer

Newton's law of cooling

50. Write down the Stefan Boltzmann law with its Unit

The total energy emitted by a black body at a particular temperature is given by

$Eb = \sigma T4$

Where σ – Stefan Boltzmann constant – 5.669 x 10-8 w/m2k4

UNIT IV – QUANTUM PHYSICS

1. **Explain Planck's hypothesis or what are the postulates of Planck's quantum theory?**
   (i) The black body radiation chamber is filled with a large number of oscillating particles. The particles can vibrate in all possible frequencies.
   (ii) The frequency of radiation emitted by an oscillator is the same as that of the frequency of that vibrating particle.
   (iii)The oscillatory particles cannot emit energy continuously. They will radiate energy only in the form of a discrete packet of energy, i.e., a small unit called quantum photon.

2. **What is meant by blackbody radiation?**

A perfect black body is one that absorbs radiation of all wavelengths incident on it. Further, such a body cannot transmit or reflect any radiation and therefore it appears black. A black body can radiate energy in all possible wavelengths when it is heated to a suitable temperature. The radiation emitted from black body is known as black body radiation or total radiation.

3. **Give the importance of Planck`s radiation formula.**
   1. It explains all region of block body spectrum
   2. It is based on quantum theory
   3. It is used derive other laws related to black body radiation

4. State Compton effect. (Or) Give a brief account on Compton effect.

When a beam of X – rays is scattered by a substance of low atomic number, the scattered X-ray radiation consists of two components, one component has the same wavelength λ as the incident ray and the other component has a slightly longer wavelength λ'. This phenomenon is known as Compton effect.

5. What is the physical significance of a wave function?

1. It relates the particles and wave nature of matter elastically.
2. The square of the wave function is a measure of the probability of finding the particle at a particular position.It cannot predict the exact location of the particle.
3. The wave function is a complex quantity, where as the probability is a real and positive quantity.
4. The wave function has no physical meaning.
5. $|\psi|2$ = is real and positive, amplitude may be positive or negative but the intensity(square of amplitude) is always real and positive.
6. $|\psi|2$ represents the probability density or probability of finding the particle in the given region.
7. For a given volume dτ, probability $P = \int\int\int |\psi|2\, d\tau$ where $d\tau = dx\, dy\, dz$

6. What is meant by photon?

The discrete energy values in the form of small packets or quantas of definite frequency or wavelength are called photons. Photons propagate like a particle with speed of light as 3×10^8 ms^{-1}.

7. State Wien's displacement law.

According to Wien's displacement law, the product of the wavelength corresponding to aximum energy (λm) and absolute temperature is a constant. i.e λmT = constant.

8.What is a wave function?

A variable quantity which characterizes de-Broglie wave is known as wave function and it is donoted by the symbol Ψ.

9. What is black body and what are its characteristics?

1. A perfect black body is the one which absorbs and also emits the radiations completely.
2. There is no black body in nature. We have to coat the black colour over the inner surface to make a black body.
3. Black body is said to be a perfect absorber, since it absorbs all the wavelengths Of the incident radiation.
4. The black body is the perfect radiator because it radiates the entire wavelength absorbed by it. This phenomenon is called black body radiation.

10. State Planck's quantum theory (or) State Planck's hypothesis (or) What are the postulates of Planck's quantum theory? (or) What are the assumptions of quantum theory of black body radiation? (or) Give the special features of Quantum theory.

1. The electrons in the black body are assumed as simple harmonic oscillators.
2. The oscillators will not emit energy continuously.

3. The emit radiation in terms of quantas of magnitude 'hυ', discretely.i.e. E = nhυ, where n = 0, 1, 2, 3, …..

11. What are meant by a degenerate state and Non-degenerate state?

1. For various combinations of quantum numbers, if we get same eigen value but different eigen functions, it is called degenerate state.
2. For various combinations of quantum numbers, if we get same eigen value but same eigen functions, it is called Non-degenerate state.

12. What is the principle electron microscopy?

In an electron microscope, a stream of electrons are passed through the object and the electrons which carry the information about the object are focused by electric and magnetic lenses (or) electromagnetic lenses.

