

B.E./B.Tech. DEGREE EXAMINATION, JANUARY 2018

First Semester

Civil Engineering

PH 8151 – ENGINEERING PHYSICS

(Common to : All Branches)

(Regulations 2017)

Time : Three Hours

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Maximum : 100 Marks

Answer ALL questions.

PART – A

(10×2=20 Marks)

1. What are the effects of hammering and annealing on elasticity of a material ?
2. When a wire is bent back and forth, it becomes hot. Why ?
3. Define forced and damped oscillations.
4. How will you classify optical fibers based on the material ?
5. Distinguish between conduction and convection.
6. For a free particle moving within a one dimensional potential box, the ground state energy cannot be zero, why ?
7. State Wien's displacement law.
8. What is a bimetallic strip ? Give its applications.
9. For a cubic system, sketch the planes with miller Indices (110), (101), (011).
10. Determine the lattice constant for FCC lead crystal of radius 1.746 \AA .



11. a) What is Torsion pendulum ? Explain how it is used to determine the moment of inertia and rigidity modulus of the material of a thin wire. (16)

(OR)

- b) Derive an expression for the deflection produced at the free end of a rectangular cantilever subjected to point load at free end. What will be the deflection produced at the free end, with same load, if the cantilever is of circular cross section. (16)

12. a) Compare a homojunction semiconductor laser with a hetero junction semiconductor laser and detail their features. (16)

(OR)

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- b) Derive an expression for Acceptance angle and Numerical aperture of an optical fiber. Bring out the differences between step index and graded index fiber. (12+4)

13. a) i) How will you determine the thermal conductivity of a poor conductor using Lee's disc method. Give the necessary theory.

- ii) A metal cube takes 5 minutes to cool from 60°C to 52°C. How much time will it take to cool to 44°C, if the temperature of the surroundings is 32°C ?

(12+4)

(OR)

- b) How are heat exchangers helpful in refrigerators, ovens and solar water heater ? (16)

14. a) What is Compton effect ? Give the theory of Compton effect and show that the Compton shift. (16)

$$\lambda' - \lambda = \frac{h}{m_0 c} (1 - \cos\theta)$$

(OR)

- b) What are the drawbacks of classical free electron theory ? Derive Schrodinger time dependent and time independent wave equations. (2+7+7)

15. a) What is packing factor ? Obtain packing factors for SC, BCC, FCC and HCP structures. (2+3+3+3+5)

(OR)

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- b) Write a note on point imperfections in crystals. Discuss in detail a suitable method to grow single crystal of semiconducting materials. (8+8)

Reg. No. :

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Question Paper Code : 80277

B.E./B.Tech. DEGREE EXAMINATIONS, APRIL/MAY 2019.

First Semester

Civil Engineering

PH 8151 — ENGINEERING PHYSICS

(Common to all Branches)

(Regulation 2017)

Time : Three hours

Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. List any two factors affecting elastic modulus and tensile strength.
2. An artificial denture with ultimate strength of 10^7 Nm^{-2} breaks when the jaws exerted a normal force of just 2N while eating. Estimate the area in which the force acted on the denture.
3. Show that it is possible for stimulated emission to be predominant over spontaneous emission at microwave frequencies (~GHz) at room temperature 300K.
Given that $h = 6.626 \times 10^{-34} \text{ Js}$ $k = 1.38 \times 10^{-23} \text{ J/K}$
4. List the two major differences of homojunction and heterojunction lasers.
5. What are bimetallic strips? Give its application.
6. Give any two examples in daily life demonstrating thermal insulation is done through compound media.
7. Give the two important characteristics of black body radiation.
8. Define Compton effect.
9. Determine the lattice constant of a FCC crystal having atomic radius of 14.76 nm.
10. How does plastic deformation occur in solids?

PART B — (5 × 16 = 80 marks)

11. (a) (i) Derive an expression for couple per unit twist for a cylinder. (16)
(ii) Show that it is higher for a hollow cylinder than a solid cylinder made of the same material, mass and length. (6)

Or

- (b) Derive an expression for rigidity modulus and explain how rigidity modulus of a wire can be determined using a torsion pendulum. (16)
12. (a) (i) Derive Einstein's relations for spontaneous and stimulated emission of radiation. (12)
(ii) Obtain the ratio of Stimulated emission rate to stimulated absorption rate and discuss population inversion. (4)

Or

- (b) Derive Numerical Aperture and Acceptance Angle of a fiber. Discuss the various types of optical fiber. (8 + 8)
13. (a) Explain Forbe's method to determine the thermal conductivity of a good conductor. (16)

Or

- (b) Explain Lee's Disc method to determine the thermal conductivity of a poor conductor. (16)
14. (a) Derive an equation for Plank's quantum theory of radiation. (16)

Or

- (b) Solve time independent Schrödinger wave equation for a particle trapped in a potential well and obtain eigen functions and energy eigen values for the particle. Also show that the energy values are quantized. (16)
15. (a) Describe the two bulk crystal growth methods in detail using suitable schematic diagrams to fabricate semiconductor and dielectric materials. (16)

Or

- (b) (i) Derive the packing factor for HCP crystal structure. (10)
(ii) Write short notes on crystal imperfections and its advantages. (6)



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Question Paper Code : 25170

E.E./B.Tech. DEGREE EXAMINATION, DECEMBER/JANUARY 2019.

First Semester

Civil Engineering

PH 8151 - ENGINEERING PHYSICS

(Common to All Branches)

(Regulations 2017)

Time : Three hours

Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)



1. What is Hook's law?
2. Define tensile strength.
3. What is meant by cavity loss?
4. Why does inter modal dispersion occur?
5. Comment on the thermal behavior of Invar.
6. List the important characteristics of a material to be a thermal insulator.
7. Mention the physical significance of wave function.
8. Brief about the tunneling phenomenon.
9. Show the atomic positions in fcc and hcp crystal structures in a sketch.
10. What is Burger vector?

PART B — (5 × 16 = 80 marks)

11. (a) (i) Draw the typical stress-strain diagram of a wire and mention its uses. (8)
- (ii) Derive an expression for the rigidity modulus using torsion pendulum. (10)

Or

- (b) (i) Compare uniform and non-uniform bending. (8)
- (ii) Appraise the properties and applications of I shape grids. (8)

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12. (a) (i) Explain forced and damped oscillations.
(ii) Derive the equation of motion. With appropriate figures. (8 + 8)

Or

- (b) (i) Give a schematic sketch of normal and population inversion state of a Laser and obtain Einstein coefficients A and B. (8)
(ii) Demonstrate the working of any one type of fiber optic pressure sensor. (8)
13. (a) (i) Relate the linear and volume thermal expansion coefficients for an isotropic solid. (6)
(ii) Compare the thermal expansion in solids and liquids. (10)

Or

- (b) (i) With a neat sketch, explain the Forbe's method of thermal conductivity determination. (8)
(ii) Write a note on the following:
(1) Heat exchangers (2) Solar water heaters. (8)
14. (a) (i) Derive the time-independent and time dependent Schrodinger wave equations. (12)
(ii) A photon of frequency ν_0 scatters from an electron at rest and moves in a direction making an angle of 60° with the incident direction. If the frequency of the scattered photon is half that of incident photon, calculate the frequency of the incident photon. (4)

Or

- (b) (i) Demonstrate the working of scanning tunneling microscope. (6)
(ii) Derive an expression for black body radiation using Planck's theory of radiation. (10)
15. (a) (i) Explain various crystal systems with neat diagrams. (8)
(ii) Describe the steps to determine Miller indices and also mention its importance. (8)

Or

- (b) (i) Derive the Packing factor for HCP. (10)
(ii) Explain any one experimental method of growing single crystal. (6)

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DEPARTMENT OF MECHANICAL ENGINEERING
PH8151-ENGINEERING PHYSICS
QUESTION BANK
UNIT-I
PROPERTIES OF MATTER

1. What is elasticity? (June 2010)

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

2. What are elastic bodies? (Dec 2011)

Bodies which regain its original shape and size after the removal of deforming force are called elastic bodies.

3. Define stress. Give its unit. (Nov 2008)

The restoring force acting per unit area of the body is called the stress. The restoring force is equal and opposite to the applied force. S I Unit: Nm^{-2}

4. What are types of stresses? (Nov 2008)

It is found that a deforming force may change length or shape or volume of a body. Accordingly there are three types of stresses. (i) Linear stress (ii) Shearing stress (iii) Volume stress.

