INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)
Dundigal, Hyderabad - 500 043

COMPUTER SCIENCE AND ENGINEERING

QUESTION BANK

Course Title	**APPLIED PHYSICS**				
Course Code	AHSD07				
Program	B.Tech				
Semester	I				
Course Type	Foundation				
Regulation	BT23				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	3	-	3	-	-
Course Coordinator	Dr. Rizwana, Associate Professor				

COURSE OBJECTIVES:

The students will try to learn:

I	Fundamental concepts needed to explain a crystal structure in terms of atom positions, unit cells, and crystal symmetry.
II	Basic formulations in wave mechanics for the evolution of energy levels and quantization of energies for a particle in a potential box with the help of mathematical description.
III	The metrics of optoelectronic components, lasers, optical fiber communication and be able to incorporate them into systems for optimal performance.
IV	The appropriate magnetic, superconducting and nanomaterials required for various engineering applications.

COURSE OUTCOMES:

After successful completion of the course, students should be able to:

CO 1	Use the general rules of indexing of directions and planes in lattices to identify the crystal systems and the Bravais lattices.
CO 2	Extend the principles of dual nature of matter and Schrodinger wave equation to a particle enclosed in simple systems.
CO 3	Analyze the concepts of laser with normal light in terms of mechanism for applications in different fields and scientific practices.

CO 4	Comprehend the knowledge on functionality of components in optical fiber communication system by using the basics of signal propagation, attenuation and dispersion.
CO 5	Gain knowledge on properties of magnetic and superconducting materials suitable for engineering applications.
CO 6	Formulate the principle factors, fabrication, characterization techniques and the applications of nanomaterials.

QUESTION BANK:

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MODULE I				
CRYSTAL STRUCTURES				
PART-A ANALYTICAL QUESTIONS				
1	1. Calculate the No. of atoms per unit cell of a metal with lattice parameter $2.9A0$, given molecular weight 55.85 Kg/m3, density is 7870 Kg/m3 and Avogadro number is $6.023 \times 10^{26} kmol^{-1}$	Apply	Learner to recall equation for lattice parameter and solve the problem for no. of atoms per unit cell.	CO1
2	Chromium has BCC structure, its atomic radius is, 1249 nm. Calculate the free volume per unit cell.	Apply	Learner to recall packing fraction of BCC and relation between r and a and solve the problem	CO1
3	Copper has FCC structure and the atomic radius is 1.278 A^0 , calculate the density of copper crystal. Given atomic weight of copper is 63.5.	Apply	Learner to recall the FCC Structure and relation between r and a solve the problem	CO1
4	S.T in a simple cubic lattice the separation between successive lattice planes (100), (110), (111) are in the ratio 1:0.71:0.58	Understand	Learner to recall concept of miller indices for simple cubic lattice	CO1
5	Find the miller indices of a set of parallel planes which makes intercepts in the ratio 3a:4b on the X and Y axes and are parallel to Z axis: a, b, c being primitive vectors of the lattice?	Apply	Learner to recall concept of miller indices	CO1

6	In a triclinic crystal, a lattice plane makes intercepts of lengths a, 2b, and -3c/2. Find the miller indices of the plane.	Understand	Learner to recall concept of miller indices	CO1
7	Determine the spacing between (i)100 planes (ii)110 planes and (iii) 111 planes in a NaCl crystal having the lattice constant a=5.64 A^0.	Apply	Learner to equation for interplanar spacing in solving the problem	CO1
8	The distance between (110) planes in BCC is .203 nm. Calculate size of unit cell, radius of atom.	Apply	Learner to equation for interplanar spacing in solving the problem	CO1
9	A copper has FCC structure with atomic radius 0.1278 nm, calculate the inter planar spacing for (111) and (321) planes.	Apply	Learner to equation for interplanar spacing in solving the problem	CO1
10	Potassium Chloride is a FCC crystal having a density of 1980 Kg/m3. If its molecular weight is 74.6, calculate (i) the distance from one atom to the next atom of the same kind and (ii) the distance between adjacent atoms.	Apply	Learner to recall the FCC structure and relation between no. of atoms, coordination number and density of atom in solving the problem	CO1
PART-B LONG ANSWER QUESTIONS				
1	Explain the concepts space lattice, basis, unit cell and lattice parameter	Understand	Learner to recall concepts of space lattice, basis and lattice parameter	CO1
2	Enlist the seven crystal systems, draw their diagrams neatly.	Understand	Learner to recall the seven crystal systems and draw them.	CO1
3	Draw the fourteen Bravais lattices.	Understand	Learner to recall the 14 Bravais lattices	CO1
4	Define co-ordination number, packing fraction and obtain the packing fraction of SC	Apply	Learner to recall coordination number, atomic paking fraction, explain the SC structure and obtain their packing fraction.	CO1