13. For a free particle moving within a one dimensional potential box, the ground state energy cannot be zero. Why?

For a free particle moving within a one dimensional potential box, when n = 0, the wave function is zero for all values of x, i.e., it is zero even within the potential box. This would mean that the particle is not present within the box. Therefore the state with n = 0 is not allowed. As energy is proportional to n2, the ground state energy cannot be zero since n = 0 is not allowed.

14. Mention the applications of scanning tunneling microscope.

1. Scanning tunneling microscope is a microscope commonly used in fundamental and industrial research.
2. STM has a good resolution is 0.1nm lateral resolution and 0.01nm depth resolution
3. The high resolution of STM`s enable researches to examine surface at an atomic level.

15. List out the advantages and disadvantages of STM.

Advantage:

1. It can be used to examine specimens of large thickness.
2. It can be used to get a three dimensional image of the object.
3. Since the image can be directly viewed in the screen, structural details can be resolved in a precise manner.
4. The magnification may be upto 3,00,000 times greater than that of the size Of the object.

Disadvantage:

1. The resolution of the image is limited to about 10-20 nm, hence it is very poor.

16. State wave duality.

Wave–particle duality is the concept that every particle or quantic entity maybe partly described in terms not only of particles, but also of waves. It expresses the inability of the classical concepts "particle" or "wave" to fully describe the behavior of quantum-scale objects.

17. What is mean by electron diffraction?

Electron diffraction refers to the wave nature of electrons. However, from a technical or practical point of view, it may be regarded as a technique used to study matter by firing electrons at a sample and observing the resulting interference pattern.

18. Define wave duality.

The behaviors of the electron does not allow for it to be observable as a particle and as a wave. The two sided nature of the electron is known as the Wave-Particle Duality: The property of particles behaving as waves and the property of waves behaving as particles as well as waves. Although the duality is not very effective in large matter. The wave characteristic of the electron implicates many of the electron's particle behaviors.

19. What is mean by tunneling?

Quantum tunnelling or tunneling (see spelling differences) refers to the quantum mechanical phenomenon where a particle tunnels through a barrier that it classically could not surmount. ... The effect was predicted in the early 20th century and its acceptance as a general physical phenomenon came mid-century.

20. Define STM.

Scanning tunneling microscopy is a microscopical technique that allows the investigation of electrically conducting surfaces down to the atomic scale. In the following I will give a very short overview of the basic principle

21. What are matter waves?

The waves associated with moving particles of matter (e.g., electrons , photons , etc) are known as matter waves or de-Broglie

22. What is meant by photon?

The discrete energy values in the form of small packets or quantas of definite frequency or wavelength are called photons. Photons propagate like a particle with speed of light as 3×10^{8} ms^{-1}

23. Write the principle of TEM.

When the electrons are passed through the specimen, image is produced by using either transmitted (bright field image) or diffracted (dark field image) electron beam through the specimen. This gives the three dimensional image of the specimen.

24. Bring out the differences between Scanning Electron Microscope (SEM) and Transmission Electron Microscope (TEM).

S.NO	SEM	TEM
1	Scattered electrons are used	Transmitted electrons are used
2	SEM provides a 3D image	TEM provides an detailed image of a specimen
3	Magnification upto 2 million times	Magnification upto 50 million times
4	Preparation of sample is easy	Preparation of sample is difficult
5	Thick specimen can also be analyzed	The specimen should be thin
6	SEM is used for surface analysis	TEM is used for analyzing sections

25. Give the special features of Quantum theory.

(i) The electrons in the black body are assumed as simple harmonic oscillators. (ii) The oscillators will not emit energy continuously. (iii)The emit radiation in terms of quantas of magnitude 'hυ', discretely. i.e. E = nhυ, where n = 0, 1, 2, 3, …..

26. What are meant by a degenerate state and Non-degenerate state?

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28. Define Quantum Mechanics

Quantum Physics The classical world-view works fine at the everyday (macroscopic) level – much of modern engineering relies on this – but there are things at the macroscopic level that cannot be understood using classical physics, these including the colour of a heated object, the existence of solid objects . . . . So where does classical physics come unstuck? Non-classical behaviour is most readily observed for microscopic systems – atoms and molecules, but is in fact present at all scales. The sort of behaviour exhibited by microscopic systems that are indicators of a failure of classical physics are • Intrinsic Randomness • Interference phenomena (e.g. particles acting like waves) • Entanglement

29. What aspect of all physical theories do the principles of quantum mechanics apply?

The principles must apply to theories as diverse as Newton's Laws describing the mechanical properties of matter, Maxwell's equations describing the electromagnetic field, the laws of thermodynamics .