5. Define strain and its unit. (Jan 2012)

The change in dimension or shape of a body due to the deforming force results in strain. It is defined as the ratio of change in dimension to the original dimension. i.e,

$$\text{Strain} = \frac{\text{Change in dimension}}{\text{Original dimension}}$$

6. What are types of strain?(Jan 2012)

According to the changes takes place in length, area and volume, there are three types of strains namely,

- (i) Linear strain
- (ii) Shearing strain
- (iii) Volume strain

7. State Hooke's law. (Dec 2004, Jan 2019)

It states that within the elastic limit stress developed in the body is directly proportional to the strain produced in it.

Stress \propto Strain

$$\frac{\text{Stress}}{\text{Strain}} = E \text{ (Constant)}$$

E -coefficient of elasticity or modulus of elasticity.

8. What are the types of Moduli of Elasticity? (Dec 2011)

Within the elastic limit.

$$\text{Young's modulus (Y)} = \frac{\text{Longitudinal Stress}}{\text{Longitudinal Strain}}$$

$$\text{Rigidity modulus (n)} = \frac{\text{Tangential Stress}}{\text{Shearing Strain}}$$

$$\text{Bulk modulus (K)} = \frac{\text{Volume Stress}}{\text{Volume Strain}}$$

Unit: SI unit of elasticity modulus Nm^{-2} .

9. Define Young's modulus of elasticity and mention its unit. (Dec 2013)

Within the elastic limit the ratio of linear stress to linear strain is called Young's modulus. It is denoted by the letter Y.

Young's modulus of elasticity (Y) = Linear stress / Linear strain

S.I. unit of Young's modulus is Nm^{-2} .

10. Define rigidity modulus and mention its unit. (Dec 2012)

Within the elastic limit the ratio of tangential stress to shearing strain is called rigidity modulus. It is denoted by the letter n.

Rigidity modulus (n) = Tangential stress / Shearing strain.

S.I. unit of rigidity modulus is Nm^{-2} .

11. Define bulk modulus and mention its unit. (April 2012)

Within the elastic limit the ratio of volume stress to volume strain is called bulk modulus. It is denoted by the letter K.

Bulk modulus (Y) = Volume stress / Volume strain

S.I. unit of bulk modulus is Nm^{-2} .

12. What is the use of stress – strain diagram? (Jan 2012)

The elastic behavior of solid materials is studied by the stress – strain diagram.

13. What are the effects of change in hammering and annealing on elasticity of material? (Dec 2009, Apr 2015, Jan 2018)

A change in the temperature affects the elastic properties of a material. A rise in temperature usually decreases the elasticity of the material. A carbon filament which highly elastic at normal temperature becomes plastic when it is at high temperature.

Similarly a decrease in temperature will increase the elastic property. Lead is not a very good elastic material. But at low temperature it becomes a very good elastic material. However, in some cases like the invar steel, the elasticity is not affected by any change in temperature.

14. Define bending moment of a beam? (June 2016)

The moment of the couple due to the elastic reactions (restoring couple) which balances the external couple due to the applied load is called bending moment.

5. What is uniform bending? (Jan 2011)

The beam is loaded uniformly on its both ends; the bent beam forms an arc of a circle. The elevation in the beam is produced. This bending is called uniform bending.

6. What is non-uniform bending? (April 2010)

If the beam is loaded at its mid-point, the depression produced does not form an arc of a circle. This type of bending is called non-uniform bending.

17. What is I Shape Girder? Mention its applications. (Dec 2009)

A girder is the one in which the upper and lower sections are broadened and the middle of the section is tapered so that it can withstand heavy loads over it. Since the girder looks like letter I, it is called as I shape girder.

Applications:

- (i) They are used in the construction of bridges over the rivers.
- (ii) They are very much useful in the production of iron rails which are employed in railway tracks.
- (iii) They are used as supporting beams for the ceilings in the construction of buildings

18. What are the advantages of I Shape Girder?

- (i) More stability
- (ii) More strength
- (iii) High durability
- (iii) Manufactured by less amount of raw material.

19. Define tensile strength. (Jan 2019)

It is defined as the maximum value of tensile stress withstand by the material before fracture under a steady load.

20. Define safety factor.

The ratio between the ultimate tensile stress and the working stress is called the safety factor.

21. What is Poisson's ratio?

Within the elastic limit, the lateral strain is directly proportional to longitudinal strain i.e. the ratio between lateral strain and longitudinal strain is called as Poisson's ratio(σ)

$$\text{Poisson ratio}(\sigma) = \frac{\beta}{\alpha}$$

22. List any two factors affecting elastic modulus and tensile strength. (May 2019)

- i) Effect of stress
- ii) Effect of change in temperature
- iii) Effect of impurities
- iv) Effect of hammering, rolling and annealing
- v) Effect of crystalline mature

23. Define neutral surface and neutral axis.

Neutral surface and Neutral axis:

In the middle of the beam along the thickness, there is a layer which is neither elongated nor compressed due to bending of the beam. This layer is called neutral layer and the line at which neutral layer intersects the plane of bending is called neutral axis.

24. Define Cantilever.

Cantilever:

Cantilever is a beam fixed at one end and loaded at the other end.

25. What is meant by torsional pendulum and mention its uses.

Torsional pendulum:

A circular metallic disc suspended using a thin wire that executes torsional oscillation is called torsional pendulum.

Uses:

- It is used to find rigidity modulus of the wire
- Moment of inertia of disc.

26. What is meant by torsional stress?

Torsional stress:

The shear stress set up in the shaft when equal and opposite torques are applied to the ends of a shaft about its axis is called torsional stress.

UNIT-II

WAVES AND FIBRE OPTICS

1. Define damped oscillation. (Jan 2018)

Most of the oscillations in air or in any medium are damped. When an oscillation occurs, some kind of damping force may arise due to friction of air resistance offered by the medium. So a part of the energy is dissipated in overcoming the resistive force.

Consequently, the amplitude of oscillations decreases with time and finally becomes zero. Such oscillations are called damped oscillations.

2. What is forced oscillation? (Jan 2018)

When a vibrating body is maintained in the state of oscillations by a periodic force of frequently (n) other than its natural frequently of the body, the oscillations are called forced oscillations.

3. Define progressive wave.

A progressive wave is defined as the vibratory motion of a body which is transmitted continuously in the same direction from one particle to the successive particle of the medium and travel forward through the medium due to its elastic property.

4. Define plane progressive wave.

Progressive wave originating from a point source and propagating through an isotropic medium travel with equal velocity in all directions.

At any instant, the wave front will be spherical in nature. If the sphere of very large radius is considered, the spherical wave will approximate to a plane surface and the waves are called plane progressive waves.

5. What is Laser?

Laser is a device which produces a powerful, monochromatic, collimated beam of light in which the light waves are coherent.

6. What is stimulated emission? (Jan 2012)

The process of forced emission of photons caused by the incident photons is called stimulated emission. This process is the key factor to the operation of a laser.

7. What are the conditions necessary for stimulated emission of radiation? (April 2010)

- (i) The atoms must be in the excited state.
- (ii) The photon of light radiation must strike the atoms in the excited state.

8. What is meant by population inversion and how it is achieved? *

(Jan 2009, Dec 2014, June 2016)

In laser technology, the establishment of a situation in which the number of atoms in higher energy level is greater than the number of atoms in the lower energy level is called population inversion. It is an essential requirement for producing a laser beam. It is achieved by pumping action.

9. What is pumping action? (May 2013)

In laser technology, the process of creating a population inversion in the atomic states is known as pumping action. It is essential requirement for producing a laser beam.

10. Write the differences between spontaneous emission and stimulated emission?

(Dec 2011)

S.No	Stimulated emission	Spontaneous emission
1	The emitted photons move in same direction and high directionally.	The emitted photons move in all direction and are random.
2	The radiation is high intense, monochromatic and coherent.	The radiation is less intense and is incoherent.
3	The photons are in phase.	The photons are not in phase.
4	This process is a key factor for laser operation	This is not a key factor for laser action

11. What are the characteristics of the laser? (Or) What are the properties of the laser beam? * (Jan 2010, May 2011, Jan 2012)

- Laser light is highly coherent
- It is highly powerful
- It is directional and monochromatic
- It is capable of propagation over long distances.
- It is extremely bright
- Laser beam is not easily absorbed by the water.

12. Compare the characteristics of laser with ordinary thermal source of light. *(Jan 2011, May 2012, Jan 2013)

S.No	Ordinary light	Laser Light
1	In Ordinary light the angular spread is more.	In Laser light the angular spread is
2.	They are not directional.	They are highly directional.
3.	It is less intense.	It is highly intense.
4.	It is not coherent beam and is not in phase	It is coherent beam and it is in phase
5.	The radiations are polychromatic	The radiations are monochromatic
6.	Example: Sunlight, Mercury vapour lamp	Example: CO ₂ laser, He – Ne laser

13. Can a two level system be used for the production of laser? Why? (Jan 2014)

No, two level system cannot be used for the production of laser. To achieve population inversion, three level laser systems is needed.

