DEPARTMENT OF PHYSICS
Academic Year: 2016-17
QUESTION BANK - ODD SEMESTER

PH6151 – ENGINEERING PHYSICS -I

UNIT 1 – CRYSTAL PHYSICS

(Dr H.Krishnan & Mrs.S.Gandhimathi)

PART –A

S.No	Questions	Level
1	Distinguish between crystalline and non-crystalline materials.	BTL 4
2	What is unit cell?	BTL 1
3	Define Space lattice. How it is useful to describe a crystal structure?	BTL 2
4	What are the lattice parameters for a unit cell?	BTL 1
5	Name the seven crystal systems.	BTL 4
6	What are Bravais lattices?	BTL 1
7	Draw the Bravais lattices belonging to the orthorhombic crystal system.	BTL 2
8	Based on the criteria find out the crystal structure for the following. i) $a = b = c = 4.74$ Å and $\alpha = \beta = \gamma = 60°$. ii) $a = b = c = 4.74$ Å and $\alpha = \beta = \gamma = 90°$.	BTL 5
9	Define co-ordination number and atomic packing factor.	BTL 1
10	Iron has BCC structure with atomic radius 0.123 Å. Find the lattice constant.	BTL 3
11	Copper has FCC structure and its atomic radius is 1.273 Å. Find the lattice parameter.	BTL 3
12	Name the crystal structure of the following. a) Gold b) Germanium c) Barium d) Zinc.	BTL 4
13	Why diamond is called a loosely packed system.	BTL 5
14	List the uses of graphite?	BTL 4
15	How carbon atoms are arranged in diamond and graphite structure?	BTL 2
16	What are Miller Indices?	BTL 1
17	Draw the planes for Miller Indices (100), (110) and (111).	BTL 2
18	Classify the crystal growth techniques.	BTL 4
19	Discuss the limitations of Bridgman technique.	BTL 6
20	Compare the advantages of Czochralski's and Bridgman technique.	BTL 5

PART B

S.No	Questions	Level
1	Explain Seven Crystal System with neat diagram. (16)	BTL 5
2	Explain the No. of atoms, atomic radius, Co-ordination number and packing factor for SC, BCC and FCC structures. (16)	BTL 2

3	a.) Describe BCC structure. Derive expression for the no. of atoms co-ordination number, atomic radius and packing factor. (10)	BTL 2
	b.) The density of copper is 8980 kg/m^3 and unit cell dimension is 3.61 Å. atomic weight of Cu is 63.54. Determine its crystal structure. Calculate the atomic radius and interplanar spacing of (110) plane. (6)	BTL 3
4	a.) Describe FCC structure. Derive the details about no. of atoms, Co-ordination number, atomic radius and packing factor. (8)	BTL 2
	b.) Metallic iron changes from BCC to FCC at 910° C and corresponding atomic radii vary from 1.258$\dot{A}$ to 1.292 $\dot{A}$. Calculate the percentage volume change during this structural change. (4)	BTL 3
	c.) α- iron of atomic weight 55.85 solidifies into BCC structure and has a density of 7860 kg/m^3. Calculate the radius of an atom? (4)	BTL 3
5	Explain HCP structure. Show that for an HCP structure c/a = $\sqrt{8}$ /$\sqrt{3}$ and hence calculate Packing Fraction for HCP structure. (4 + 12)	BTL 2
6	a.) Show that atomic packing factor for FCC and HCP are same (8)	BTL 4
	b.) What are Bravais lattices? List out the axial length and interfacial angles of seven crystal systems (6)	BTL 1
	c.) Show that for a simple cubic system d_{100} : d_{100} : d_{111} : $\sqrt{6}$: $\sqrt{3}$: $\sqrt{2}$ (2)	BTL 4
7	a.) Define the following terms i) No of atoms per unit cell ii) Atomic Radius iii) Co-ordination number iv) Atomic packing factor. (8)	BTL 1
	b.) Calculate the volume of an FCC unit cell in terms of atomic radius 'r'. (4)	BTL 3
	a.) An element has HCP structure. If the radius of the atom is 1.605 Å. Find the volume of the unit cell. (4)	BTL 3
8	Describe the following structures. i) Diamond cubic ii) Graphite structure. (8 + 8)	BTL 4
9	a.) Describe the various steps involved for finding the Miller Indices. (8)	BTL 1
	b.) Show that for a cubic lattice the distance between two successive plane (hkl) is given by $d = a / (h^2+k^2+l^2)^{½}$ (8)	BTL 1
10	b.) Derive the expression for the interplanar spacing or d-spacing for (hkl) planes of a cubic structure. (12)	BTL 2
	c.) Determine lattice constant for FCC lead crystal of radius 1.746 Å. Also find the spacing of (i) (1 1 1) planes (ii) (2 0 0) planes (iii) (2 2 0) planes (4)	BTL 3
11	Explain the two melt growth techniques. i) Czochralski's method ii) Bridgman technique (8 + 8)	BTL 2
12	a.) Discuss the various solution growth techniques along with its merits and demerits. (12)	BTL 2
	b.) Summarize the atomic radius values of SC, BCC, FCC and HCP (4)	BTL 2
13	a.) Explain vapour growth techniques for growing crystal. (10)	BTL 2
	b.) Explain slow cooling and slow evaporation techniques. (6)	BTL 2
14	Discuss in detail about any two suitable method to grow single crystal of semiconducting materials. (8 + 8)	BTL 4

