VALLIAMMAI ENGINEERING COLLEGE

SRM Nagar, Kattankulathur – 603 203

DEPARTMENT OF PHYSICS

QUESTION BANK

I SEMESTER

PH8151-ENGINEERING PHYSICS

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SUBJECT : PH8151- ENGINEERING PHYSICS

SEM / YEAR: I SEM/AY-2018-2019

UNIT I - PROPERTIES OF MATTER			
Elasticity – Stress-strain diagram and its uses - factors affecting elastic modulus and tensile strength – torsional stress and deformations – twisting couple - torsion pendulum: theory and experiment - bending of beams - bending moment – cantilever: theory and experiment – uniform and non-uniform bending: theory and experiment - I-shaped girders - stress due to bending in beams.			
PART - A			
Q.No	**Questions**	**BT Level**	**Competence**
1.	Draw stress-strain diagram for brittle and ductile material.	BT L 2	Understand
2.	What is non-uniform bending and why is said to be non-uniform?	BT L 1	Remember
3.	What are the different types of stress and strain?	BT L 1	Remember
4.	Define elastic fatigue.	BT L 2	Understand
5.	State Hooke's law.	BT L 2	Understand
6.	What do you infer from stress and strain diagram?	BT L 4	Analyse
7.	List the three modulii of elasticity.	BT L 1	Remember
8.	What force is required to stretch a steel wire to double its length when its area of cross section is 2 cm^2 and young's modulus is 2 x 10^{11} N/m^2.	BT L 3	Apply
9.	What is Poison's ratio?	BT L 1	Remember
10.	How do temperature and impurity affect the elasticity of materials?	BT L 4	Analyse
11.	Define torque.	BT L 2	Understand
12.	A wire of length 1 m and diameter 1 mm is clamped at one of its ends. Calculate the couple required to twist the other end by 90°. Given modulus of rigidity = 298 GPa.	BT L 3	Apply
13.	Define torsional stress.	BT L 1	Remember
14.	What is a beam?	BT L 2	Understand
15.	How are the various filaments of a beam affected when the beam is loaded?	BT L 4	Analyse
16.	Define cantilever.	BT L 2	Understand
17.	When a wire is bent back and forth it becomes hot? Why?	BT L 5	Evaluate
18.	Calculate the young's modulus of the material in the cantilever depression method. The length of cantilever beam is 1m which is suspended with a load of 150 gm. The depression is found to be 4 cm. The thickness of the beam is 5 mm and breadth is 3 cm.	BT L 3	Apply
19.	An elastic wire is cut into half of its original length. How will it affect the maximum load the wire can support?	BT L 5	Evaluate
20.	What are the advantages of I- shaped girders?	BT L 5	Evaluate
PART - B			
1.	How will you classify three types of elastic moduli? Explain with necessary diagrams. Write the relationship between three moduli of elasticity. (16)	BT L 5	Evaluate

2.	Draw stress strain diagram and discuss the behaviour of ductile material under loading. (16)	BT L 2	Understand
3.	Explain the factors affecting the elasticity of the material. (16)	BT L 2	Understand
4.	Derive an expression for the torsional couple per unit angular twist when a cylinder is twisted. (16)	BT L 5	Evaluate
5.	Derive an expression for the period of oscillation of a torsional pendulum. How can it be used to determine the torsional rigidity of a wire? (16)	BT L 5	Evaluate
6.	What is torsional pendulum? How it is used to determine the a) Moment of inertia of the disc. b) Rigidity modulus of the wire using moment of inertia c) moment of inertia of a irregular body. (16)	BT L 1	Remember
7.	What is torsion pendulum? Explain how it is used to determine the rigidity modulus of the material of a thin wire. (16)	BT L 1	Remember
8.	What is meant by bending moment of a beam? Derive the expression for the bending moment of a beam. (16)	BT L 1	Remember
9.	Derive the expression for the depression at the free end of a cantilever due to load. Describe an experiment to determine the young's modulus of the cantilever using this expression. (16)	BT L 1	Remember
10.	i) Derive with relevant theory how a cantilever may be used to determine the Youngs modulus of the material of bar? (12) ii) 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. (4)	BT L 4	Analyse
11.	Explain with 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. Describe an experiment to determine the young's modulus of the material using this method. (16)	BT L 5	Evaluate
12.	Derive an expression for the elevation at the centre of the beam which is loaded at both ends. (16)	BT L 4	Analyse
13.	How will you determine the young's modulus of material of a bar by non-uniform bending method? Explain briefly the theory behind the determination of young's modulus. (16)	BT L 4	Analyse
14.	i) Write a short note on I shaped girders. Give its applications and advantages. (12) ii) Explain stress due to bending in beams. (4)	BT L 1	Remember