14. What are the methods commonly used for pumping action? (Dec 2008)

- Optical pumping (excitation by photons)
- Electrical discharge method (excitation by electrons)
- Direct conversion
- Inelastic collision between atoms.

15. What is meant by active material in laser? (Jan 2012)

A material in which population inversion can be achieved is called as active material.

16. Under which conditions a set of laser beams is said to be coherent? (Dec 2012)

A set of laser beams is said to be coherent if they have same frequency and constant phase difference among them with respect to space and time.

17. Why Nd-YAG laser is more efficient than a Ruby laser? (Dec 2015)

Ruby laser is a three level laser. The ground energy level of ruby material is lower lasing energy level. So large input energy is required to establish population inversion. But Nd-YAG laser is a four level laser. So less input energy is required to establish population inversion. Hence Nd-YAG laser is more efficient than a Ruby laser.

18. Write the differences between homojunction and heterojunction laser. (Dec 2008, May 2019)

S.No	Homojunction laser	Heterojunction laser
1	Homojunction laser is made by single crystalline material.	Heterojunction laser is made by different crystalline materials.
2.	Power output is low	Power output is high.
3.	Pulsed output (sometimes continuous)	Continues output
4.	It has high threshold current density	It has low threshold current density.
5.	Cost is less	Cost is more
6.	Life time is less	Life time is more.
7.	Examples: 1)GaAs 2) InP	Examples:1)GaAs/GaAlAs 2)InP/InAlP

19. What is semiconductor laser? (Jan 2009)

Semiconductor diode laser is a specially fabricated p-n junction device. It emits laser light when it is forward biased.

20. Mention the applications of laser in industry. * (Jan 2004, May 2006)

Nd: YAG and CO₂ lasers are very much used in industries for the following processes:

- Welding, Cutting, Drilling
- **Heat treatment:** of metallic and non-metallic (plastic, ceramic, glass) materials
- **Non Destructive Testing (NDT):** For testing the materials for flaws or defects without damaging them.

21. What is an optical fiber?

Optical fiber is a hair thin structure made up of transparent material which can guide the light beam from one place to another by total internal reflection.

22. Define acceptance angle. (Jan 2010)

The maximum angle 'θ₀' with which a ray of light can enter through one end of the fiber and still be total internally reflected is called acceptance angle of the fibre.

23. Define Numerical aperture of a fibre. * (Dec 2010, May 2011, May 2012, June 2014)

Numerical aperture of the fibre is the light collecting efficiency of the fibre and is a measure of the amount of light rays that can be accepted by the fibre. It is equal to the sine of the angle of acceptance.

$$NA = \sin \theta_a = \sqrt{n_1^2 - n_2^2}$$

where n₁ and n₂ are the refractive indices of core and cladding respectively.

24. What are types of optical fibers based on number of modes & material?

(Jan 2013, Jan 2018)

Optical fibers are classified depending on modes of propagation in the guide.

- (i) Single mode fiber-one mode
- (ii) Multimode fiber-many mode

Optical fibers are classified depending on material.

- (i) Glass fibers
- (ii) Plastic fibers

25. What are the differences between single mode fiber and multimode fiber? (Jan 2010)

S.No	Single mode fiber	Multimode fiber
1.	In single mode fiber only one mode can propagate through the fiber.	Multimode fiber allows a large number of paths or modes for the light rays travelling through it.
2.	It has smaller core dia and the differences between the refractive index of core and cladding is very small.	It has large core dia and refractive index difference is larger than the single mode fiber.
3.	No dispersion i.e. degradation of signal during travel in fiber.	There is signal degradation due to multimode dispersion.
4.	Fabrication is difficult and costly.	Fabrication is less difficult and not costly.

26. What are types of optical fibers based on the refractive index profile? (Jan 2011)

The optical fibers are also classified depending on the refractive index profile and the number of modes that the fibre can guide. There are

- i. Step-index single mode fiber
- ii. Step- index multimode fiber
- iii. Graded index multimode fiber

27. What is basic principle in optical fibre communication system? (Jan 2013)

The basic optic fibre communication is the transmission of information by propagation of optical signal through optical fibres over the required distance. It involves deriving optical signal from electrical signal at the transmitting end and conversion of optical signal back to electrical signal at the receiving end.

28. What is attenuation? (Dec 2008)

Attenuation in fibers means 'loss of optical power' suffered by the optical signal in the fiber itself. It is also known as fibers loss or signal loss

29. What are the differences between step index and graded index fiber? (May 2010, May 2011, Jan 2012, June 2016)

S. No	Step index fiber	Graded index fiber
1.	The refractive index of the core is uniform throughout and undergoes an abrupt (or)step change at the cladding boundary	The refractive index of the core is made to vary in the parabolic manner such that the maximum refractive index is present at the centre of the core.
2	The diameter of the core is about 50-200µm in the case of multimode fiber and 10 µm in the case of single mode fiber.	The diameter of the core is about 50 µm in the case of multimode fiber.
3	Attenuation is more for multimode step index fibers but for single mode step index fiber, it is very less	Attenuation is less
4.	Numerical aperture is more for multimode step index fiber but for single mode step index fiber it is very less.	Numerical aperture is less.

30. What are basic attenuation mechanisms? (May 2012)

The basic attenuation mechanisms in a fibre are

- 1. Absorption
- 2. Scattering
- 3. Radiative losses

31. What are the basic components of fiber optic communication system? Draw the block diagram. (May 2012, May 2015)

The main parts of fibre optic communication system are

- 1. Information signal source
- 2. Transmitter
- 3. Propagation medium
- 4. Light source
- 5. Photo detector
- 6. Receiver.

32. Give any 4 advantages of fibre optic communication system. (Jan 2014, Dec 2015)

- Light in weight and small in size.
- There is no possibility of cross talk and internal noise generation.
- No hazards of short circuits as in metal wires.
- Lower cost.

33. What are the uses of optical fibers? (Dec 2014)

- Fiber optic endoscopes are used to find minor cracks, pores in big machineries.
- They are used in coagulation in chemical industries and laboratories.
- It is also used to connect monitoring station and a remote sensor in industries.

34. Why intermodal dispersion is reduced in graded index fibers? (Jan 2016, Jan 2019)

By improving the quality of the light source, this dispersion is reduced in graded index fibers.

UNIT -III

THERMAL PHYSICS

1. Define heat conduction. (Jan 2018)

Conduction is the process of transmission of heat from one point to another through substance without the actual motion of the particles of the substance.

2. Define coefficient of thermal conductivity and mention its unit.

It is defined as the quantity of heat conducted per second normally across unit area of cross-section per unit temperature difference per unit length of the material.
Its unit is watt/metre/kelvin(W/m/K)

3. What is basic principle behind Lee's disc method in determining thermal conductivity of bad conductor?

The given bad conductor is taken in the form of disc is placed in between the metal disc and steam chamber. The steam is passed through the steam chamber. Heat conducted through bad conductor per second is calculated. Amount of heat lost per second by disc is also calculated.

4. How are heat conduction and electrical conduction analogous to each other?

S.No	Heat conduction	Electrical conduction
1	Heat is conducted from a point of higher temperature to a point of lower temperature.	Electricity is conducted from a point at higher potential to a point at lower potential.
2	In metals, heat conduction is mainly due to free electrons.	In metals, electrical conduction is due to free electrons.
3	The ability to conduct heat is measured by thermal conductivity.	The ability to conduct electricity is measured by electrical conductivity.

5. Define superficial expansion.

The coefficient of superficial expansion of a solid is the increase in area produced in unit area of the solid when the temperature is raised by 1K. It is denoted by the letter β .

- 6. Define of coefficient of cubical expansion.**
Coefficient of cubical expansion of a solid is the increase in volume of unit volume of a solid for 1K rise of temperature. It is denoted by the letter γ .
- 7. Define coefficient of real expansion of liquid.**
It is the real increase in volume of unit volume of a liquid per degree Kelvin rise of temperature. It is denoted by γ_r .
- 8. What is an expansion joint?**
An expansion joint or movement joint is an assembly designed to safely absorb the heat induced expansion or contraction of a pipeline, duct or vessel. It helps to hold parts together.
- 9. What is bimetallic strip?(Jan 2018,May 2019)**
A bimetallic strip means a strip made of two metals pined together. It is like compound bar. It operates on the principle that different metals have different coefficients of expansion.
- 10. Define thermal insulation(Jan 2019,May 2019).**
It will resist the flow of heat to and from a body. It is a material that reduces the rate of heat flow.
- 11. What are heat exchangers?**
They are devices used to transfer heat between two or more fluid streams at different temperatures.
- 12. Define convection.(Jan 2018)**
It is the process in which heat is transmitted from one place to another by the actual motion of the heated particles.
- 13. Define refrigerator.**
It is a machine which produces cold. It is used to remove heat from the refrigerated space and reject it to atmosphere. Hence, it maintains the temperature below the surrounding atmosphere.
- 14. Define oven.**
An oven is a thermally insulated chamber used for heating, backing or drying of a substance and most commonly used for cooking. Kilns and furnaces are special-purpose ovens, used in pottery and metalworking, respectively.
- 15. What is solar power?**
The energy obtained from the sun is called solar energy. Sun is the source of all energy. Sunlight contains infrared radiations in large proportion, and these infrared rays heats all objects on which they fall.