UNIT II –PROPERTIES OF MATTER AND THERMAL PHYSICS

(Mrs R.Sasireka & Mrs M.P.Ramya Rajan)

PART A

S.NO	QUESTIONS	LEVEL
1	State Hooke's law.	BTL 1
2	Define stress and strain. Write their units.	BTL 1
3	What is the significance of stress-strain diagram?	BTL 2
4	What is Poisson's Ratio?	BTL1
5	Calculate the Poisson's ratio for the material, given Y = 12.25×10^{10} N/m^2 and n = 4.55×10^{10} N/m^2.	BTL 3
6	How do temperature and impurity in a material affect the elasticity of the materials?	BTL 5
7	Define neutral axis.	BTL1
8	An elastic wire is cut into half its original length. How will it affect the maximum load the wire can support?	BTL 6
9	A copper wire of 3 m length and l mm diameter is subjected to a tension of 5 N. Calculate the elongation produced in the wire, if the Young's Modulus of copper is 120 GPa.	BTL 3
10	A circular and a square cantilever are made of same material and have equal area of cross section and length. Find the ratio of their depression, for the given load.	BTL 6
11	What are the different modes by which heat is transferred from one place to another?	BTL 2
12	Define coefficient of thermal conductivity.	BTL 1
13	What are the basic entities responsible for thermal conduction of a solid?	BTL 2
14	State Newton's law of cooling.	BTL 3
15	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?	BTL 2
16	When a wire is bent back and forth it becomes hot. Why?	BTL 4
17	Define steady state and thermal diffusivity.	BTL 1
18	The total area of the glass window pane is 0.6 m^2. Calculate how much heat is conducted per hour through the glass window pane if the thickness of glass is 5 mm, the inside temperature is 20 °C and outside temperature is 40 °C. Thermal conductivity of glass is 1.1 Wm^{-1}K^{-1}.	BTL 3
19	Why the specimen used to determine thermal conductivity of a bad conductor should have larger area and smaller thickness?	BTL 5

20	The ends of two rods A and B with thermal conductivities k_1 and k_2 are maintained at temperatures $\theta_1 and \theta_2$. The rods are of equal length. What is the condition under which there will be equal rate of flow of heat through both the rods?	BTL 4