5	Define atomic packing fraction and obtain the packing fraction of BCC	Apply	Learner to recall coordination number, atomic paking fraction, explain the BCC structure and obtain their packing fraction.	CO1
6	Explain the FCC structure and obtain the packing fraction of FCC	Apply	Learner to recall the FCC and obtain the packing fraction of FCC	CO1
7	What are miller indices? Explain the rules for defining miller indices with an example. Show the planes (100), (110) and (111).	Understand	Learner to recall the concept of Miller Indices and use its rules in identifying the planes.	CO1
8	Obtain the equation for interplanar spacing for orthogonal systems. Calculate the ratio of the planes (100), (110) and (111).	Understand	Learner to recall the concept of orthogonal systems and obtain the equation for interplanar spacing.	CO1
9	Write a short note on lattice parameter, derive an expression for lattice parameter based on density of the atom, volume of the unit cell. .	Apply	Learner to recall the concept of lattice parameter and use it to derive an expression for lattice parameter	CO1
10	Define the packing density, Obtain the packing fractions of SC, BCC, FCC	Understand	Learner to recall the structures of SC, BCC and FCC in determining their packing fractions.	CO1
11	What are Bravais lattices? Draw the Bravais lattices for Orthogonal systems.	Understand	Learner to recall the concept of Bravais lattices and to show the Bravais lattices for lattice structures whose interfacial angles are 90	CO1
12	Explain the seven crystal systems based on interfacial angles and interatomic distances and mention the Bravais lattice strutures for each crystal system.	Understand	Learner to recall the seven crystal systems and the lattice arrangements possible for each crystal system.	CO1

13	List the type of lattice arrangements in crystals. Explain them with neat diagrams.	Understand	Learner to recall lattice structures possible and draw them	CO1
14	prove that the FCC has the highest packing fraction than SC and BCC.	Apply	Learner to recall the FCC, SC and BCC stuctures and obtain the packing fraction of Sc, BCC, FCC, compare the packing fractions of SC, BCC and FCC.	CO1
15	What are lattice planes? Obtain the interplanar seperation of simple cubic lattice.	Understand	Learner to recall lattice plane and use it for deriving interplanar seperation of simple cubic lattice.	CO1
16	Differentiate SC, BCC and FCC strutures based on coordination number, nearest neighbour distance, atomic radius and atomic paking fraction.	Understand	Learner to recall the simple cubic, body centered cubic and face centered cubic structures.	CO1
17	What are lattice planes? Explain the concept of miller indices, Obtain miller indices for a plane making intercepts pa,qb,rc with crsytallographic axes	Understand	Learner to recall the concept of lattice planes and Miller Indices and obtain miller indices.	CO1
18	Define space lattice and explain the concept of space lattice for a 2-D array of infitesimal points, also explain the concept of basis and relate them	understand	Learner to recall the concept of space lattice and basis and relate them.	CO1
19	Explain the terms coordination number, nearest neighbour distance, atomic radius, packing fraction	understand	learner to recall the concepts of coordination number, nearest neighbour distance, atomic radius, packing fraction.	CO1
20	Define atomic radius and nearest neighbour distance and obtain the relation between atomic radius and interatomic separation for SC, BCC and FCC	Apply	Learner to recall the concept of atomic radius and nearest neighbour distance relation between r and a for SC, BCC and FCC	CO1

Part - C(Short Answer Questions)				
1	Explain the concept of space lattice	Understand	Learner to recall the concept of space lattice	CO1
2	Explain the concept of basis	Understand	Learner to recall the concept of basis	CO1
3	How can we relate space lattice and basis to crystal structure	Understand	Learner to recall the concepts of space lattice and basis	CO1
4	Obtain an equation for lattice parameter for a cubic system	Understand	Learner to recall the concept of lattice parameter and obtain its equation.	CO1
5	List the seven crystal systems and mention relation interfacial angles and interatomic distances.	Remember	Learner to recall the seven crystal systems.	CO1
6	What are Bravais lattices, mention the 14 Bravais lattices	Remember		CO1
7	What are crystalline and non-crystalline soilds?	Remember		CO1
8	Define coordination number and packing fraction	Remember		CO1
9	Write expressions relating r and a for SC, BCC, FCC structures	Remember		CO1
10	Define atomic packing factor, mention its value for SC, BCC and FCC structures	Remember		CO1
11	Explain the concept of lattice planes	Remember		CO1
12	What is the building block in a crystal mention its types.	Understand	Learner to recall the concept of unit cell.	CO1
13	Define miller indices, obtain miller indices for the plane, a, 2b, 3c	Understand	Learner to recall and understand the concept of Miller Indices	CO1
14	What is interplanar seperation write its expression for an orthogonal system	Remember		CO1
15	Draw the SC, BCC and FCC structures	Remember		CO1

16	Obtain the packing fraction of SC sturture	Understand	Learner to recall Simple cubic struture.	CO1
17	Obtain the packing fraction of BCC sturture	Understand	Learner to recall Body centered cubic struture.	CO1
18	Obtain the packing fraction of FCC sturture	Understand	Learner to recall Face centered cubic struture.	CO1
19	What are the different lattice arrangements possible in a crystal system?	Remember		CO1
20	Draw the four lattices for a Orthorhombic crystal system	Remember	Learner to recall the Orthorhombic crystal system.	CO1
MODULE II				
QUANTUM PHYSICS				
PART-A ANALYTICAL QUESTIONS				
1	Calculate the velocity and kinetic energy of an electron having wavelength of 0.21nm.	Understand	Learner to recall the Planck's and Einstein's theory and Understand about de Broglie wavelength.	CO2
2	Determine the de Broglie wavelength associated with a proton moving with a velocity of 1/10 of velocity of light. (Mass of proton = 1.674×10^{-27} kg).	Understand	Learner to recall the Planck's and Einstein's theory and Understand about de Broglie wavelength.	CO2
3	Estimate the wavelength of an electron rose to a potential 15kV.	Understand	Learner to recall the Planck's and Einstein's theory and Understand about de Broglie wavelength associated with electron.	CO2
4	Obtain de-Broglie wavelength of neutron. (Given kinetic energy of the neutron is 0.025eV mass of neutron = 1.674×10^{-27} kg).	Understand	Learner to recall the Planck's and Einstein's theory and Understand about de Broglie wavelength.	CO2
5	Calculate the velocity and kinetic energy of an electron of wavelength $1.66 \times 10^{-10}m$.	Understand	Learner to recall the Planck's and Einstein's theory and Understand about de Broglie wavelength.	CO2