UNIT-IV QUANTUM PHYSICS

- 1. What is a black body and what are its characteristics?(May 2019)**

A perfect black body is the one which absorbs and also emits the radiations completely. In practice no body is perfectly black. We have to coat the black colour over the surface to make a black body. Black body is said to be a perfect absorber, since it absorbs all the wavelengths of the incident radiation. The black body is a perfect radiator, because it radiates the entire wavelength absorbed by it. This phenomenon is also called black body radiation.

2. State Kirchhoff's law of radiation?

Ratio of emissive power to the coefficient of absorption, of any given wavelength is the same for all bodies at a given temperature and is equal to the emissive power of the black body at that temperature.

3. State Planck's hypothesis.

The atomic oscillators can absorb or emit energy in the multiples of small unit called quantum. The quantum of radiation is called photon. The energy of the Photon (E) is proportional to the frequency of radiation (ν). $E \propto \nu$; i.e., $E = h\nu$

where h is a constant known as Planck's constant.

4. State Planck's law of radiation? (A.U.Dec 2008)

The energy density of radiation in an enclosure at temperature T in the wavelengths λ and $\lambda + d\lambda$ is

$$E_{\lambda} = \frac{8\pi hc}{\lambda^5 (e^{\frac{hc}{\lambda kT}} - 1)}$$

h – Planck's constant

c- speed of light

k- Boltzmann's constant

T- Temperature of the enclosure

5. Explain 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?

- A black body radiation chamber is not only filled up with the radiations but also with a large number of oscillating particles.
- The oscillators will not emit or absorb energy continuously.
- They emit radiation in terms of quanta of magnitude ($h\nu$), discretely.

$$\text{i.e., } E = nh\nu$$

$$\text{where } n = 1, 2, 3, 4, \dots$$

6. State Compton Effect. (A.U.Jan 2011, May 2019)

When a beam of high frequency radiation (X-ray or γ - ray) is scattered by a substance of low atomic number, the scattered radiation consists of two components, one has the same wavelength λ as the original incident ray and the other has a slightly longer wavelength λ' . This is known as Compton effect.

7. What is Compton wavelength? (A.U.Jan 2008)

The shift in wavelength corresponding to the scattering angle of 90° is called Compton wavelength.

$$\Delta\lambda = \frac{h}{m_0 c} (1 - \cos\theta)$$

$$\theta = 90^\circ$$

$$\Delta\lambda = 0.02\text{Å}$$

8. Define Wien's displacement law. Give its limitation. (Jan 2018)

It is defined as, "The product of the wavelength (λ_m) of maximum energy emitted and the absolute temperature (T) is a constant".

$$\lambda_m T = \text{Constant}$$

Limitation: It holds good only for shorter wavelength

9. Define Rayleigh-Jeans law. Give its limitation.

It is defined as, "The energy is directly proportional to the absolute temperature and is inversely proportional to the fourth power of the wavelength".

$$E_\lambda = \frac{8\pi KT}{\lambda^4}$$

Where, k-Boltzmann constant

T-temperature

λ -wavelength

Limitation: It holds good only for longer wavelength.

10. Arrive at Wien's displacement law from Planck's law.

$$E_\lambda = \frac{8\pi hc}{\lambda^5 e^{\frac{hc}{\lambda T}}}$$

11. Arrive at Rayleigh Jeans law from Planck's law.

$$E_\lambda = \frac{8\pi KT}{\lambda^4}$$

12. What are matter waves? (A.U.2012)

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

13. State the properties of the matter waves.?(A.U.Jan 2012)

- i. Lighter is the particle, greater is the wavelength associated with it.
- ii. Smaller is the velocity of the particle, greater is wavelength associated with it.
- iii. These waves are not electromagnetic waves but they are a new kind of waves.
- iv. The wave and particle aspects of moving bodies can never appear together in the same experiment.

14. State de-Broglie's hypothesis (or) Explain the concept of wave nature.(or) What is meant by matter waves? Give the origin of this concept. (A.U.May 2012)

We know nature loves symmetry, since the light exhibits the dual nature (i.e) it can behave both as a particle and the wave, de-broglie suggested that an electron, which is particle can also behave as a wave and exhibits the dual nature.

Thus the wave associated with a material particle (electron) is called as matter waves. If v is the velocity and m is the mass of the particle then

$$\text{de-Broglie wavelength } \lambda = \frac{h}{mv}$$

15. What is the physical significance of a wave function? (May 2011, Jan 2013, Jan 2019)

- (a) The probability of finding a particle in space, at any given instant of time is characterised by a function $\psi(x,y,z)$, called wave function.
- (b) It relates the particle and the wave statistically.
- (c) It gives information about the particle behaviour.
- (d) It is a complex quantity.

16. What is meant by photon? Give any two properties.

Photons are discrete energy values in the form of small quantas of definite frequency (or) wavelength.

Properties:

- 1. They do not have any charge and they will not ionise.
- 2. The energy and momentum of the photon is given by

$$E = h\nu \text{ and } p = mc$$

Where ν - frequency

m - mass of photon

c - velocity of photon, h - Planck's constant

17. What is an electron microscope? (A.U. Dec. 2012)

- (i) It is a microscope in which the object is illuminated by highly accelerated fast-moving electron beam.
- (ii) It has a very high magnification of about 100,000X and very high resolving power.
- (iii) It works on the principle of electron diffraction

18. State the principle of electron microscope. (A.U. Nov. 2011)

The given object is illuminated by highly accelerated fast-moving electron. The focussing of electron beam is done by magnetic fields (magnetic lenses).

The shorter wavelength of electron permits the detailed examination of tiny objects due to reduction of diffraction effects.

19. What is G.P Thomson experiment?

G.P Thomson made investigations with high speed electrons, accelerated by a potential difference ranging from 10,000 to 50,000 volts and studied the electron diffraction effects. Thomson found the diffraction patterns exactly analogous to X-ray patterns. Moreover he was able to determine the wavelengths associated with electrons.

20. For a free particle moving within a one dimensional potential box, the ground state energy cannot be zero, why? (Jan 2018)

26. Wh

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 n^2 the ground state energy cannot be zero since $n=0$ is not allowed.

21. What are types of electron microscope? (A.U.Dec 2012)

- i) Transmission Electron Microscope (TEM)
- ii) Scanning Electron Microscope (SEM)
- iii) Scanning Transmission Electron Microscope (STEM)
- iv) Scanning Tunneling Microscope (STM)

22. What are eigen values and eigen functions?

Energy of a particle moving in one dimensional box of width 'a' is given by

$$E_n = \frac{n^2 h^2}{8ma^2}$$

$$\psi_n = \sqrt{\frac{2}{a}} \sin\left(\frac{n\pi x}{a}\right)$$

For each value of n , there is an energy level. Each value of (E_n) is called an eigen value. For every quantum state (i.e. for different 'n' values), there is a corresponding wave function (ψ_n) . This corresponding wave function is called eigen function.

Eigen function associated with an electron in a one dimensional box.

23. Define tunneling effect(Jan 2019)

Quantum mechanics leads to an entirely new result. It shows that there is a finite chance for the electron to leak to the other side of the barrier. We can say that the electron tunneled through the potential barrier and hence in quantum mechanics, the phenomenon is called tunneling.

24. What are the application of tunneling effect?

Tunneling is significant in many area of physics. The tunnel diode is a semiconductor diode in which electrons tunnel through a potential barrier. The current can be switched on and off very quickly by varying the height of the barrier, which is done with an applied voltage. The scanning tunneling microscope uses electron tunneling to produce images of surfaces down to the scale of individual atoms.

25. What is scanning tunneling microscope?

In 1981, Gerd Binnig and Heinrich Rohrer developed the scanning tunneling microscope (STM), a significantly superior tool for observing surface atom by atom. STM is the highest resolution imaging and nano fabrication technique available. It relies on quantum tunneling of electrons from a sharp metal tip to a conducting surface.

6. What is the principle of scanning tunneling microscope?

STM has a metal needle that scans the sample by moving back and forth over it, gathering information about the curvature of the surface and follow the smallest changes in the contours, of a sample. The needle does not touch the sample, however, but stays about the width of two atoms above it.