30. Is particle physics and quantum physics the same?

Quantum physics (also known as quantum mechanics, or QM) is more general. ... Particle physics, on the other hand, involves the application of QM or other fundamental type of theories to specific particles that we see in nature. You probably know about atoms.

31. What is the magnification of the scanning tunneling microscope?

The scanning electron microscope is capable or rendering images at magnifications ranging from 10X to 500,000X, 250 times the limit of the most powerful optical microscopes. A SEM produces a beam of electrons with an electron gun.

32.What is meant by photon?

The discrete energy values in the form of small packets or quantas of definite frequency or wavelength are called photons. Photons propagate like a particle with speed of light as 3 x 108 ms-1.

33.Write the principle of TEM.

When the electrons are passed through the specimen, image is produced by using either transmitted (bright field image) or diffracted (dark field image) electron beam through the specimen. This gives the three dimensional image of the specimen.

34. What is black body and what are its characteristics?

A perfect black body is the one which absorbs and also emits the radiations completely. (ii) There is no black body in nature. We have to coat the black colour over the inner surface to make a black body. (iii) Black body is said to be a perfect absorber, since it absorbs all the wavelengths Of the incident radiation. (iv) The black body is the perfect radiator because it radiates the entire wavelength absorbed by it. This phenomenon is called black body radiation.

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38.Mention the applications of scanning electron microscope

(i) It is used to examine the structure of specimens in a three dimensional view. (ii) This microscope also has wide range of applications in various fields such as biology, industry, engineering, physics, chemistry etc.

39. List out the advantages and disadvantages of SEM.

Advantages: (i) It can be used to examine specimens of large thickness. (ii) It has large depth of focus. (iii) It can be used to get a three dimensional image of the object. (iv) Since the image can be directly viewed in the screen, structural details can be resolved in a precise manner. (v) The magnification may be upto 3,00,000 times greater than that of the size Of the object.

Disadvantages: The resolution of the image is limited to about 10-20 nm, hence it is very poor.

40. What is the concept of wave-particle duality?

On the basis of experimental facts like interference, diffraction and polarization it is clear that EM radiation possess wave nature. On the other hand there are experimental evidences like photoelectric effect, emission and absorption spectra, black body radiation etc., which shows that EM radiation consists of discrete indivisible packets of energy (hυ), photons. Hence we can conclude that EM radiation has dual character, i.e., particle as well as wave. However, both the characteristics can never be observed simultaneously.

41. Why the de-Broglie wave associated with a moving car is not observable.

We know that λ in inversely proportional to m. Since m is very large for a car therefore λ is very small. Consequently, the de-Broglie wave associated with moving car is not visible.

42. Are matter waves electromagnetic?

No. This is because electromagnetic waves are produced by accelerated charge. On the other hand, the de-Broglie wave is independent of the charge of a particle.

UNIT V – CRYSTAL PHYSICS

1. What is a Crystal? (or) What are crystalline materials? Give examples.

Crystalline solids (or) Crystals are those in which the constituent atoms (or) molecules are arranged in an orderly fashion throughout in a three dimensional pattern .Example :Copper, Silver.

2. What is an amorphous solid? Give example. (or) Non-Crystalline materials.

It is a type of solid, in which the atoms (or) molecules are not arranged in an orderly fashion. (ie) the same atomic groups are arranged more randomly. Example: Plastic, rubber

3. What is meant by Crystallography?

The study of the geometric form and other physical properties of crystalline solids, using x-rays (or) electron beam (or) neuron beam etc is termed as the science of crystallography.

4. What is a single crystal?

A crystal in which solid contains only one crystal. These single crystals are produced artificially from their vapor (or) Liquid State.

5. What is a poly crystal? Give example.

A crystal structure in which has an aggregate of many small crystals (or) grains separated by well defined grain boundaries. These crystals will have a sharp melting point. Examples: Diamond, Copper, Platinum, Silver, Polonium, Gold, Aluminum, Nickel, Cadmium, Iron etc.