6	An Electron is confined in a 3-D box of side 0.1 nm, find the ground state energy and first three excited state energies in eV.	Apply	Learner to recall the concept of matter wave and Understand quantization of energy and apply it to potential box.	CO2
7	Calculate the energies that can be possessed by a particle of mass 8.50×10^{-31} kg which is placed in an infinite potential box of width $10^{-9}m$.	Apply	Learner to recall the concept of matter wave and Understand quantization of energy and apply it to potential box.	CO2
8	Find the lowest energy of an electron confined in a square box of side 0.1 nm.	Apply	Learner to recall the concept of matter wave and Understand quantization of energy and apply it to potential box.	CO2
9	Electrons are accelerated by 344 volts and are reflected from a crystal. The first reflection maximum occurs when the glancing angle is 60°. Determine the spacing of the crystal.	Apply	Learner to recall the concept of matter wave and Understand quantization of energy and apply it to potential box.	CO2
10	An electron is bound in one-dimensional infinite well of width 1×10^{-10} m. Find the energy levels in the ground state and first two excited states.	Apply	Learner to recall the concept of matter wave and Understand quantization of energy and apply it to potential box.	CO2
PART-B LONG ANSWER QUESTIONS				
1	Compare a particle with a wave and discuss about dual nature of radiation.	Understand	Learner to recall the properties of particle and wave and understand the dual nature of light radiation	CO2
2	Enlist physical significance of wave function according to Schrodinger and Max – Born interpretation.	Understand	Learner to recall the characteristics of wave function and Understand Max Born and Schrodinger's interpretation of wave function.	CO2

3	Matter waves are new kind of waves. Justify this concept by discussing different properties of matter waves.	Understand	Learner to recall the concept of dual nature of material particle and Understand the behavior of matter wave.	CO2
4	Using Planck's and Einstein's theory of radiation, Show that the wavelength associated with an electron of mass 'm' and kinetic energy 'E' is given by $\frac{h}{\sqrt{2mE}}$	Understand	Learner to recall the Planck's and Einstein's theory and Understand the derivation of de Broglie wavelength.	CO2
5	Determine an expression for the wavelength associated with an electron, accelerated by a potential V.	Understand	Learner to recall the concept of de Broglie wavelength and understand the wavelength associated with electron.	CO2
6	Explain the difference between a matter wave and an electromagnetic wave.	Understand	Learner to recall the properties of matter wave and understand that matter waves are not electromagnetic waves	CO2
7	Describe Davisson Germer experiment with a neat diagram and explain how it established the proof for wave nature of electrons.	Understand	Learner to recall the concept of dual nature of material particle and Understand the proof for existence of matter wave.	CO2
8	Considering dual nature of electron, derive Schrodinger's time independent wave equation for the motion of an electron.	Understand	Learner to recall the concept of matter wave and understand the wave equation associated with matter wave.	CO2
9	Assuming that a particle of mass m is confined in a field free region between impenetrable walls in infinite height at $x = 0$ and $x = a$, show that the permitted energy levels of a particle are given by $n^2h^2/8ma^2$.	Apply	Learner to recall the concept of matter wave and Understand quantization of energy and apply it to potential box.	CO2

10	Discuss the results from the eigen values, eigen functions and probability density for a particle in a one dimensional potential box of infinite height. Also sketch the figures.	Apply	Learner to recall the concept of matter wave and Understand quantization of energy and apply it to potential box.	CO2
11	Show that the energies of a particle confined between two rigid walls of infinite potential are quantized.	Apply	Learner to recall the concept of matter wave and Understand quantization of energy and apply it to potential box.	CO2
12	What is de-Broglie wave? Derive expression for de Broglie wavelength associated with a particle having mass m and velocity v.	Understand	Learner to recall the Planck's and Einstein's theory and Understand the derivation of de Broglie wavelength.	CO2
13	Discuss different phenomenon's that show the behavior of light radiation interacting with matter.	Understand	Learner to recall the properties of particle and wave and understand the dual nature of light radiation	CO2
14	Write major differences between classical mechanics and quantum mechanics.	Understand	Learner to recall the basics of classical mechanics and Understand to compare with quantum mechanics.	CO2
15	Differentiate between ψ and $\|\psi\|^2$.	Understand	Learner to recall the characteristics of wave function and Understand Max Born and Schrodinger's interpretation of wave function.	CO2
16	Highlight the conditions for an acceptable wave function.	Understand	Learner to recall the characteristics of wave function and Understand the dual nature of material particle.	CO2
17	Derive the expresions for eigen vector and eigen function of a particle confined in a potential square well.	Apply	Learner to use the time independent schrodinger equation for the case of a particle confined in potential well.	CO2