UNIT II - WAVES AND FIBER OPTICS

Oscillatory motion – forced and damped oscillations: differential equation and its solution – plane progressive waves – wave equation. Lasers : population of energy levels, Einstein's A and B coefficients derivation – resonant cavity, optical amplification (qualitative) – Semiconductor lasers: homojunction and heterojunction – Fiber optics: principle, numerical aperture and acceptance angle - types of optical fibres (material, refractive index, mode) – losses associated with optical fibers - fibre optic sensors: pressure and displacement.

PART – A

Q.No	Questions	BT Level	Competence
1.	Define the terms i) Amplitude ii)Time period iii) Frequency iv)Phase	BTL 1	Knowledge

2.	Define Simple Harmonic motion.	BTL 1	Knowledge
3.	Define Forced and damped oscillation	BTL 2	Understand
4.	What do you understand by the term Dead Beat? Give Examples	BTL 4	Analyse
5.	Calculate the maximum amplitude of velocity, for a particle executing S.H.M of period 10 sec and amplitude 5.0 cm.	BTL 4	Analyse
6.	Define plane progressive wave.	BTL 1	Knowledge
7.	State the properties of laser beam.	BTL 2	Understand
8.	Spatial and temporal coherence are major attributes of a lasing beam. Comment.	BTL 6	Creating
9.	Write the difference between spontaneous emission and stimulated emission.	BTL 4	Analyse
10.	What is meant by population inversion and metastable state?	BTL 1	Knowledge
11.	Can a two level system be used for the production of laser? Why?	BTL 2	Understand
12.	What is an optical resonator cavity? Mention its role in a laser?	BTL 3	Apply
13.	Calculate the wavelength of light emission from GaAs whose band gap is 1.44 eV.	BTL 4	Analyse
14.	List out the conditions to be satisfied for total internal reflection.	BTL 3	Apply
15.	What do you mean by the acceptance angle for an optical fibre? Show that it is related to the numerical aperture.	BTL 3	Apply
16.	Differentiate between single mode and multi mode fibre.	BTL 4	Analyse
17.	A silica optical fibre has a core refractive index of 1.51 and a cladding refractive index of 1.48. Determine the critical angle at the core cladding interface.	BTL 3	Apply
18.	Find out the numerical aperture and acceptance angle of an optical fibre, if the refractive indices for core and cladding are 1.6 and 1.5 respectively.	BTL 3	Apply
19.	How will you classify optical fibres based on the materials?	BTL 4	Analyse
20.	What is an active and passive fibre optic sensor?	BTL 1	Knowledge
	PART – B		
1.	Obtain the differential equation of damped harmonic oscillation and discuss the special cases of oscillatory motion. (16)	BTL2	Understand
2.	Derive the differential equation and its solution for Forced oscillations. Also discuss its special cases. (16)	BTL 4	Analyse
3.	Establish a differential equation of motion for a damped harmonic oscillator. Discuss the conditions for over damped, critical damped and under damped oscillations. (16)	BTL 1	Knowledge
4.	Derive the expression for the wave equation of a plane progressive wave. (16)	BTL 2	Understand
5.	i) Derive an expression for Einstein's coefficient of spontaneous and stimulated emissions. (12) (ii) How laser light differ from ordinary light? (4)	BTL 2 BTL 4	Understand Analyse
6.	Explain the principle, construction and working of a semiconductor diode laser. Mention its advantages and disadvantages. (16)	BTL 4	Analyse
7.	Compare a homojunction semiconductor laser with hetero junction semiconductor laser and detail their features. (16)	BTL 4	Analyse