7. What are the applications of STM?

The STM shows the positions of atoms-or more precisely, the position of some of the electrons. Uses of STM to study metals and semiconductors surface can provide non-trivial real space information especially in studying semiconductor such as Silicon (100) surface. One innovation applications of STM recently found is manipulation of atoms. For example, iron atoms are placed on Cu surface and dragged by the STM tip and moves across the surface to a desired position. Then, the tip was withdrawn by lowering the tunneling current. To analyze the electronic structures of the active sites at catalyst surfaces.

8. What are the disadvantages of STM?

A small vibration, even a sound, could smash the tip and the sample together. A single dust particle, for example, could damage the needle.

UNIT- V

CRYSTAL PHYSICS

1. What is a space lattice? (May 2008, Dec 2009)

Space lattice is an infinite arrangement of points in three dimensions in which every point has an identical surrounding.

2. What is unit cell?(Jan 2009, May 2011, Apr 2017)

It is the smallest geometrical structure of a solid from which the entire crystal structure can be constructed by repetition in three-dimension.

3. Name the seven crystal systems. (Jan 2010, May 2012)

- (i) Cubic
- (ii) Tetragonal
- (iii) Orthorhombic
- (iv) Monoclinic
- (v) Triclinic
- (vi) Rhombohedral
- (vii) Hexagonal

4. What is primitive cell? (May 2011, Jan 2014)

A primitive cell is the simplest type of unit cell which contains one lattice point per unit cell.

13. S

5. What are Bravais lattices? (May 2010, Jan 2012, Jan 2013, Nov 2015)

There are only 14 ways of arranging points in space such that the environment looks same from each point. i.e., there are 14 possible types of space lattices out of the seven crystal systems. These 14 space lattices are called as Bravais lattice.

6. Define Coordination number. (Dec 2010)

It is the number of nearest atoms directly surroundings a particular atom in a crystal.

7. Give the values of number of atoms in unit cell of SC, BCC, FCC and HCP. (Jan 2008, 2009)

Type of Structure	Number of atoms per unit cell
Simple Cubic	1
Body Centred Cubic	2
Face Centred Cubic	4
Hexagonal Close Packed	6

8. What are the Coordination numbers for SC, BCC, FCC and HCP and Diamond? (May 2009, Apr 2015)

Type of Structure	Coordination number
Simple Cubic	6
Body Centred Cubic	8
Face Centred Cubic	12
Hexagonal Close Packed	12
Diamond	4

9. Define Atomic radius. (Jan 2011)

The half of the distance between nearest neighbouring atoms in a crystal is known as atomic radius. It is denoted by 'r' and it is usually expressed in terms of the cube edge 'a' (lattice parameter).

10. Define Packing factor. What is its unit? (May 2013, May 2014, Nov 2016)

➤ It is defined as the ratio of the total volume occupied by the atoms in a unit cell to the total volume of a unit cell.

$$\text{Packing factor} = \frac{\text{Total volume occupied by the atoms in a unit cell (v)}}{\text{Total volume of the unit cell (V)}}$$

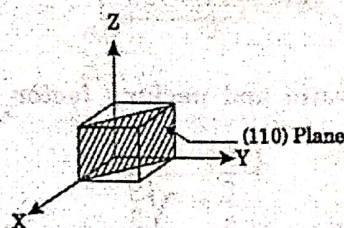
$$= \frac{\text{Number of atoms in a unit cell} \times \text{Volume of one atom}}{\text{Total volume of the unit cell}}$$

➤ There is no unit since it is a same ratio.

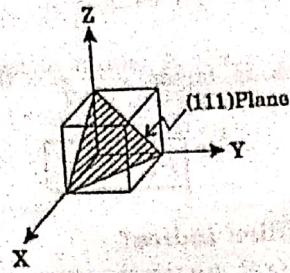
11. What are Miller indices? (May 2010, Jan 2011, Apr 2011, Nov 2014)

Miller indices are defined as a set of three numbers to designate a plane in a crystal.

12. Sketch the (110) plane in a cubic system. (May 2008, Jan 2009, Jan 2018)



13. Sketch the (111) plane in a cubic system. (May 2010, Jan 2011)



14. Obtain Miller indices of a plane whose intercepts are a , $b/2$, $3c$ in a simple cubic unit cell. (Jan 2010)

Actual intercepts are $a, b/2, 3c$

Numerical parameters are $1, 1/2, 3$

Reciprocals of the above $1, 2, 1/3$

Take L.C.M (i.e.) $3, 6, 1$

Miller indices of the plane = $(3\ 6\ 1)$

15. State the conditions imposed on the cell parameters for crystal systems having the largest Bravais lattices and the least number of nearest neighbours.

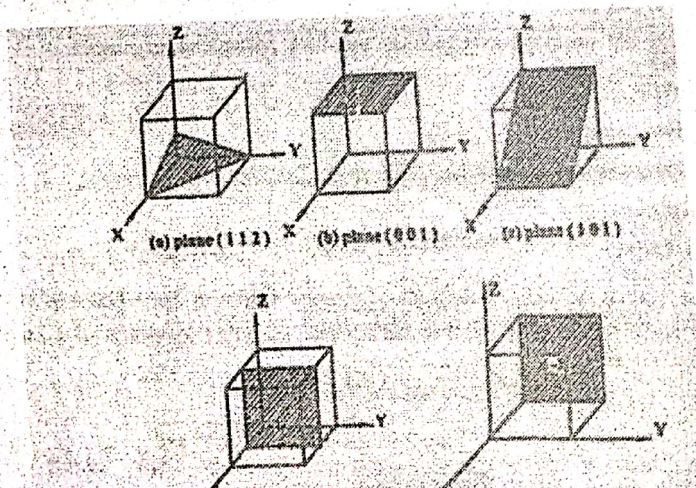
- System having largest number of Bravais lattices is orthorhombic. Its cell parameters $a \neq b \neq c$;
 $\alpha = \beta = \gamma = 90^\circ$
- System having least number of nearest neighbours is in diamond cubic (4). Its cell parameters $a = b = c$; $\alpha = \beta = \gamma = 90^\circ$

16. What is crystal defect?

The deviation from the regularity of arrangement of atoms is called crystal imperfection or crystal defect.

17. Draw the following planes in a cubic structure. $(1\ 1\ 2)$, $(0\ 0\ 1)$, $(1\ 0\ 1)$, $(2\ 0\ 0)$ and $(1\ 0\ 0)$

(Jan 2018)



18. Figure below shows the three crystal planes. Compute the miller indices of those planes.

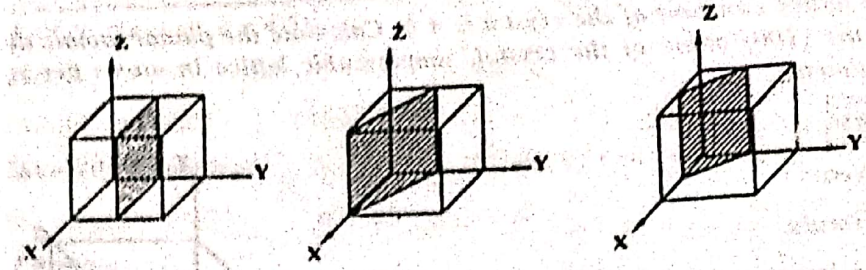


Fig (a)

Fig (b)

Fig (c)

In Fig (a) the given plane is parallel to X and Z axes. Thus, its numerical intercepts on these two axes are infinity. The numerical intercept on Y axis is $\frac{1}{2}$ (or) 0.5. Thus, the numerical intercepts of the plane is $(\infty, \frac{1}{2}, \infty)$

\therefore Miller indices of the plane is $(0\ 2\ 0)$

In fig (b) the given plane is parallel to Z axis. Thus, its numerical intercept of the Z axis is infinity. The numerical intercept on X axis is 1 and Y axis is $\frac{1}{2}$. Thus, the numerical intercepts of the plane is $(1, \frac{1}{2}, \infty)$.

\therefore Miller indices of the plane is $(1\ 2\ 0)$

In Fig (c) The given plane is parallel to Z axis. Thus, its numerical intercept on this Z axis is infinity. The numerical intercept on X and Y axis $\frac{1}{2}$ and $\frac{1}{2}$. Thus numerical intercepts of the plane is $(\frac{1}{2}, \frac{1}{2}, \infty)$.

\therefore Miller indices of the plane is $(2\ 2\ 0)$

19. What are the differences between Crystalline and Non Crystalline Materials? (Nov 2014)

S.No	Crystalline Materials	Non Crystalline Materials
1	They have definite geometrical shape.	They don't have definite geometrical shape.
2	They are anisotropic	They are Isotropic
3	They are more stable	They are less stable
4	Examples : NaCl, KCl etc.	Examples : Plastic, Rubber etc.