18	Why matter waves are observed for particles of atomic or nuclear size.	understand	Learner to recall the concept of dual nature of material particle and understand the behavior of matter wave.	CO2
19	Explain the concept of phase velocity and group velocity deduce a relation between them	understand	learner to recall the concept of dual nature and understand the concept of matter wave.	CO2
20	Derive the equation for energy of a particle confined in a 1-D infinite square well and explain energy quantization, zero-point energy and spatial nodes.	Apply	Learner to recall the concept of matter wave and Understand quantization of energy and apply it to potential.	CO2
Part - C(Short Answer Questions)				
1	Relate the dependency of wavelength of matter waves on velocity and mass of material particle.	Remember		CO2
2	Write an expression for de-Broglie wavelength in terms of momentum and kinetic energy.	Remember		CO2
3	Explain the conception of light behaving both as a particle and wave.	Understand	Learner to recall the properties of Particle and wave and understand the dual nature of light radiation	CO2
4	Show that the product of phase velocity and group velocity is square of velocity of light.	Understand	Learner to recall the properties of matter wave	CO2
5	Prove that matter waves travel with a velocity greater than velocity of light. Also justify it.	Understand	Learner to recall the Planck's and Einstein's theory and Understand how matter wave travel with velocity of light.	CO2
6	Write one dimensional time independent Schrodinger equation associated with matter wave.	Remember		CO2

7	Explain the feature of wave function which connects the particle nature and wave nature of matter wave.	Understand	Learner to recall the characteristics of wave function and Understand the dual nature of material particle.	CO2
8	Describe behavior of matter waves by giving any two of its properties.	Understand	Learner to recall the properties of particle and wave and understand the dual nature of material particle.	CO2
9	Define Phase Velocity associated with a matter wave.	Remember	Learner to recall the concept of matter wave	CO2
10	Define Group velocity associated with a matter wave.	Remember	Learner to recall the concept of matter wave	CO2
11	Write expressions for eigen function and eigen values for a particle in one dimensional square well box of infinite potential.	Remember		CO2
12	Discuss about Normalization condition as postulated by Max Born.	Apply	Learner to recall the characteristics of wave function and Understand Max Born interpretation of wave function and apply it to probability density.	CO2
13	What is the Schrödinger's interpretation of complex and not observable wave function?	Understand	Learner to recall the characteristics of wave function and Understand Schrodinger's interpretation of wave function and apply it to charge density.	CO2
14	How energy of a particle confined in a potential box is related to the width of the box.	Apply	Learner to recall the concept of matter wave and Understand quantization of energy and apply it to potential box.	CO2
15	Write about probability density of moving material particle as explained by Born and Schrodinger.	Apply	Learner to recall the characteristics of wave function, understand Max Born interpretation of wave function and apply it to probability density.	CO2

16	What is the minimum energy possessed by the particle in an infinitely deep potential well?	Apply	Learner to recall the concept of matter wave, understand quantization of energy and apply it to potential box.	CO2
17	Discuss about the nature of the walls of the box in which a particle is bound.	Apply	Learner to recall the concept of matter wave,understand quantization of energy and apply it to potential box.	CO2
18	What happens to the wavefunction associated with a particle in an infinitely deep potential well	Apply	Learner to recall the characteristics of wave function, understand Max Born interpretation of wave function and apply it to probability density.	CO2
19	What is the boundary condition for normalized wave function?	Apply	Learner to recall the characteristics of wave function, understand Max Born interpretation of wave function and apply it to probability density.	CO2
20	Define square well potential associated with a bound electron moving along one dimension.	Apply	Learner to recall the concept of matter wave, understand quantization of energy and apply it to potential box.	CO2
MODULE III				
LASERS AND FIBER OPTICS				
PART-A ANALYTICAL QUESTIONS				
1	Find the relative population of the two states in a ruby laser that produces a light beam of wavelength 6943 Å at 300 K.	Understand	Learner to recall expression for population and understand to calculate relative population.	CO3
2	For a He-Ne laser at 1 m and 2 m distances from the laser the output beam spot diameters are 4 mm and 6 mm respectively. Calculate the divergence.	Understand	Learner to recall divergence and understand to find its value from the data given.	CO3

3	A He-Ne laser emits light at a wavelength of 632.8 nm and has an output power of 2.3 mW. How many photons are emitted in each minute by this laser when operating?	Understand	Learner to recall energy bandgap and understand to find photons emitted from energy gap and energy of photon.	CO3
4	Solve the value of the wavelength of emitted radiation from a semiconductor diode laser, which has a band gap of 1.44eV.	Understand	Learner to recall energy bandgap and understand to find wavelength of laser from it.	CO3
5	A semiconductor diode laser has a wavelength of 1.55µm. Estimate its band gap in eV.	Understand	Learner to recall energy bandgap and understand to find its value once given wavelength of laser.	CO3
6	A step index fiber has a numerical aperture of 0.16 and core refractive index of 1.45. Estimate the acceptance angle of the fiber and refractive index of the cladding.	Understand	Learner to recall acceptance angle and understand to find its value from the data given.	CO4
7	The refractive indices of core and cladding materials of a step index fiber are 1.48 and 1.45 respectively. Simulate i) Numerical aperture ii) Acceptance angle.	Understand	Learner to recall acceptance angle and numerical aperture and understand to find their values from the data given.	CO4
8	An optical fiber has a numerical aperture of 0.02 and a cladding refractive index of 1.59. Solve the value of acceptance angle for the fiber in water which has a refractive index of 1.33.	Understand	Learner to recall acceptance angle and understand to find its value from the data given.	CO4