PART B

S.NO	QUESTIONS	LEVEL
1	(i) How will you classify three types of elastic modulii. Explain with necessary diagrams. Write the relationship between three modulii of elasticity. (10+2) (ii) A wire of length 10 m and diameter 2 mm elongates 0.2 mm when stretched by a weight of 0.55 kg. Calculate Young's modulus of the material of the wire. (4)	BTL 4
2	(i) Draw stress - strain diagram and discuss the behavior of ductile material under loading. (8) (ii) Explain the factors affecting the elasticity. (8)	BTL 2
3	(i) What is meant by bending beam moment? Derive the expression for the bending momentof the beam. (2+8) (ii) Write short notes on I shaped girders. (6)	BTL 1
4	(i) What is cantilever? Derive an expression for the depression at the free end of a Cantilever, due to load. (2+10) (ii) A cantilever of length 50 cm fixed at one is depressed by 20 mm at the loaded end. Calculate the depression at a distance of 40 cm from the fixed end. (4)	BTL 3
5	Derive an expression for depression at the free end of a cantilever due to load. Describe an experiment to determine the Young's modulus of the cantilever material using this expression. (16)	BTL 1
6	(i) Describe with necessary theory, the method of determining the Young's modulus of the beam of rectangular cross section by bending it uniformly. (12) (ii) A uniform rectangular bar of 1.0 m long, 2.5 cm breadth and 4.9 mm thickness is supported on its flat face symmetrically on two knife edges 80 cm apart. If loads of 0.125 kg are hung from the two ends, Calculate the radius of curvature of the bar in equilibrium position. Young's Modulus of the material is 12×10^9 N/m^2. (4)	BTL 3
7	Derive an expression for the elevation at the center of a beam which is loaded at both ends. Describe the experiment to determine Young's Modulus of the beam using uniform bending method. (8+8)	BTL 5
8	Derive an expression for rectilinear flow of heat along an uniform bar (one dimensional flow of heat) . (16)	BTL 1
9	Derive a differential equation (second order) to describe the heat conduction along a uniform bar. Hence obtain the steady state solution of it. (16)	BTL 2
10	Describe with relevant theory the method of determining the coefficient of thermal conductivity of a bad conductor by Lee's method. (16)	BTL 1
11	Derive an expression for the quantity of heat flow through a metal slab whose faces are kept at two different temperatures. Use this expression to determine the thermal conductivity of a bad conductor. (16)	BTL 2
12	(i) Derive the expression for effective thermal conductivity through compound media in series and parallel. Also discuss the application of it. (12) (ii) Two metal bars A and B are 50 cm and 70 cm long respectively and have	BTL 2

	thermal conductivities 385 $Wm^{-1}K^{-1}$ and 296 $Wm^{-1}K^{-1}$ respectively. They are joined together by welding. The outer end of A is at 363 K and the outer end of B is at 303 K. Calculate the temperature at the welded joined assuming that their cross sections are equal. (4)	
13	(i) Derive an expression for thermal conductivity of the material of a thick pipe through which a hot liquid is flowing. (12)	BTL 4
	(ii) How are heat conduction and electrical conduction analogous to each other? (4)	
14	(i) Describe the theory of radial flow of heat and explain the experiment of determining coefficient of thermal conductivity of a thick rubber pipe through which steam is flowing. (12)	BTL 5
	(ii) A metal pipe having an external diameter 20 cm carries steam at 100 °C. This is covered by a layer 2.0 cm thick of insulating material with co efficient of thermal conductivity 0.20 $Wm^{-1}K^{-1}$.If the outer surface is 30 °C, calculate the heat lost by the pipe of 2m length per hour. Neglect the temperature drop across the pipe. (4)	

UNIT - III – QUANTUM PHYSICS

(Dr.M.Anbuchezhiyan & Mrs S.Sowmiya)

PART-A

S.No	Questions	Level
1	What is black body radiation?	BTL 1
2	Define Wien's displacement law.	BTL 1
3	State Rayleigh - Jeans law. What are its limitations?	BTL 1
4	What is quantum theory of light? Give the special features of quantum theory of radiation.	BTL 1
5	List the applications of Schrodinger wave equation.	BTL 2
6	What is Compton wavelength? Give its value.	BTL 1
7	Find the change in wavelength of an X-ray photon when it is scattered through an angle of 90° by a free electron.	BTL 3
8	Write a short note on dual nature of matter and radiation.	BTL 2
9	A neutron of mass 1.675×10^{-27} kg is moving with a kinetic energy 10 keV. Calculate the de-Broglie wavelength associated with it.	BTL 3
10	Calculate the de-Broglie wavelength of an electron having a velocity of 10^6 m/s.	BTL 3
11	An electron at rest is accelerated through a potential of 5000 V. Calculate the de-Broglie wavelength of matter wave associated with it	BTL 3
12	What do you understand by the term wave function?	BTL 2
13	Why should the wave function of a particle be normalised?	BTL 2