6. What are the differences between crystalline and non-crystalline materials?

Crystalline material .	Non-crystalline material
They have definite and regular geometrical shapes which extend through the crystal.	They don't have definite geometrical shapes
They are anisotropic	They are isotropic
They are most stable	They are less stable
Example: Nacl , Kcl	Example: Plastic, Glass, rubber

7. What is meant by crystallization and X-ray crystallography?

The phase change from Liquid (or) gas to solid is called Crystallization. The crystal structure gives the arrangement of atoms within a crystal. Determination of crystal structure with the help of X-ray is known as X-ray crystallography.

8. Define Lattice.

Lattice is defined as an array which are imaginarily kept points to represent the position of atoms in the crystal such that every lattice point has got the same environment as that of the other and hence one lattice point can not be distinguished from the other lattice point.

9. Define space lattice (or) crystal lattice. (May 2003, June 2005)

A three dimensional collection of points in space are called space lattice (or) crystal lattice. The environment about any particular point is in every way the same. (or) A geometrical representation of the crystal structure in terms of lattice points are called space lattice, provided the environment about every point is identical to that of every other point.

10. Define lattice points.

Lattice points denote the position of atoms (or) molecules in the crystal (or) The points in the space lattice are called lattice points.

11 .Define Basis.

Basis is an unit assembly of atoms (or) molecules which are identified with respect to the position of lattice points, identical in composition arrangement and orientation.

12 What is meant by structure?

A crystal lattice refers to the geometry of a set of point in space, Where the crystal structure refers to the actual ordering (or) alignment of its constituent ions, atoms (or) molecules in the space. The crystal structure is formed by the addition of basis to every lattice point of the lattice. (ie) Space lattice + Basis (or) Mot if = Crystal structure

13. Define lattice planes?

A set of parallel and equally spaced planes in a space lattice, Which are formed with respect to the lattice points are called lattice planes.

14. Define unit cell.

The unit cell is defined as the smallest geometric figure, the translational repetition of which in all over the three dimensions gives the actual crystal structure.(OR) The unit cell may also be defined as the fundamental elementary pattern with minimum number of atoms, molecules (or) groups of molecules which represents the total characteristics of the crystal.

15.What is called as crystallographic axis?

The lines drawn parallel to the lines of intersection of any three faces of the unit cell which do not lie in the same place called crystallographic axis.

16.What is unit cell parameter (or) lattice parameters?

The three intercept quantities a, b and c are called the fundamental translational vectors (or) axial lengths (or) intercepts (a,b and c) and three inter facial angles are called unit cell parameter (or) lattice parameters.

17.What are primitives (or) Characteristic intercepts?

The intercepts a, b and c are nothing but the edge of the unit cell (ie the distance between two lattice points) which define the dimensions of an unit cell. These intercepts are known as its primitives (or) characteristic intercepts on the axis.

18.What is primitive cell? (May 2003, Nov 2003)

A primitive cell is the simplest type of unit cell which contains only one lattice point per unit cell (contains lattice points at its corner only) Example :Simple Cubic (SC)

19.Which are called Non-Primitive cell.

If there are more than one lattice point in an unit cell, it is called a non-primitive cell.

Example: BCC and FCC.

20.Name of the seven crystal system.

Triclinic, Mono clinic, Orthorhombic, Tetragonal, Hexagonal, Trigonal and Cubic.

21.What are Bravais lattices? (May 2004)

The 14 possible ways of arranging points in space lattice such that, all lattice points have exactly the same surroundings. These 14 lattice in seven crystal structure are called Bravais lattice.

22.What is known number of atoms per unit cell (or) effective number?

The total number of atoms present in (or) shared by an unit cell is known as number of atoms per unit cell.

23.Define atomic radius.

Atomic radius is defined as half of the distance between any two nearest neighbor atoms which have direct contact with each other, in a crystal of a pure element. It is interns of cube edge 'a'.

24.Define co-ordination number.

Co-ordination number is the number of nearest neighboring atoms to a particular atom. (or) Co-ordination number is the number of nearest neighbors directly surrounding a given atom.