9	Calculate the fractional index change for a given optical fiber if the refractive indices of the core and the cladding are 1.563 and 1.498 respectively.	Understand	Learner to recall relative refractive change and understand to find its value from the data given.	CO4
10	When the mean optical power launched into an 8 Km length of fiber is 120 µW. The mean optical power at the fiber output is 3 µW. Find the overall signal attenuation and signal attenuation per Km.	Understand	Learner to recall logarithmic formula for attenuation and understand to find its value from the data given	CO4
PART-B LONG ANSWER QUESTIONS				
1	Illustrate the characteristics of lasers, and highlight the phenomenon of lasing action required for the production of laser light.	Understand	Learner to recall characteristics of laser and understand its principle.	CO3
2	Explore the phenomena's of absorption and pumping mechanism related to excitation of atoms from lower to higher energy states?	Understand	Learner to recall transition between energy states and understand excitation to higher state with energy.	CO3
3	Demonstrate the construction and working of a Ruby laser in detail, with the help of a neat suitable diagram.	Understand	Learner to recall ruby laser and understand its construction and working.	CO3
4	Narrate the construction and working of He-Ne gaseous laser in detail, with the help of a neat diagram.	Understand	Learner to recall He-Ne laser and understand its construction and working.	CO3
5	Enlist the importance of lasers in various fields like industry, medicine, science, etc., by giving their applications.	Understand	Learner to recall characteristics of laser and understand its applications in various fields.	CO3
6	Discuss in detail the phenomenon's of spontaneous emission and stimulated emission.	Understand	Learner to recall transition between energy states and understand de-excitation to lower state.	CO3

7	What do you mean by population inversion? Explain it using three energy level diagram. Also discuss why population inversion is essential for laser action.	Understand	Learner to recall excitation process with energy and understand its role in laser emission.	CO3
8	Illustrate the purpose of an active medium and optical resonator in a laser system.	Understand	Learner to recall different parets of laser system and understand role of them in laser emission.	CO3
9	How light amplification is achieved in a laser system.	Understand	Learner to recall stimulated emission and understand role optical resonator for light amplification.	CO3
10	Explain the pumping process involved in laser emission. Also discuss in detail different pumping mechanisms.	Understand	Learner to recall excitation process and understand different ways of excitation to achieve population inversion.	CO3
11	Describe an optical fiber? Explore its construction and principle with a neat diagram.	Understand	Learner to recall optical fiber and understand its construction and principle.	CO4
12	Derive an expression for angle of acceptance of an optical fiber in terms of refractive indices of core and cladding.	Understand	Learner to recall acceptance angle and understand to get expression for it.	CO4
13	What is a Numerical aperture? Determine an expression for numerical aperture of an optical fiber.	Understand	Learner to recall Numerical Aperture and understand to get expression for it.	CO4
14	Compare different types of optical fibers based on number of modes propagation through core medium of an optical fiber.	Understand	Learner to recall single and multimode fibers and understand that single mode is best suitable for communication.	CO4
15	Draw the block diagram of fiber optic communication system and explain the functions of each block in the system.	Understand	Learner to recall different parts of optical fiber communication system and understand role of each.	CO4

16	Describe the step index fiber with a neat diagram and explain the transmission of a signal through it.	Understand	Learner to recall step index fiber and understand how its refractive index profile affects signal transmission.	CO4
17	Illustrate the advantages of optical fibers in communication system over ordinary cable communication.	Understand	Learner to recall advantages of optical fibers and understand its importance.	CO4
18	Discuss in detail graded index optical fiber with a neat figure and explain the transmission of signal through it.	Understand	Learner to recall Graded index fiber and understand how its refractive index profile reduces dispersion.	CO4
19	What do you mean by attenuation in optical fibers? Write a brief note on different losses in optical fibers.	Understand	Learner to recall transmission loss in optical fibers and understand different reasons for losses.	CO4
20	Write a note on the applications of optical fibers in different fields.	Understand	Learner to recall advantages of optical fibers and understand its application in different fields.	CO4
PART C-SHORT ANSWER QUESTIONS)				
1	Mention the three distinct processes by which a transition can take place.	Remember		CO3
2	What do you mean by coherence? Name two types of coherence.	Understand	Learner to recall coherence and understand spatial and temporal coherence.	CO3
3	State the properties of laser beam that makes it different from normal light.	Remember		CO3
4	List out the different types of lasers?	Remember		CO3
5	What is the advantage of using laser as light sources in CD player?	Understand	Learner to recall principle of laser and understand its use in CD player	CO3
6	What are the three important requisites for laser action to take place?	Remember		CO3
7	What does the term laser stand for? Illustrate about the principle of laser.	Understand	Learner to recall abbreviation of laser and understand its principle.	CO3

8	Recall the role of metastable state in achieving the population inversion.	Remember		CO3
9	Define the terms lifetime and population of an energy state.	Remember		CO3
10	List any two applications of lasers in engineering.	Remember		CO3
11	Explain the basic principle used in optical fiber for transmission of light.	Understand	Learner to recall optical fiber and understand its principle.	CO4
12	Define Acceptance angle, Acceptance cone and Numerical Aperture of an optical fiber.	Remember		CO4
13	List any two applications of optical fibers in day to day life.	Remember		CO4
14	Mention any three advantages of optical fiber communication system.	Remember		CO4
15	How is attenuation loss in optical fiber measured? Mention its units.	Understand	Learner to recall propagation of signal through fiber and understand loss during propagation.	CO4
16	Recall the expressions for Acceptance angle and Numerical aperture of an optical fiber.	Remember		CO4
17	Illustrate a neat sketch of refractive index profile of step index optical fiber.	Remember		CO4
18	State the expressions for Snell's law and critical angle associated with an optical fiber.	Remember		CO4
19	Enlist different types of attenuation in optical fibers that occur during propagation of light signals.	Remember		CO4