14	For a free particle moving within a one dimensional potential box, the ground state energy cannot be zero. Why?	BTL 4
15	Calculate the minimum energy of an electron can possess in an infinitely deep potential well of width 4 nm.	BTL 3
16	What are eigen values and eigen function?	BTL 1
17	What is the principle of electron microscope?	BTL 4
18	Compare the resolution and magnification of optical microscope with that of electron microscope.	BTL 5
19	Write any four differences between SEM and TEM.	BTL 5
20	List out the limitations of transmission electron microscope.	BTL 4

PART-B

S.No	Questions	Level
1	Write the postulates of Planck's quantum theory of radiation. 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. (6 + 10)	BTL 2
2	Derive the expression for Planck's quantum theory of radiation. (10)	BTL 2
	Deduce Wien's displacement law & Rayleigh-Jeans law from Planck's quantum theory of radiation. (6)	BTL 4
3	What is Compton Effect? Give the theory of Compton effect and show that the Compton shift $\Delta\lambda = \frac{h}{m_{0C}}(1 - \cos\theta)$. (2 + 14)	BTL 3
4	a.) Derive an expression for the change in wavelength suffered by an X-ray Photon when it collides with an electron and describe the experimental part with necessary diagrams. (16)	BTL 2
5	a.) What are matter waves? Write the properties of matter waves. (8)	BTL 2
	b.) Describe G. P. Thomson gold foil experiment that proved the existence of matter waves. (8)	BTL 4
6	Derive the expression for de-Broglie wavelength for matter waves. Express the de-Broglie Wavelength in terms of energy and voltage. (6 + 6 + 4)	BTL 5
7	a.) Explain the physical significance of wave function. (8)	BTL 4
	b.) X-rays of 1$\dot{A}$ are scattered from a carbon block. Find the wavelength of the scattered beam in a direction making 60° with the incident beam. How much kinetic energy is imparted to the recoiling electron? (4)	BTL 3
	c.) Calculate the de-Broglie wavelength of a proton and an electron accelerated by a potential of 150 V. (4)	BTL 3
8	Derive Schrodinger's time independent wave equation. (16)	BTL 2
9	Derive Schrodinger's time dependent wave equation. (16)	BTL 2
10	Derive Schrodinger's wave equation for a particle in a box. Solve it to obtain Eigen function and show that Eigen values are discrete. (16)	BTL 3
11	Derive an expression for energy levels of a particle enclosed in one- dimensional box of width 'a' and infinite height. (16)	BTL 3
12	a.) Compare optical microscope with electron microscope. (6)	BTL 1
	b.)With Schematic diagram explain the construction and working of Scanning Electron Microscope. (10)	BTL 1

13	Discuss the construction, working and applications of Scanning Electron Microscope. Also mention its advantages and disadvantages. (16)	BTL 1
14	Explain the principle, construction, working and applications of Transmission Electron Microscope. Also mention its advantages and disadvantages. (16)	BTL 1

UNIT IV –ACOUSTICS AND ULTRASONICS

(Dr K.Thirupathi & Mrs D.Praveena)

PART A

S.NO	QUESTIONS	LEVEL
1	Classify sound waves based on frequency.	BLT4
2	State Weber-Fechner law.	BLT1
3	Distinguish between loudness and intensity of sound.	BLT2
4	Define absorption coefficient with unit.	BLT1
5	Suppose a single violin produced 60 dB of sound intensity level, calculate the effective sound intensity level of 8 such violins.	BLT5
6	A source of sound produces an intensity level of dB at a given point. Calculate the intensity of sound.	BLT3
7	Show that a 26% change in intensity alters the sound intensity level by 1 decibel.	BLT4
8	Define reverberation and reverberation time of an auditorium.	BLT1
9	A lecture hall has a volume of 120000m^3. It has reverberation of 2.5 sec .What is the average absorbing coefficient of the surface, if the total sound absorbing surface is 20000 sq.mts?	BLT4
10	What are the requisites for a good auditorium?	BLT1
11	How to control reverberation in a hall.	BLT2
12	Mention the properties of ultrasonics.	BLT1
13	Mention the four applications of ultrasonic waves.	BLT6
14	Are ultrasonic waves electromagnetic waves in nature? Explain.	BLT2
15	Why not ultrasonics be produced by passing high frequency alternating current through a loud speaker?	BLT6
16	Can we use copper rod in magnetostriction generator. Why?	BLT5
17	What is the principle of A-Scan display in ultrasonics?	BLT2
18	Calculate the velocity of ultrasonic waves in a liquid in an acoustic grating experiment using the following data. Wavelength of the light used = 600 nm. Frequency of ultrasonic waves = 100 MHz Angle of diffraction for first order diffracted beam is equal to 5°	BLT3
19	What is cold welding?	BLT2
20	Ultrasonic pulse echo method is used to detect possible defects in a steel bar of thickness 40 cm. if the pulse arrival times are 40 and 80 μs, determine the position of defect in the steel bar.	BLT4