20. What is impurity defect? What are the types of impurity defects?

A foreign substance added to a crystal is called impurity. The impurity atom may fit in the structure in two ways giving rise to two kinds of impurity defects. One is Substitutional impurity and another one is Interstitial impurity.

21. What are vacancies?

Vacancies are empty atomic sites. Vacancies may occur as a result of imperfect packing during the original crystallization or they may arise from the thermal vibrations of atoms at higher temperatures. There are different kinds of vacancies like Frenkel defect, Schottky defect, Colour centres etc.

22. What are the various types of crystal defects?

(i) Point defect (Zero dimensional)

(a) Impurity defect

- Substitutional impurity
- Interstitial impurity

(b) Vacancies

- Frenkel defect
- Schottky defect

(ii) Line defect (One Dimensional)

(a) Edge dislocation

(b) Screw dislocation

(iii) Surface defect (Two Dimensional)

(a) Grain boundaries

(b) Twin boundaries

(c) Tilt boundaries

(d) Stacking fault

(e) Ferromagnetic domain walls

(iv) Volume defect (Three Dimensional)

(a) Cavities or voids

(b) Cracks and holes

23. What is Frenkel defect? (Jan 2010, May 2010)

A vacancy associated with interstitial impurity is called Frenkel defect.

24. What is Schottky defect? (Jan 2010, Nov 2010, Apr 2011)

If an atom is missing from its lattice site, the vacancy is called Schottky defect.

25. What is line defect? What are its types?

The defect along a line is called line defect. There are two types of line defect. One is Edge dislocation and another one is Screw dislocation.

26. What is Burger Vector? (May 2009, May 2013, Jan 2019)

The magnitude and the direction of the displacement due to edge dislocation are defined by a vector called Burger's vector.

27. What are twin boundaries?

If the atomic arrangement on one side of the boundary is the mirror image of the arrangement on the other side, the defect is called twin boundaries.

28. What is stacking fault?

This defect arises due to defect in the stacking of atomic planes. In some cases a part of certain atomic plane will be missing where as in some other case a portion of extra atomic plane is present, changing the sequence of arrangement of atoms.

29. Mention the various crystal growing techniques.

- Melt growth
- Low temperature solution growth
- High temperature solution growth
- Epitaxial growth

30. What is Melt growth? (Jan 2014)

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

31. What are the advantages of Czochralski method?

- Growth from free surface
- Growth of large oriented single crystals.
- Convenient chemical composition
- Control of atmosphere

32. What is the basic principle of Bridgman technique?

A common technique for growing single crystals involves selective cooling of the molten material so that solidification occurs along a particular crystal direction. In this technique, the melt in a sealed crucible is progressively frozen from one end.

33. What are the disadvantages of slow evaporation method?

- The growth substance should not react with the solvent.
- This method is applicable for substances fairly soluble in a solvent.

34. What is epitaxial growth? Mention its applications.

The process of growing an oriented single crystal layer on a substrate wafer is called epitaxial growth. This method is mainly used in the manufacture of LED's and detectors.

35. What is the basic principle of slow evaporation method?

In this method, the saturated solution is kept at a particular temperature and provision is made for evaporation.

KNOWLEDGE INSTITUTE OF TECHNOLOGY
DEPARTMENT OF MECHANICAL ENGINEERING
PH8151-ENGINEERING PHYSICS
QUESTION BANK
UNIT-I
PROPERTIES OF MATTER

1. What is elasticity? (June 2010)
2. What are elastic bodies? (Dec 2011)
3. Define stress. Give its unit. (Nov 2008)
4. What are types of stresses? (Nov 2008)
5. Define strain and its unit. (Jan 2012)
6. What are types of strain? (Jan 2012)
7. State Hooke's law. (Dec 2004, Jan 2019)
8. What are the types of Moduli of Elasticity? (Dec 2011)
9. Define Young's modulus of elasticity and mention its unit. (Dec 2013)
10. Define rigidity modulus and mention its unit. (Dec 2012)
11. Define bulk modulus and mention its unit. (April 2012)
12. What is the use of stress – strain diagram? (Jan 2012)
13. What are the effects of change in hammering and annealing on elasticity of a material?
(Dec 2009, Apr 2015, Jan 2018)
14. Define bending moment of a beam? (June 2016)
15. What is uniform bending? (Jan 2011)
16. What is non-uniform bending? (April 2010)
17. What is I Shape Girder? Mention its applications. (Dec 2009)
18. What are the advantages of I Shape Girder?
19. What is Poisson's ratio?
20. Draw the Stress- strain diagram.
21. Define tensile strength. (Jan 2019)
22. Define safety factor.
23. List any two factors affecting elastic modulus and tensile strength. (May 2019)
24. Define neutral surface and neutral axis.
25. Define Cantilever.
26. What is meant by torsional pendulum and mention its uses.
27. What is meant by torsional stress?

Part – B

- (i) A cantilever is clamped horizontally at one end and loaded at the other. Obtain the relation between the depression at the loaded end and the load applied. (Jan 2018)
 - (ii) Give an account of I-shaped girders. (Nov 2014, Apr 2015, Dec 2015, Jan 2019)
- Explain the necessary theory, the determination of Young's modulus of elasticity of the material of the beam, supported at its ends and loaded in the middle. (June 2016, Jan 2019)
- (i) Derive an expression for the internal bending moment of a beam in terms of radius of curvature. (Nov 2008)
 - (ii) Explain Stress strain diagram. (Jan 2019)
- Explain the factors affecting the elasticity.
- Give an expression for the couple to produce a unit twist in a long cylindrical wire fixed at one end. How is it used in the determination of modulus of rigidity of a wire? (May 2019)
- Derive an expression for the elevation at the center of beam which is loaded at both ends. Describe an experiment to determine Young's modulus of the material of the beam by uniform bending. (Jan 2011, Jan 2019)
- Describe with relevant theory, how the moment of inertia of the disc of the torsional pendulum is experimentally determined, using two equal symmetrical masses. Also indicate how the rigidity modulus of the suspension wire is found. (Jan 2018, Jan 2019, May 2019)

UNIT-II WAVES AND FIBER OPTICS PART-A

- Define damped oscillation. (Jan 2018)
- What is forced oscillation? (Jan 2018)
- Define progressive wave.
- Define plane progressive wave.
- What is Laser?
- What is stimulated emission? (Jan 2012)
- What are the conditions necessary for stimulated emission of radiation? (April 2010)
- Write the differences between spontaneous emission and stimulated emission? (Dec 2011)
- What is meant by population inversion and how it is achieved? (June 2016)
- Explain the need for population inversion in the production of laser? (Dec 2010)
- What is pumping action? (May 2013)
- What are the methods commonly used for pumping action? (Dec 2008)
- What is meant by optical pumping? (Jan 2009)

14. What is meant by active material in laser? (Jan 2012)
15. What are the characteristics of the laser? (Or) What are the properties of the laser beam? (Jan 2010, May 2011, Jan 2012)
16. Under which conditions a set of laser beams is said to be coherent? (Dec 2012)
17. Compare the characteristics of laser with ordinary thermal source of light. (Jan 2013)
18. What is optical resonant cavity? (Jan 2010)
19. What is the function of resonator cavity in laser? (May 2001).
20. What is the principle of laser action? (May 2003)
21. What are the three important components of any laser device? (Jan 2012)
22. What are the conditions required for laser action? (Dec 2010)
23. What are Einstein's coefficients? (Jan 2009)
24. Can a two level system be used for the production of laser? Why? (Jan 2014)
25. How lasers are classified? Or Mention the various types of lasers. (May 2013)
26. What is Nd-YAG laser? (May 2012)
27. Why Nd-YAG laser is more efficient than a Ruby laser? (Dec 2015)
28. What are the applications of Nd-YAG laser? (Jan 2013)
29. What is semiconductor laser? (Jan 2009)
30. Write the differences between homojunction and heterojunction laser. (Dec 2008)
31. What is homo-junction laser? (Jan 2010)
32. What is hetero-junction laser? (Jan 2011)
33. What are the drawbacks of homojunction laser diodes? (April 2009)
34. What are the applications of semiconductor laser? (May 2003)
35. Mention the medical applications of laser (Jan 2010, May 2011)
36. What are the scientific and engineering applications of the laser? (Jan 2011)
37. Mention the applications of laser in industry. (Jan 2004, May 2006)
38. What is an optical fiber?
39. Define acceptance angle. (Jan 2010)
40. Define Numerical aperture of a fibre. (June 2014)
41. What are types of optical fibers based on number of modes & material? (Jan 2013, Jan 2018)
42. What are the differences between single mode fiber and multimode fiber? (Jan 2010)
43. What are types of optical fibers based on the refractive index profile? (Jan 2011)
44. What are the differences between step index and graded index fiber? (June 2016)
45. What is attenuation? (Dec 2008)
46. What are basic attenuation mechanisms? (May 2012)
47. What is basic principle in optical fibre communication system? (Jan 2013)