8.	i) For a hetero junction semiconductor laser, the band gap of the semiconductor used is 1.44 eV. By doping, the band gap of the semiconductor is increased by 0.2 eV. Calculate the change in the wavelength of the laser. (6) ii) Differentiate between homo junction and hetero junction laser. (10)	BTL 3 BTL 4	Apply Analyse
9.	Define numerical aperture and derive an expression for numerical aperture and angle of acceptance of fibre in terms of refractive index of the core and cladding. Mention any six advantages of optical fibre for communication as a wave guide. (16)	BTL 1	Knowledge
10.	How optical fibers are classified based on modes, material and refractive index profile? (16)	BTL 2	Understand
11.	i) Discuss the following losses in optical fibres. a). Scattering loss b). Bending loss c). Absorption loss (12) ii) The optical power after propagating through a fibre of 1.5 km length is reduced to 25 % of its original value. Compute the fibre loss in db/km. (4)	BTL 2 BTL 5	Understand Evaluation
12.	Explain the construction and working of pressure and displacement sensors. (16)	BTL 4	Analyse
13.	What is attenuation? Discuss the different mechanisms which are responsible for attenuation in the optical fiber. (16	BTL 2	Understand
14.	What are the different types of fibre optic sensors? Explain the working of any two sensors. (16)	BTL 1	Knowledge

UNIT III - THERMAL PHYSICS

Transfer of heat energy – thermal expansion of solids and liquids – expansion joints - bimetallic strips - thermal conduction, convection and radiation – heat conductions in solids – thermal conductivity - Forbe's and Lee's disc method: theory and experiment - conduction through compound media (series and parallel) – thermal insulation – applications: heat exchangers, refrigerators, ovens and solar water heaters.

PART – A

Q.No	Questions	BT Level	Competence
1.	Define the three modes of heat transfer.	BTL 1	Knowledge
2.	Distinguish between conduction and convection.	BTL 4	Analyze
3.	Define coefficient of thermal expansion of solids.	BTL 1	Knowledge
4.	Define coefficient of cubical expansion.	BTL 1	Knowledge
5.	Explain the term co-efficient of apparent and real expansion of liquid.	BTL 2	Understand
6.	Define coefficient of thermal conductivity .What is the principle involved in Lee's disc method to determine the thermal conductivity of bad conductors?	BTL 2	Understand
7.	What is meant by thermal gradient?	BTL1	Knowledge
8.	A rod of length 50 cm is heated at one end to 98°C, while the other end is kept at the room temperature. The area of cross section of rod is 0.67 cm^2.The thermal conductivity of the rod is 81 W/mk. Calculate the amount of heat conducted through the rod in 3(1/2) minutes.	BTL 3	Apply
9.	How are heat conduction and electrical conduction analogous to each other?	BTL 4	Analyze
10.	Is it possible for two objects to be in thermal equilibrium if they are not in contact with each other? Explain.	BTL 3	Apply
11.	What do you understand by the term bimetallic strip? Give its use.	BTL 2	Understand
12.	What is meant by thermal insulation?	BTL 1	Knowledge