PART B

S.NO	QUESTIONS	LEVEL
1	Obtain Sabine's expression for reverberation in a hall. (16)	BTL1
2	Derive expression for growth and decay of energy density inside a hall and hence deduce Sabine's formula for the reverberation time of a hall. (16)	BTL1
3	(i) Explain the various factors affecting the architectural acoustics of a building and their remedies. (12) (ii) Derive the expression for absorption co-efficient. (4).	BTL3
4	(i) Discuss the salient points associated with acoustics of auditorium. (12) (ii) A hall has a volume of 12500 m^3 and reverberation time of 1.5 sec. If 200 chairs are additionally placed in the hall, what will be the new reverberation time of the hall? The absorption of each chair is 1 O.W.U. (4)	BTL3
5	(i) Discuss the factors, reverberation , resonance, echelon effect , focusing and reflection that affect the acoustics in a hall and the remedies for them. (16)	BTL2
6	(i) A rectangular closed room whose internal dimensions are 20 x 30 x 16 m^3 has a surface whose average absorption coefficient is 0.04 calculate the time of reverberation of the room. when a material of area 2000m^2 is brought into the room the time of reverberation falls to 3 sec. Calculate the absorption coefficient of the material introduced. (6) (ii) Compare the merits and demerits of Magnetostriction oscillator and Piezo electric oscillator. (6) (iii) A quartz crystal of thickness 0.005 m is vibrating at resonance. Calculate the fundamental and first overtone frequency, given the Young's modulus for quartz as 7.9×10^{10} N/m^2 and density of quartz 2650 kg/m^3. (4)	BTL4
7	What is magnetostriction effect? Explain how ultrasonic waves can be produced by magnetostriction oscillator. Also mention its advantages, disadvantages and applications. (16)	BTL2
8	(i) Explain the phenomenon of producing high frequency sound waves by magnetostriction method with necessary diagrams. (12) (ii) Calculate the natural frequency of 40mm length of a pure iron rod. Given that the density of pure iron is 7.25 x 10^3 kg/m^3 and its Young's modulus is 115 x10^9 N/m^2. (4)	BTL2
9	(i) What is piezo electric effect? Describe the production of ultrasonic waves by piezoelectric oscillator method. (12) iii) Discuss its advantages, disadvantages and applications of piezoelectric oscillator method. (4)	BTL4
10	(i) What is acoustic grating? How it is used to find the velocity of ultrasonic waves in liquid medium? (12). ii) An ultrasonic pulse sent by a source in sea is reflected by a submerged target at a distance 597.50m and reaches the source after 0.83 seconds. Find the velocity of sound in sea water. (4)	BTL5
11	i) Explain the process of Non-destructive testing of materials using ultrasonic waves by pulse echo method. (12) (ii) Write in detail how a A-Scan technique is employed to locate a defect. (4)	BTL6
12	(i) Describe the different modes of scanning used in ultrasonic imaging technique. (12) (ii) Give the applications of ulrasonics in engineering field. (4)	BTL1

13	(i) Draw a block diagram of ultrasonic flaw detector. Describe the working of ultrasonic flaw detector for NDT by reflection mode. (12) ii) Write down the differences between Reflection mode and transmission mode. (4)	BTL4
14	(i) What is sonogram? Describe the principle and working of sonogram with block diagram. (2+8) (ii)Explain the medical applications of ulrasonics. (4)	BTL1