25.Define Atomic packing factor (or) Packing density (or) density of packing (May 2004).

Atomic packing factor is defined as the ratio between the volume occupied by the total number of atoms per unit cell (v) to the total volume of the unit cell (V). APF=Volume occupied by the total number of atoms per unit cell(v) Total volume of the unit cell(V) (or) APF=Total Number of atom per unit cell * Volume of one atom (v) Total volume of the unit cell(V) APF=v/V

26.Name the crystal structure of the following materials.

(a).Gold – FCC (b) Germanium –Diamond cubic (c).Barium – BBC (d) Zinc – HCP

27.Bismuth has a=b=c=4.74AU and angle α=β= γ=60ºwhat is its crystal structure?(Nov 2003)

a=b=c=4.74AU α=β=r=60º Bismuth is Trigonal (or) Rhombohedral

28. State the condition imposed on the coll parameter for systems having the largest number of bravais lattices the least number of nearest neighbors.

1. Crystal with least number of nearest neighbours is simple (six neighbours)
2. crystal system with largest number of bravais lattice is orthorhombic (4 bravaais lattices).

29.Define inter atomic distance and inter planer distance.

Inter atomic distance: The distance between any two atoms is called inter atomic distance.

Inter planar distance: The distance between any two planer is called inter – planar distance.

30.What are point defects? (or) Zero dimensional defects?

The defects which take place due to imperfect packing of atoms during crystallization are known as point defects.

31.What are franked (or) Scotty defects?

Franked defect is an conic crystal imperfection that occurs when an ion moves into an interstitial site, thereby creating two defects. Simultaneously (ie) One vacancy and the other self interstitial. A pair of ion vacancies in an ionic crystal is termed as Scotty defect.

32.What is a line defect (or) a one dimensional defect?

The defects which take place due to dislocation (or) distortion of atoms along a line in some direction is called line defect.

33.What is edge dislocation?

It is a region of lattice disturbance extending along on edge inside a crystal due to the insertion of an extra place of atoms.

34. What is screw dislocation?

Screw dislocation results from a displacement of the atoms in one part of a crystal relative to the rest of crystal forming a spiral ramp around the dislocation line.

35.What is meant by stacking fault?

The stacking faults are planar surface imperfection and are caused by faults in the stacking sequence of atomic planer in construction FCC and HCP materials

36. What are the differences between edge and grew dislocation?

Edge dislocation	Screw dislocation
These dislocations arise due to introduction (or) elimination of an extra place of atoms.	Screw dislocation results from a displacement of the atoms in one part of a crystal relative to the rest of

	crystal forming a spiral ramp around the dislocation line.
Region of lattice disturbance extends along an edge inside a crystals	Region of lattice disturbance extends in two separate planes each other.
An edge dislocation can glide and climb	A screw dislocation can glide only
Burger vector is always perpendicular to the dislocation line.	Burger vector is parallel to the dislocation line.
These are formed during deformation and crystallization	These are also formed during deformation and crystallization.

37. Classify the crystal growth techniques.

The crystal growth technique is classified into 6 types. They are

1. Melt growth
2. Low temperature solution growth
3. High temperature solution growth (Flux growth)
4. Hydrothermal growth
5. Gel growth
6. Vapour phase growth

38. Name the two important Melt growth techniques.

Melt growth is the process of crystallization by fusion and resolidification of the starting materials from the melt.

Czochralski's and Bridgman technique are the two important techniques of crystal growth from melt.

39. What is difference between crystal structure and crystal systems?

A crystal structure is described by both the geometry and atomic arrangements within, the unit cell, whereas a crystal system is described only in terms of the unit cell geometry. For example, face-centered cubic and body-centered cubic are crystal structures that belong to the cubic crystal system.

40. What is the difference between atomic structure and crystal structure?

Atomic structure relates to the number of protons and neutrons in the nucleus of an atom, as well as the number and probability distributions of the constituent electrons. On the other hand, crystal structure pertains to the arrangement of atoms in the crystalline solid material.

41. What is meant by structure?

A crystal lattice refers to the geometry of a set of point in space, Where the crystal structure refers to the actual ordering (or) alignment of its constituent ions, atoms (or) molecules in the space. The crystal structure is formed by the addition of basis to every lattice point of the lattice. (ie) Space lattice + Basis (or) Mot if = Crystal structure.