13.	What are the important properties of thermal insulating materials?	BTL 2	Understand
14.	The roof building is often painted white during summer. Why?	BTL 4	Analyze
15.	A slab with area of 73×10^{-4} m^2 through which 16 J of heat is flowing through the both faces in 15 seconds and a temperature difference of 27 k is maintained. Calculate the thickness of the slab where its thermal conductivity is 0.01 /mk.	BTL 3	Apply
16.	What is meant by high temperature furnace? Give its objectives.	BTL 4	Analyze
17.	What is meant by heat exchangers? How the heat is measured using it?	BTL 1	Knowledge
18.	What is meant by solar power? How will you estimate it?	BTL 5	Evaluate
19.	Explain the principle of refrigeration.	BTL 2	Understand
20.	Define oven.	BTL 1	Knowledge
	PART – B		
1.	i) Discuss the phenomenon of heat transfer in solids and liquids. (5) ii) Prove that the volume expansion coefficient is three times that of linear expansion coefficient. (5) iii) A railway track, made of iron is laid in winter when the average temperature is 18°C .the track consists of sections of 12 m placed one after the other. How much gap should be left between two sections so that there is no compression during summer when the maximum temperature goes to 48° C? Co- efficient of linear expansion of iron is 11×10^{-6} °/C. (6)	BTL 1 BTL 4 BTL 5	Knowledge Analyze Evaluate
2.	Define expansion of joints. What are the types of expansion joints and write in detail about it. (16)	BTL 1	Knowledge
3.	How will you determine then thermal conductivity of a poor conductor using Lee's disc method? Give the necessary theory. (16)	BTL 2	Understand
4.	With a neat diagram, Explain a method to determine the thermal conductivity of a bad conductor. (16)	BTL 1	Knowledge
5.	Describe Forbe's method to determine thermal conductivity of metals with relevant theory and experiment. (16)	BTL 2	Understand
6.	Explain the method of determining thermal conductivity of good conductors. (16)	BTL 3	Apply
7.	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	Understand
8.	Derive the expression for effective thermal conductivity through compound media in series and parallel. Also discuss the application of it. (16)	BTL 3	Apply
9.	Write short notes on i) Thermal insulation to walls. (5) ii) Thermal insulation to ceilings and floors. (5) iii) Thermal insulation to doors and windows (6)	BTL 2	Understand
10.	What is meant by high temperature furnace? Describe any one of them in detail. (16)	BTL 1	Knowledge
11.	How are heat exchangers helpful in refrigerators, ovens, solar water heater? (16)	BTL4	Analyze
12.	Describe the working of a refrigerator. Give a few applications of refrigerators. (16)	BTL 3	Apply

13.	Describe the working of a hot air oven. Discuss its applications. (16)	BTL 1	Knowledge
14.	Describe the principle, construction and working of solar water heater. Mention two advantages and Disadvantages of it. (16)	BTL 3	Apply

UNIT IV - QUANTUM PHYSICS

Black body radiation – Planck's theory (derivation) – Compton effect: theory and experimental verification – wave particle duality – electron diffraction – concept of wave function and its physical significance – Schrödinger's wave equation – time independent and time dependent equations – particle in a one-dimensional rigid box – tunnelling (qualitative) - scanning tunnelling microscope.

PART – A

Q.No	Questions	BT Level	Competence
1.	What is mean by black body radiation?	BTL 1	Knowledge
2.	Write any two postulates of Planck's quantum theory.	BTL 1	Knowledge
3.	Define Wien's displacement law.	BTL 1	Knowledge
4.	State Rayleigh - Jeans law. What are its limitations?	BTL 1	Knowledge
5.	Define Compton effect.	BTL 1	Knowledge
6.	State the expression for Compton shift. Why it is not observable in the visible region of electromagnetic spectrum?	BTL 2	Understand
7.	Find the change in wavelength of an X-ray photon when it is scattered through an angle of 90° by a free electron.	BTL2	Understand
8.	Write any two physical significance of wave function.	BTL 5	Evaluate
9.	How are matter-waves different from electromagnetic waves?	BTL 4	Analyze
10.	What is wave particle duality?	BTL 2	Understand
11.	An electron at rest is accelerated through a potential of 5000 V. Calculate de-Broglie wavelength of matter wave associated with it.	BTL 2	Understand
12.	What is the importance of Schrodinger wave equation?	BTL 3	Apply
13.	Calculate the minimum energy an electron can possess in an infinitely deep potential well of width 4 nm.	BTL 3	Apply
14.	A cylinder filled with helium and heated up to 27 ^{0}C. If a beam of helium atoms emerges out of the cylinder, then calculate the de-Broglie wavelength associated with the helium atoms. Given that mass of one helium atom is 6.7 x 10^{-27} kg and k = 1.38x10^{-23} J/K.	BTL 2	Understand
15.	For a free particle moving within a one dimensional potential box, the ground state energy cannot be zero. Why?	BTL 3	Apply
16.	Calculate the energy required for an electron to jump from ground state to second excited state in a potential well of width "L".	BTL 1	Knowledge
17.	What are Eigen values and Eigen function?	BTL 4	Analyze
18.	What is an electron microscope?	BTL 2	Understand
19.	What is the principle of scanning tunnelling microscope?	BTL 5	Evaluate
20.	Mention the major applications of quantum tunnelling.	BTL 3	Apply