48. What are the basic components of fiber optic communication system? Draw the block diagram. (May 2012, May 2015)
49. What are the uses of optical fibers? (Dec 2014)
50. Why intermodal dispersion is reduced in graded index fibers? (Jan 2016, Jan 2019)

PART-B

1. Form the equation of damped oscillation. Solve the equation and discuss its general and particular solutions. (Jan 2019)
2. Develop the general theory of damped oscillations and discuss on the following cases, (i) motion is dead-beat, (ii) motion is critically damped, and (iii) motion is oscillatory
3. Develop the theory of forced harmonic motion. Find the amplitude of motion at resonant frequency. (Jan 2019)
4. What are forced vibrations? Give the theory of forced vibrations and discuss on the conditions of resonance.
5. Derive the expression for the wave equation of a plane progressive wave.
6. For atomic transitions, derive Einstein relations and hence deduce the expressions for the ratio of spontaneous emission to the stimulated emission rate. (Jan 2011, Jan 2019, May 2019)
7. Describe the construction and working of semiconductor diode laser with necessary diagrams. (Jan 2011, 2013, Jan 2018)
8. Explain the propagation of light through optical fiber and the applications of optical fiber as wave guide and sensor. (Dec 2015, June 2016, Jan 2018, May 2019)
9. Define numerical aperture and derive an expression for numerical aperture and angle of acceptance of fiber in terms of refractive index of the core and cladding. Mention any six advantages of optical fiber for communication as a wave guide. (Nov 2010, Dec 2015, June 2016).
10. Discuss the various types of optical fibers. (Dec 2012, May 2019)
11. Discuss in detail the classification of optical fiber based on material, mode and refractive index profile. (Dec 2014, May 2015, Jan 2018).
12. What are the different types of fiber optic sensors? Explain the working of displacement and temperature sensors. (Jan 2010, 2012, 2014, Jan 2019).
13. Explain fiber optic communication system with a neat block diagram. (Jan 2009).
14. Explain the importance of fiber optic communications. (June 2016)

UNIT -III

Thermal Physics

Part - A

1. Define heat conduction (Jan 2018)
2. Define coefficient of thermal conductivity and mention its unit.

- block
3. What is basic principle behind Lee's disc method in determining thermal conductivity of bad conductor?
 4. How are heat conduction and electrical conduction analogous to each other?
 5. Define superficial expansion.
 6. Define of coefficient of cubical expansion.
 7. Define coefficient of real expansion of liquid.
 8. What is an expansion joint?
 9. What is bimetallic strip? (Jan 2018, May 2019)
 10. Define thermal insulation. (Jan 2019, May 2019)
 11. What are heat exchangers?
 12. Define convection. (Jan 2018)
 13. Define refrigerator.
 14. Define oven.
 15. What is solar power?
 16. Explain why the specimen used to determine thermal conductivity of a bad conductor should have a larger area and smaller thickness. (April 2013)
 17. Write down an expression for the amount of heat conducted through a compound media of two layers. (Jan 2009)
 18. What are the three modes of transferring heat?
 19. What are the characteristics of good and bad conductors? (Nov 2011)
 20. What is thermal resistance? (Jan 2012)

PART-B

1. Describe Forbe's method to determine thermal conductivity of metal with relevant theory. (Jan 2019, May 2019)
2. Describe with relevant theory the method of determining the coefficient of thermal conductivity of a bad conductor by Lee's disc method. (Dec 2011, Jan 2014, Jan 2018, May 2019)
3. Describe heat exchangers and refrigerators. (Jan 2018, Jan 2019)
4. Write notes on oven. (Jan 2018)
5. Describe the working of solar water heater. (Jan 2018, Jan 2019)
6. Compare the thermal expansion in solids and liquids. (Jan 2019)
7. Relate the linear and volume thermal expansion coefficient for an isotropic solid. (Jan 2019)

UNIT-IV **QUANTUM PHYSICS** **PART-A**

1. What is a black body and what are its characteristics? (May 2019)
2. State Kirchhoff's law of radiation?
3. State Planck's hypothesis.
4. State Planck's law of radiation? (Dec 2008)
5. Explain 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?
6. State Compton Effect. (Jan 2011)
7. What is Compton wavelength? (Jan 2008, May 2019)

8. Define Wien's displacement law. Give its limitation. (Jan 2018)
9. Define Rayleigh-Jeans law. Give its limitation.
10. Arrive at Wien's displacement law from Planck's law.
11. Arrive at Rayleigh Jeans's law from Planck's law.
12. What are matter waves? (2012)
13. State the properties of the matter waves? (Jan 2012).
14. State de-Broglie's hypothesis (or) Explain the concept of wave nature. (or) What is meant by matter waves? Give the origin of this concept. (May 2012)
15. What is the physical significance of a wave function? (May 2011, Jan 2013, Jan 2019)
16. What is meant by photon? Give any two properties.
17. What is an electron microscope? (Dec.2012)
18. State the principle of electron microscope. (Nov.2011)
19. What is G.P Thomson experiment?
20. For a free particle moving within a one dimensional potential box, the ground state energy cannot be zero, Why? (Jan 2018)
21. What are types of electron microscope? (Dec 2012)
22. What are Eigen values and Eigen functions?
23. Define tunneling effect. (Jan 2019)
24. What is the application of tunneling effect?
25. What is scanning tunneling microscope?
26. What is the principle of scanning tunneling microscope?
27. What are the applications of STM?
28. What are the disadvantages of STM?

PART-B

1. (a) Explain Planck's quantum hypothesis.
(b) Derive Planck's radiation law. (May 2013)
2. Derive Planck's law for black body radiation and hence deduce Wien's law and Rayleigh Jean's law. (May 2008, Jan 2019, May 2019) (or) Derive an expression for Planck's radiation law and discuss the same for shorter and longer wavelength.
4. (i) Define Compton Effect.
(ii) Derive an expression for the wavelength of the scattered photon (Compton shift). (May 2009, Jan 2010, Jan 2018)
(iii) Describe and experiment to verify Compton Effect.
5. Using Quantum theory derive an expression for the average energy emitted by a black body and arrive at Planck's radiation law in terms of frequency. State the assumption before starting the derivation.
6. Explain G.P.Thomson experiment to prove the wave nature of electron.

7. Derive the time independent Schrodinger equation for a one-dimensional case. Use it to prove that a particle enclosed in a one-dimensional box has quantized energy values. (April 2012, Jan. 2012, Jan. 2013, May 2019)
8. Derive the expression for Schrodinger time independent and time dependent wave equation. (Jan 2012, Jan 2018, Jan 2019)
9. Explain the principle and working of scanning tunneling electron microscope and list out its limitations. (Jan. 2012, Jan 2019)

UNIT- V

CRYSTAL PHYSICS

PART -A

1. What is a space lattice? (May 2008, Dec 2009)
2. What is unit cell? (Jan 2009, May 2011, Apr 2017)
3. Name the seven crystal systems. (Jan 2010, May 2012)
4. What is primitive cell? (May 2011, Jan 2014)
5. What are Bravais lattices? (May 2010, Jan 2012, Jan 2013, Nov 2015)
6. Define Coordination number. (Dec 2010)
7. Give the values of number of atoms in unit cell of SC, BCC, FCC and HCP. (Jan 2008, 2009)
8. What are the Coordination numbers for SC, BCC, FCC and HCP and Diamond? (Apr 2015)
9. Define Atomic radius. (Jan 2011)
10. Define Packing factor. What is its unit? (May 2013, May 2014, Nov 2016)
11. What are Miller indices? (May 2010, Jan 2011, Apr 2011, Nov 2014)
12. Sketch the (110) plane in a cubic system. (May 2008, Jan 2009, Jan 2018)
13. Sketch the (111) plane in a cubic system. (May 2010, Jan 2011)
14. Obtain Miller indices of a plane whose intercepts are a , $b/2$, $3c$ in a simple cubic unit cell. (Jan 2010)
15. State the conditions imposed on the cell parameters for crystal systems having the largest
16. Bravais lattices and the least number of nearest neighbours.
17. Draw the following planes in a cubic structure. (1 1 2), (0 0 1), (1 0 1), and (1 0 0) (Jan 2018)
18. Figure below shows the three crystal planes. Compute the miller indices of those planes.
19. What are the differences between Crystalline and Non Crystalline Materials? (Nov 2014)
20. What is crystal defect?
21. What are the various types of crystal defects?
22. What is impurity defect? What are the types of impurity defects?
23. What are vacancies?
24. What is Frenkel defect? (Jan 2010, May 2010)
25. What is Schottky defect? (Jan 2010, Nov 2010, Apr 2011)
26. What is line defect? What are its types?
27. What is Burger Vector? (May 2009, May 2013, Jan 2019)
28. What are twin boundaries?
29. What is stacking fault?
30. Mention the various crystal growing techniques.
31. What is Melt growth? (Jan 2014)
32. What are the advantages of Czochralski method?