20	State the two different types of bending losses in an optical fiber.	Remember		CO4
MODULE IV				
MAGNETIC AND SUPERCONDUCTING PROPERTIES				
PART-A ANALYTICAL QUESTIONS				
1	Calculate magnetization and magnetic flux density if magnetic field intensity 250 amp/m and relative permeability is 15.	Apply	Learner to recall terms related to magnetism and understands relation between them and applies it to find magnetization and flux density from the data given.	CO5
2	Find relative permeability, if $H = 220$ amp/m and $M = 3300 amp/m$.	Apply	Learner to recall terms related to magnetism and understands relation between them and applies it to find relative permeability from the data given.	CO5
3	The magnetic susceptibility of aluminium is 2.3×10^{-5}. Find its permeability and relative permeability.	Apply	Learner to recall terms related to magnetism and understands relation between them and applies it to find permeability from the data given.	CO5
4	If a magnetic field of strength 300 $amp/meter$ produces a magnetization of 4200 A/m in a ferromagnetic material, find the relative permeability of the material.	Apply	Learner to recall terms related to magnetism and understands relation between them and applies it to find relative permeability from the data given.	CO5
5	A paramagnetic material has a magnetic field intensity of $104 A/m$. If the susceptibility of the material at room temperature is 3.7×10^{-3}, calculate the magnetization and magnetic flux density in the material.	Apply	Learner to recall terms related to magnetism and understands relation between them and applies it to find magnetization and flux density from the data given.	CO5

6	The transition temperature for Pb is 7.2 K. However, at 5 K it loses the superconducting property if subjected to magnetic field of $3.3 \times 10^4 A/m$. Find the maximum value of H which will allow the metal to retain its superconductivity at 0 K.	Apply	Learner to recall the relation between critical temperature and applied magnetic field intensity.	CO5
7	The critical field of niobium is $1 \times 10^5 A/m$at 8 K and $2 \times 10^5 A/m$at 0 K. Calculate the transition temperature of the element.	Apply	Learner to recall the relation between critical temperature and applied magnetic field intensity.	CO5
8	The critical magnetic field at 5 K is $2 \times 10^3 A/m$ in a superconductor ring of radius 0.02 m. Find the value of critical current	Apply	Learner to recall relation between critical current and critical magnetic field for superconducting materials.	CO5
9	A superconducting Tin has critical tempature of 3.7k at zero magnetic field and critical field of 0.0306 t at 0 k. Find critical field at 2 k. Find critical current also if r =1 m.	Apply	Learner to recall relation between critical current and critical magnetic field for superconducting materials and solve the problem based on data given.	CO5
10	Calculate the critical current for a wire of lead having a diameter of 1 mm at 4.2 K. The critical temperature for lead is 7.18 K and $H_{C(0)} = 6.5 \times 10^4 A/m$	Apply	Learner to recall relation between critical current and critical magnetic field for superconducting materials and solve the problem based on data given.	CO5
PART-B LONG ANSWER QUESTIONS				
1	Explain the terms magnetic dipole, magnetic dipole moment, magnetic field intensity and magnetic induction.	Understand	Learner to recall different terms related to magnetism and understands measurement of dipole moment and magnetic induction.	CO5

2	Discuss in detail about the magnetic permeability, relative permeability, Intensity of magnetization and magnetic susceptibility.	Understand	Learner to recall different terms related to magnetism and understands measurement of permeability and magnetic susceptibility.	CO5
3	Obtain a relation between magnetic susceptibility, magnetization and magnetic field intensity.	Understand	Learner to recall different terms related to magnetism and understands relation between susceptibility and magnetization.	CO5
4	Describe the origin of magnetic moment and find the magnetic dipole moments due to orbital and spin motions of an electron.	Understand	Learner to recall spins in magnetic materials and understand how magnetic moment is developed from their spins.	CO5
5	What is a Bohr magneton? How it is related to magnetic moment of electron.	Understand	Learner to recall Bohr magneton and understand how it helps to measure magnetic moment of atomic systems.	CO5
6	Distinguish between diamagnetic, paramagnetic and ferromagnetic materials. Explain their behavior with the help of examples.	Understand	Learner to recall different magnetic materials and understand their properties in terms of magnetization.	CO5
7	Illustrate the phenomenon of magnetization. Show that $B = \mu_0(H + M)$.	Understand	Learner to recall magnetization and understand derivation of relation between magnetic induction and permeability.	CO5
8	Draw the B-H curve for a ferromagnetic material and identify the retentivity and the coercive field on the curve.	Understand	Learner to recall hysteresis curve and understand to get retentivity and coercivity from it.	CO5
9	Explain soft and hard magnetic materials	Understand	Learner to recall soft and hard ferro magnetic materials and understand the differences between them	CO5