PART – B			
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. (4 + 12)	BTL 2	Understand
2.	i) Derive the expression for Planck's quantum theory of radiation. (12) ii) Deduce Wien's displacement law & Rayleigh-Jeans law from Planck's quantum theory of radiation. (4)	BTL 2	Understand
3.	What is Compton Effect? Give the theory of Compton effect and show that the Compton shift $\Delta\lambda = \frac{h}{m_{oc}}(1 - \cos\theta)$. (16)	BTL 4	Analyze
4.	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 3	Analyze
5.	Explain Compton effect and its physical significance. Derive the relation giving the change of wavelength the energy of recoil electron and recoil angle. (16)	BTL 2	Understand
6.	Derive the expression for de-Broglie wavelength for matter waves. Express the de-Broglie Wavelength in terms of energy and voltage. (16)	BTL 2	Understand
7.	i) Explain the physical significance of wave function. (8) ii) What are matter waves? Write the properties of matter waves.(8)	BTL 5	Evaluate
8.	Derive Schrodinger's time independent wave equation. (16)	BTL 4	Evaluate
9.	Derive Schrodinger's time dependent wave equation. (16)	BTL 3	Apply
10.	Derive Schrodinger's wave equation for a particle in a one dimensional box. Solve it to obtain Eigen function and show that Eigen values are discrete. (16)	BTL 2	Understand
11.	Discuss the case of particle in a box on Schrodinger wave equation. Apply this to electron in metal. (16)	BTL 3	Apply
12.	Show that wave function for a particle confined in an infinite one dimensional potential well of length 'L' is given. Hence discuss the energy levels and their discreteness. (16)	BTL 3	Apply
13.	Explain the phenomenon of quantum tunnelling with schematic diagram explain the construction and working of Scanning Tunnelling Microscope.	BTL 1	Knowledge
14.	Discuss the construction, working and applications of Scanning Tunnelling Microscope. Also mention its advantages and disadvantages. (16)	BTL 2	Knowledge

UNIT V - CRYSTAL PHYSICS

Single crystalline, polycrystalline and amorphous materials – single crystals: unit cell, crystal systems, Bravais lattices, directions and planes in a crystal, Miller indices – inter-planar distances - coordination number and packing factor for SC, BCC, FCC, HCP and diamond structures - crystal imperfections: point defects, line defects – Burger vectors, stacking faults – role of imperfections in plastic deformation - growth of single crystals: solution and melt growth techniques.

PART - A

Q.No	Questions	BT Level	Competence
1.	What are single crystalline materials?	BTL1	Knowledge
2.	Distinguish between crystalline and non-crystalline materials.	BTL4	Analysing