4. Define density of a material.

$$\rho = \frac{mass\ of\ the\ unit\ cell}{volume\ of\ the\ unit\ cell}$$

$$\rho = \frac{nM}{Na3}$$

N-avogadro's number ,

42. Define polymorphism.

- Polymorphism is defined as the ability of a material to exist in two or more crystal structure.

43. Define the term allotropy.

If the change in structures reversible,then the polymeric change is known as allotropy.

44. How many lattice point does a primitive cell have?

Primitive unit cells contain only one lattice point, which is made up from the lattice points at each of the corners.

45. How many lattice points are there in FCC?

The face centered cubic lattice contains 4 lattice point per unit cell. The maximum packing density occurs when the atoms have a radius which equals one quarter of the diagonal of one face of the unit cell.

46. What is the lattice structure of diamond?

Diamond is a metastable allotrope of carbon where each carbon atom is bonded covalently with other, surrounding four carbon atoms and are arranged in a variation of the face centered cubic crystal structure, called a diamond lattice.

47. What is the structure of diamond?

Diamond has a giant molecular structure. Each carbon atom is covalently bonded to four other carbon atoms. A lot of energy is needed to separate the atoms in diamond. This is because covalent bonds are strong, and diamond contains very many covalent bonds.

48.What is meant by crystallization and X-ray crystallography?

The phase change from Liquid (or) gas to solid is called Crystallization. The crystal structure gives the arrangement of atoms within a crystal. Determination of crystal structure with the help of X-ray is known as X-ray crystallography.

49.What is meant by Crystallography?

The study of the geometric form and other physical properties of crystalline solids, using x-rays (or) electron beam (or) neuron beam etc are termed as the science of crystallography.

50. What is the need for growing single crystals?

Many electronic devices need single crystals for their operation. Single crystal silicon is used in the fabrication of semiconductors. Another application of single crystal solids is in materials science in the production of high strength materials with low thermal creep, such as turbine blades.

51. Give any two advantages of crystal defects.

Substitutional impurities that are a mismatch in size to the host prevent dislocations from migrating smoothly along a plane. Generally, the higher the concentration of impurities, the more effectively they block migration, and the stronger the material.

If an interstitial impurity forms polar covalent bonds to the host atoms, the layers are prevented from sliding past one another, even when only a small amount of the impurity is present.

52.Draw the Bravais lattices belonging to the orthorhombic crystal system.

There are four orthorhombic Bravais lattices: primitive orthorhombic, base-centered orthorhombic, body-centered orthorhombic and face-centered orthorhombic.

53. Distinguish between Frenkel and schottky defects.

Schottky defect occurs when oppositely charged atoms (cation and anion) leave their corresponding lattice sites and create a pair of Vacancy Defects. Since both cation and anion leave the lattice sites at the same time, so overall electrical neutrality of the crystal is maintained; however, density reduces because of the vacancies. Schottky defects occur in ionic crystals where the size of anion is almost same with the size of the cation.

Frenkel Defect is one type of point defect where an atom (better to say ion, especially cation) leaves its original lattice site and occupies an interstitial position on the same crystal. Usually, this type of defect is observed in ionic solids, where size of anion is substantially larger than the size of cation.

54. Define the terms primitive and non-primitive unit cells.

A primitive cell is the simplest type of unit cell which contains only one lattice point per unit cell (contains lattice points at its corner only).

If there are more than one lattice points in a unit cell, it is called a non-primitive cell.

55. Write Packing factor for BCC and FCC structures.

Packing factor of BCC is 0.68 and packing factor of FCC is 0.74.

56.Name the crystal structure of the following (a).Gold (b) Germanium (c).Barium (d) Zinc

(a).Gold – FCC (b) Germanium –Diamond cubic

(c).Barium – BBC (d) Zinc – HCP

57.What is meant by grain boundaries?

A grain boundary is the interface between two grains, or crystallites, in a polycrystalline material.

58.Bismuth has a=b=c=4.74AU and angle α=β= =60º what is its crystal structure?

a=b=c=4.74AU α=β=r=60º

Bismuth is Trigonal (or) Rhombohedral

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