10	Explain the hysteresis loop in a ferromagnetic material in reference to the domain theory.	Understand	Learner to recall the domain movement in a ferro magnetic material.	CO5
11	Explain Meissner effect. Explain in detail	Understand	Learner to recall concept of superconductivity and perfect diamagnetism.	CO5
12	What do you mean by "perfect diamagnetism" of a superconductor?	Understand	Learner to recall concept of superconductivity and perfect diamagnetism	CO5
13	Distinguish between superconductor & normal metal.	Understand	Learner to recall differences between supercoductor and normal metal based on the properties.	CO5
14	Give an account of the phenomenon of superconductivity.	Understand		CO5
15	What is the significance of critical temperature, critical magnetic field and critical current density for superconductors?	Understand	Learner to recall relation between critical magnetic field, critical temperature and critical current density.	CO5
16	What is superconductivity? Describe type I and type II superconductors.	Understand	Learner to recall the concept of superconductivity,type I and type II superconductors.	CO5
17	Explain the BCS theory with key note of Cooper pairs.	Understand	Learner to recall BCS throey	CO5
18	Explain Meissner effect. Describe soft and hard superconductors.	Understand	Learner to recall the concepts of Meissner effect, type I and type II superconductors.	CO4
19	Explain the various properties and important applications of superconducting materials.	understand		CO5
20	Explain Meissner effect and magnetic levitation.	Understand		CO5
PART C- SHORT QUESTIONS				
1	How do you account for the magnetic properties of materials?	Understand	Learner to recall magnetic moment and understand how it helps for magnetism in some materials.	CO5

2	What is curie temperature? Is it unique for all substances?	Understand	Learner to learn curie temperature and understand transition of magnetic properties at this temperature.	CO5
3	Mention the types of magnetic materials based on electron spins.	Remember		CO5
4	Sketch neatly hysteresis loop observed in ferromagnetic materials.	Remember		CO5
5	What is hysteresis? What does the area of hysteresis curve represent?	Understand		CO5
6	Define diamagnetic, paramagnetic and ferromagnetic materials.	Remember		CO5
7	Give two examples for each diamagnetic, paramagnetic and ferromagnetic material.	Remember		CO5
8	Define coercivity and retentivity of a ferromagnetic material.	Remember		CO5
9	Discuss in detail about Bohr magneton. Also mention its value.	Understand	Learner to recall Bohr magneton and understand how it helps to measure magnetic moment of atomic systems.	CO5
10	Compare the relative permeability values of diamagnetic, paramagnetic and ferromagnetic material.	Understand	Learner to recall relative permeability and understand that ferromagnetic materials have highest relative permeability values.	CO5
11	What is flux quantization?	Remember		CO5
12	What are Cooper pairs?	Remember		CO5
13	What is the importance of isotope effect in superconductivity?	Understand	Learner to recall the isotope effect for superconductors	CO5
14	What is Meissner effect?	Remember		CO5

15	A superconducting wire and a copper wire are connected in parallel. Does the copper wire carry current when a potential difference is applied?	Understand	Learner to recall the concept of superconductivity.	CO5
16	Give any four applications of superconductivity.	Remember		CO5
17	What is Magnetic Levitation? Explain it.	Understand		CO5
18	Explain in detail, the properties of superconducting materials.	Understand	Learner to recall the properties of superconductors.	CO5
19	Enumerate the important results of BCS theory.	Understand	Learner to recall and understand the concept of BCS theory.	CO5
20	What is superconductivty?	Remember		CO5
MODULE V				
NANOTECHNOLOGY				
PART-A ANALYTICAL QUESTIONS				
1	Calculate the surface area to its volume ratio of a spherical particle of diameter 8 mm.	Understand	Learner to recall surface area to volume ratio.	CO6
2	If the radius of a sphere is made one-third, how its surface area to volume ratio changes.	Understand	Learner to recall surface area to volume ratio.	CO6
3	If the dimension of a cube is doubled, how its surface area to volume ratio varies.	Understand	Learner to recall surface area to volume ratio.	CO6
4	Calculate average particle size using X-ray diffraction pattern having 0.1541 nm of X-ray wavelength, 0.011 radian of full width and half maximum and diffraction angle of 45°.	Apply	Learner to recall formula for FWHM	CO6

5	A beam of X-rays is incident on a Nacl crystal with lattice spacing 0.282 nm.Calculate the wavelength of X-rays if the first order Bragg reflection takes place at a glancing angle of $8°35'$.	Apply	Learner to recall principle of X-ray diffraction and use it to solve the given problem.	CO6
6	X-rays of wavelength 1.5418 A^0 are diffracted by (111) planes in a crystal at an angle 30° in the first order. Calculate the interatomic spacing	Apply	Learner to recall principle of X-ray diffraction and equation for interplanar spacing, use it to solve the given problem.	CO6
7	An X-ray beam of wavelength 3 A^0 is diffracted from (100) plane of a cubic crystal. The first order maximum is obtained for glancing angle of 40°. Determine the space of the reflecting plane and also the volume of the unit cell.	Apply	Learner to recall principle of X-ray diffraction and equation for interplanar spacing, use it to solve the given problem.	CO6
8	In an X-ray diffraction experiment, peak width at half maximum is 0.6° and its corresponding Bragg angle is 24°. Calculate the crystallite size using scherrer equation, the wavelength used in X-ray diffraction experiment is 1.54 A^0	Apply	Learner to recall Debye Scherrer equation to solve the problem.	CO6
9	What is the angle at which the third order reflection of X-rays of 0.79 A0 wavelength can occur in a calcite crystal of $3.04 \times 10^{-8} cm$ spacing?	Apply	Learner to recall principle of X-ray diffraction, use it to solve the given problem.	CO6