3.	What is meant by primitive and non-primitive cell? Give an example.	BTL1	Knowledge
4.	Define unit cell.	BTL1	Knowledge
5.	Based on the criteria find out the crystal structure for the following. (i) $a = b = c = 4.74Å$ and $\alpha = \beta = \gamma = 60^\circ$ (ii) $a = b = c = 4.74$ Å and $\alpha = \beta = \gamma = 90^\circ$	BTL4	Analysing
6.	What are Bravais lattice?	BTL1	Knowledge
7.	What are lattice parameters for a unit cell?	BTL1	Knowledge
8.	Define space lattice. How it is useful to describe a crystal structure?	BTL1	Knowledge
9.	For a cubic system, sketch the planes with Miller Indices (101), (110) and (011).	BTL2	Understand
10.	A crystal plane cut at 3a, 4b and 2c distances along the crystallographic axes. Find the Miller Indices of the plane.	BTL4	Analyse
11.	Distinguish between inter planar spacing and inter atomic spacing.	BTL3	Apply
12.	Determine the lattice constant for FCC Lead crystal of radius 1.746 Å.	BTL4	Analyse
13.	How carbon atoms are arranged in diamond structure?	BTL3	Apply
14.	Defects in crystals are not always harmful. Justify.	BTL3	Apply
15.	What is meant by crystal defect?	BTL6	Creative
16.	What are Schottky defects?	BTL1	Knowledge
17.	Define Burger vector.	BTL1	Knowledge
18.	What is the cause of plastic deformation?	BTL1	Knowledge
19.	Write any two applications of Czochralski and Bridgmann techniques.	BTL1	Knowledge
20.	What are Bravais lattice?	BTL3	Applying
	PART - B		
1.	Explain Seven Crystal System with neat diagram. (16)	BTL 2	Understand
2.	Explain the No. of atoms, atomic radius, Co-ordination number and packing factor for SC, BCC and FCC structures. (16)	BTL 2	Understand
3.	What is packing factor? Obtain packing factors for SC, BCC, FCC and HCP structures. (2+3+3+3+5)	BTL 1	Knowledge
4.	i) Describe BCC structure. Derive expression for the number of atoms, co-ordination number, atomic radius and packing factor. (12) ii) 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 inter planar spacing of (110) plane. (4)	BTL 2 BTL 3	Understand Apply
5.	i) Describe FCC structure. Derive the details about number. of atoms, co- ordination number, atomic radius and packing factor. (9) ii) Metallic iron changes from BCC to FCC at 910 $^\circ$C and corresponding atomic radii vary from 1.258Å to 1.292Å. Calculate the percentage volume change during this structural change. (4) iii) 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. (3)	BTL 2 BTL 3 BTL 3	Understand Apply Apply
6.	Explain HCP structure. Show that for an HCP structure $c/a = \sqrt{8}/\sqrt{3}$ and hence calculate packing fraction for HCP structure. (3 + 10)	BTL 2	Understand

7.	i) Show that atomic packing factor for FCC and HCP are same. (6) ii) What are Bravais lattices? List out the axial length and interfacial angles of seven crystal systems. (6) iii) Show that for a simple cubic system $d_{100} : d_{110} : d_{111} = \sqrt{6} : \sqrt{3} : \sqrt{2}$. (4)	BTL 3 BTL 1 BTL 3	Apply Knowledge Apply
8.	i) Derive the expression for the inter planar spacing or d-spacing for (hkl) planes of a cubic structure. (12) ii) Determine lattice constant for FCC lead crystal of radius 1.746 Å. Also find the spacing of a) (1 1 1), b) (2 0 0), c) (2 2 0). (4)	BTL 2 BTL 3	Understand Apply
9.	Explain diamond cubic structure and obtain its no.of atoms per unit cell, atomic radius, co-ordination number and atomic packing factor. (16)	BTL 4	Analyse
10.	What is meant by crystal defects? Explain the various types of crystal defects with neat diagram. (2+14)	BTL 2	Understand
11.	Explain about point defects and line defects with neat diagram. (16)	BTL 2	Understand
12.	i) Write a note on point imperfections in crystals. (8) ii) Discuss a suitable method to grow single crystal of semiconducting materials. (8)	BTL 2	Understand
13.	Explain the various solution growth techniques along with its merits and demerits. (16)	BTL 2	Understand
14.	Explain the two melt growth techniques. i) Czochralski's method ii) Bridgmann technique (8 + 8)	BTL 2	Understand