UNIT – 5 - LASER AND FIBRE OPTICS

(Dr.K.Sarojini & Mrs. R.Nithya Balaji)

PART-A

S.NO	QUESTIONS	LEVEL
1	What are the characteristics of laser?	BTL1
2	What are population inversion and metastable state?	BTL1
3	Mention the conditions to achieve laser action.	BTL1
4	Distinguish between spontaneous and stimulated emission.	BTL4
5	There is no spontaneous absorption. Why?	BTL5
6	What is pumping? What are the different methods of pumping?	BTL1
7	Can a two level system be used for production of Laser? Why?	BTL5
8	What is the role of Nitrogen and Helium in CO_2 laser?	BTL6
9	Calculate the number of photons from green light of mercury (λ = 4961 Å) requires to do one joule of work.	BTL3
10	For InP laser diode, the wavelength of light emissions is 1.55 μm. What is its band gap?	BTL3
11	What is the principle behind optical fibre?	BTL2
12	What are the conditions for total internal reflection?	BTL2
13	A signal of 100 mW is injected into a fiber. The out coming signal from the other end is 40 mW. Find the loss in dB.	BTL3
14	What are active and passive sensors?	BTL1
15	Give any four advantages of fiber optic communication system.	BTL2
16	Why is intermodal dispersion is reduces in graded index fibre?	BTL4
17	Define dispersion.	BTL1
18	What are the essential components of optical sensors?	BTL1

19	Calculate the numerical aperture of an optical fiber whose core and cladding are made of materials of refractive indices 1.6 and 1.5 respectively.	BTL3
20	Numerical aperture of optical fiber is 0.5 core refractive index is 1.54. Find refractive index of cladding.	BTL3

PART – B

S.NO	QUESTIONS	LEVEL
1	(i) Derive an expression for Einstein's coefficient of spontaneous and stimulated emissions. (12) (ii) How laser light differ from ordinary light. (4)	BTL1
2	(i) Explain in detail about the different pumping mechanisms used in laser. Give an example for each. (12) (ii) What is the ratio of the stimulated emission to spontaneous emission at temperature of 280 °C for sodium D – line? (4)	BTL 2
3	Describe principle, construction and working of a Nd:YAG laser with neat diagram. Also mention its advantages, disadvantages and applications.(16)	BTL 2
4	Explain the principle, construction and working of a four level solid state laser. (16)	BTL 1
5	(i)Explain the vibrational modes of CO_2 molecule? Explain. (4) (ii) Describe the construction and working of CO_2 laser with energy level diagram and write its applications. (12)	BTL 2
6	With suitable diagram, explain how the laser action is achieved in homo junction and hetro junction lasers? (8+8)	BTL 3
7	(i)Distinguish between homojunction and heterojunction Laser.(8) (ii) Calculate the wavelength of emission of GaAs semiconductor laser whose band gap energy is 1.44 eV. (4) (iii) Explain Medical applications of laser. (4)	BTL 4
8	(i) Explain the propagation of light through optical fiber and obtain an expression for numerical aperature and acceptance angle (12) (ii)) Calculate the NA and acceptance angle of an optical fibre from the following data, refractive index of core is 1.55, refractive index for cladding is 1.50. (4)	BTL 5
9	(i) Explain total internal reflection with suitable diagram. (4) (ii) Derive the expression for Numerical aperture and Acceptance angle. (12)	BTL 1
10	How optical fibers are classified based on modes, material and refractive index profile? (16)	BTL 4
11	(i)Explain fibre optical communication system with neat block diagram. (12) (ii)What are the advantages of the fibre optical communication system over the conventional system? (4)	BTL 2
12	(i) What is attenuation? Discuss the different mechanisms which are responsible for attenuation in the optical fiber. (10) (ii) Explain the bending losses in an optical fiber. (6)	BTL 6
13	(i) Explain the working of temperature sensor and displacement sensor. (12) (ii) Give any four applications of fibre optic sensor. (4)	BTL 3

14	(i) Describe the construction and working of medical endoscope and give its application in medical field. (8)	BTL 4
	(ii) Distinguish between (a) Single mode fibre and multi mode fibre (4) (b) Step index and graded index fibre (4)	