10	Monochromatic X-rays of wavelength λ= 1.5 AU are incident on a crystal face having an interplanar spacing of 1.6 AU. Find the highest order for which Bragg's reflection maximum can be seen.	Apply	Learner to recall principle of X-ray diffraction, use it to solve the given problem.	CO6
PART-B LONG ANSWER QUESTIONS				
1	What are the two principle factors that cause the properties of nanomaterials to differ significantly from bulk materials? Explain them in detail.	Understand	Learner to recall surface area to volume raio and quantum confinement effect.	CO6
2	Discuss in detail how the optical, physical and chemical properties of nanomaterials vary with particle size.	Understand	Learner to recall and understand how optical, physical and chemical properties vary with size.	CO6
3	Describe the role of surface to volume ratio and quantum confinement on electrical, magnetic and mechanical properties of nano sized materials.	Understand	Learner to recall surface area to volume raio and quantum confinement effect and how they effect the properties of nano materials.	CO6
4	Discuss with neat sketch how the nanoparticles are prepared employing the bottom- up method namely sol-gel.	Understand	Learner to recall sol-gel method	CO6
5	How nanostructured materials are synthesized from the gas phase by the process of chemical vapour deposition. Also draw a schematic of a typical chemical vapour deposition reactor.	Understand	Learner to recall CVD	CO6

6	What is the principle behind TEM? Explain Transmission Electron Microscopy characterization technique to analyze nanomaterials with neat diagram	Understand	Learner to recall TEM	CO6
7	Explain the characterization of nanoparticles by using X-ray diffraction analysis which gives the information about particle size and composition.	Understand	Learner to recall XRD	CO6
8	Analyze the applications of nanotechnology in various fields such as bio field, medical, electronic and industry.	Understand	Learner to recall Applications of nano materials	CO6
9	With a neat sketch, explain ball milling process for synthesis of nano particles. List advantages and disadvantages also.	Understand	Learner to recall Ball milling method of nano fabrication	CO6
10	Desribe various techniques of physical vapour deposition.	Understand	Learner to recall PVD method of nano fabrication	CO6
11	Explain the precipitation and combustion methods of fabricating nano materials.	Understand	Learner to recall different fabrication techniques of nano materials.	CO6
12	Why [surface area/volume] ratio is very large for nanoparticles compared to bulk materials? Explain with an example.	Understand	Learner to recall surface area to volume raio	CO6
13	Explain nano science and nano technology	Understand	Learner to understand the topics nano science and nano technology	CO6
14	Explain SOL-GEL synthesis for producing nanomaterials? Explain with the help of a neat sketch.	Understand	Learner to recall sol-gel method	CO6

15	Explain how the electrical and mechanical properties of nano materials vary with size.	Understand	Learner to recall different properties of nano materials	CO6
16	Explain how the chemical and optical properties of nano materials vary with size?	Understand		CO6
17	Differentiate the CVD and PVD techniques for synthesizing the nano materials by drawing their sketches neatly.	Understand	Learner to recall PVD and CVD processes.	CO6
18	Explain the following i) Nano Scale ii) Nano Science and Nano Technology iii) Surface area to Volume ratio iv) Quantum confinement Effect	Understand		CO6
19	Discuss in detail how the mechanical and magnetic properties of nano materials vary with particle size.	Understand	Learner to understand magnetic properties and mechanical properties for nano materials	CO6
20	Mention any three properties of nano materials and how they vary with size in detail.	Understand	Learner to understand properties of nano materials	CO6
PART C-SHORT ANSWER QUESTIONS)				
1	What do you mean by Nano?	Remember		CO6
2	Define Nano Science?	Remember		CO6
3	Define Nano Technology?	Remember		CO6
4	What is the difference between Nano Science & Nano Technology?	Remember		CO6
5	"One nanometer is a magical point on the dimension scale." Why? Explain.	Understand	Learner to understand the concept of nano and its difference to bilk materials.	CO5
6	Define nanomaterial. Give classification of nanomaterials.	Remember		CO6

7	Define top down and bottom up approach	Understand	Learner to recall top down and bottom up approaches of nano fabrication.	CO6
8	What are the induced effects due to increase in surface area of nanoparticles?	Understand	Learner to recall surface area to volume ratio.	CO6
9	Write a short note on Nanomaterials and nanostructures.	Remember		CO6
10	Nanotechnology is not new. Justify this statement by discussing origin of nanotechnology.	Understand		CO6
11	Write about nanoscale and specify few examples that fall in this nanoscale range	Understand	Learner to recall nanoscale	CO6
12	Nanomaterials exhibit different properties from their bulk materials. What is the reason behind this?	Understand	Learner to recall surafe area to vulme ration and quantum confinement effect.	CO6
13	Mention the importance of nanomaterials in bio field by listing out its applications	Understand		CO6
14	List out the different processes by which nanosized particles can be fabricated	Remember		CO6
15	Reveal the difference between top-down and bottom-up approach needed for the synthesis of nanomaterials.	Understand	Learner to recall top down and bottom up approaches of fabricating nano materials.	CO6
16	There is an increasing demand of nanomaterials for potential applications. Justify this by writing their applications.	Understand		CO6
17	What are the advantages of Transmission Electron Microscope which is used to characterize nanoparticles?	Understand	Learner to recall the advantages of TEM	CO6
18	State any three applications of nano materials.	Remember		CO6

19	List the different top down approaches.	Remember		CO6
20	List the different bottom up approaches.	Remember		CO6

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