33. What is the basic principle of Bridgman technique?
34. What are the disadvantages of slow evaporation method?
35. What is epitaxial growth? Mention its applications.
36. What is the basic principle of slow evaporation method?

PART-B

1. Explain the physical basis of classifying crystals into seven crystal systems and 14 Bravais lattices. (Nov 2014, Jan 2019)
2. Derive an expression for packing factor of a BCC unit cell. (Apr 2015)
3. Define coordination number and packing factor for a hexagonal close packed structure. Show that HCP structure demands an axial ratio of 1.633. (Dec 2012, Nov 2015)
4. Show that the packing factor for HCP and FCC is equal. (Jan 2010, Dec 2013, Nov 2014, Jan 2018, Jan 2019)
5. (i) Define packing factor of a unit cell.
(ii) Explain the term atomic radius, co-ordination number and packing factor.
(iii) Obtain the expressions for packing factor of FCC and BCC unit cells. (Jan 2013, Jan 2018)
6. (i) Obtain the packing factor for the hexagonal closed packed structure. (Jan 2014, Apr 2015)
(ii) Derive an expression for the inter planar spacing of (hkl) planes of a cubic structure. (Jan 2013, Apr 2015, Nov 2015, Nov 2016, Apr 2017)
7. (i) Describe the structure of HCP crystal
(ii) Calculate the axial ratio and atomic packing factor for HCP structure. (May 2014)
8. Explain the following structures. (i) Diamond (ii) Graphite. (Nov 2016, Apr 2017)
9. (i). Describe the diamond structure. What type of bond is present in diamond?
(ii) Iron has BCC structure with atomic radius $0.123A^0$. Find the lattice constant of the unit cell. (Jan 2012)
10. (i) What are Miller indices? Mention the steps involved to determine the Miller indices with example. (Jan 2019)
(ii) Show that the packing factor for HCP is 74 %. (May 2013, Jan 2014, May 2019)
11. Explain crystal defect in detailed manner. (Jan 2012, May 2012, May 2013, Jan 2018)
12. (i) Describe Bridgman method of crystal growth. Mention its advantages and disadvantages. (Jan 2019, May 2019)
(ii) Briefly explain the Chemical Vapour Deposition method. (Nov 2015, May 2016)
13. Describe Czochralski method of crystal growth. Mention its advantages and disadvantages. (Nov 2014, May 2016, Jan 2018, May 2019)
14. Describe the solution growth of crystal and list out its advantages and disadvantages.
15. Explain the vapour growth techniques of growing crystals.

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PH8151 – ENGINEERING PHYSICS (R-2017)

QUESTION BANK

PART – A

UNIT 1 – PROPERTIES OF MATTER

1. What is stress-strain diagram and mention its uses.
2. Name the factors affect the elasticity of the body.
3. How does change in temperature affect the elastic property of a material?
4. What are the types of modulus of elasticity?
5. Define torsional stress.
6. What is meant by torsional pendulum and mention its uses.
7. Define tensile strength and safety factor.
8. What is bending moment?
9. What is Poisson's ratio?
10. What is Cantilever?
11. What is meant by uniform bending and non-uniform bending?
12. Define I-Shape girder.

UNIT 2 – WAVES AND OPTICS

13. Define damped oscillation.
14. Define forced oscillation.
15. Define plane progressive wave.

16. Differences between spontaneous emission and stimulated emission.

17. What is meant by population inversion?
18. Write down the condition for population inversion.
19. What is pumping action? Write down the pumping methods.
20. What are the conditions needed for laser action?
21. Difference between homojunction and heterojunction semiconductor laser.
22. Name the properties of laser which are making it suitable for industrial applications.
23. Mention any four applications of laser in medicine.
24. What is the principle of fiber optics?
25. What are the conditions to be satisfied for Total Internal Reflection?
26. Define Numerical aperture and Acceptance angle.
27. What are the classifications of optical fibers?
28. Difference between step index and graded index fiber.
29. What is meant by attenuation?
30. Give the advantages of fiber optic communication.
31. What are the applications of fiber optic systems?

UNIT 3 – THERMAL PHYSICS

32. Define Thermal conduction.
33. Define Thermal conductivity.

34. Define Coefficient of linear expansion.
35. Define coefficient of real expansion of liquid.
36. What are expansion joint and bimetallic strips?
37. What are the three modes of transferring heat?
38. What is the basic principle behind Lee's disc method in determining thermal conductivity of a bad conductor?
39. What are heat exchangers?
40. Define refrigerator and oven.
41. What is solar power and mention its advantages.

UNIT 4 – QUANTUM PHYSICS

42. Define black body and black body radiation.
43. Write Planck's radiation law.
44. State Wien's displacement law and Rayleigh jeans law of radiation.
45. What is Compton Effect? Write an expression for Compton wavelength.
46. What is meant by wave function?
47. Give the physical significance of wave function.
48. What is meant by matter waves? Mention its properties.
49. What are Eigen value and Eigen functions?
50. What is meant by normalization of wave function?
51. What is the basic principle in electron microscope?
52. Define tunneling effect.

53. What is the principle of Scanning tunneling microscope?
54. What are the advantages and disadvantages of STM?

UNIT 5 – CRYSTAL PHYSICS

55. Difference between crystalline and non-crystalline materials.
56. Name the seven crystal system.
57. What are Bravais lattices?
58. What are lattice parameters of unit cell?
59. What is primitive and non-primitive cell? Give an example.
60. What is unit cell?
61. What is packing factor?
62. Define atomic radius and coordination number.
63. Why diamond is called as closely packed structures?
64. Define Miller indices.
65. Sketch (100), (110), (101) and (111) plane in a cubic system.
66. Name few techniques of crystal growth from melt.
67. What is the basic principle of Czochralski and Bridgmann techniques?
68. What are the advantages and disadvantages of slow evaporation method?
69. What are the types of crystal defects?
70. What is Burger vector?

QUESTION BANK (PART-B)

UNIT – 1 (PROPERTIES OF MATTER)

1. STRESS-STRAIN DIAGRAM AND FACTORS AFFECTING ELASTICITY
2. BENDING MOMENT
3. CANTILEVER
4. UNIFORM BENDING
5. NON UNIFORM BENDING AND I-SHAPE GIRDER
6. TWISTING COUPLE OF A WIRE
7. TORSIONAL PENDULUM

UNIT – 2 (WAVES AND OPTICS)

1. DAMPED OSCILLATION
2. FORCED OSCILLATION
3. PLANE PROGRESSIVE WAVE
4. EINSTEIN RELATION
5. Nd-YAG LASER
6. SEMICONDUCTOR LASER
7. INDUSTRIAL APPLICATION (MATERIAL PROCESSING)
8. DERIVATION OF NUMERICAL APERTURE & ACCEPTANCE ANGLE
9. TYPES OF FIBER
10. LOSSES IN OPTICAL FIBER
11. FIBER OPTIC SENSORS

UNIT – 3 (THERMAL PHYSICS)

1. HEAT CONDUCTION THROUGH A COMPOUND MEDIA
2. FORBES METHOD
3. LEE'S DISC METHOD
4. EXPANSION JOINTS AND BIMETALLIC STRIP
5. THERMAL INSULATION
6. HEAT EXCHANGER
7. REFRIGERATOR
8. OVEN
9. SOLAR WATER HEATER

UNIT – 4 (QUANTUM PHYSICS)

1. PLANCK'S RADIATION LAW
2. COMPTON EFFECT
3. SCHRODINGER WAVE EQUATION
4. PARTICLE IN A ONE DIMENSIONAL BOX
5. G.P.THOMSON EXPERIMENT
6. SCANNING TUNNELING MICROSCOPE (STM)

UNIT – 5 (CRYSTAL PHYSICS)

1. TYPES OF CRYSTAL SYSTEM AND BRAVAIS LATTICE
2. SC, BCC & FCC STRUCTURE
3. HCP STRUCTURE
4. DIAMOND STRUCTURE
5. MILLER INDICES AND d - SPACING
6. CRYSTAL GROWTH TECHNIQUE (CZOCHRALSKI & BRIDGMANN METHOD)
7. CRYSTAL DEFECT