NPR College of Engineering & Technology
NPR Nagar, Natham, Dindigul - 624401, Tamil Nadu, India.
Approved by AICTE, New Delhi & Affiliated to Anna University, Chennai
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CourseCode &Name : PH3151 & Engineering Physics

Year/Semester : I/I `

Course Instructor: Dr.P.S.Satheesh Kumar, ASP/PHY

UNIT I – MECHANICS

S.NO	PART A – UNIT I (2 Marks)
1.	Define Centre of mass of the system.
2.	What are the physical significance of moment of inertia?
3.	What is radius of gyration?
4.	State parallel axis theorem.
5.	State perpendicular axis theorem.
6.	What is the difference between Centre of gravity and Centre of mass?
7.	Define rigid body rotation.
8.	How Centre of mass is determined for rigid body and regular shape?
9.	What factors the moment of inertia depends?
10.	Write down the equations of motion for rotational motion.
11.	Define angular momentum.
12.	Define torque.
13.	State conservation of angular momentum.
14.	What is gyroscope?
15.	What are the uses of gyroscope?
16.	What is torsional pendulum?
17.	What are the uses of torsional pendulum?
18.	What is double pendulum?
19.	What are the uses and applications of non-linear oscillations.
20.	Mention the uses of double pendulum.
21.	What is the relation between torque and angular momentum.

S.NO	PART B – UNIT I (8 Marks)
1.	Derive an expression for kinetic energy of the system of particles.
2.	Derive the equation of rotational motion about fixed axis.
3.	State and prove the theorem of parallel axes and perpendicular axes for the moment of inertia of a rigid body.
4.	State and prove the theorem of parallel axes and perpendicular axes for the moment of inertia of a plane lamina.
5.	Derive the relation between rotational kinetic energy and moment of inertia.
6.	Discuss the moment of inertia of a diatomic molecule.
7.	Derive an expression for angular moment of a rigid body.
8.	Explain conservation of angular momentum with examples.
9.	Discuss the rotational energy states of a rigid diatomic molecule.

S.NO	PART C – UNIT I (16 Marks)
1.	Discuss the Centre of mass and obtain the expression for the same for a system of particles. Also, outline the motion of Centre of mass.
2.	Derive an expression for the moment of inertia of a uniform rod. (i) About an axis through its centre and perpendicular to its length (ii) About an axis passing through one end of the rod and perpendicular to its length.
3.	Derive an expression for the moment of inertia of a thin ring. (i) About an axis through its centre and perpendicular to its length (ii) About a diameter. (iii) About a tangent in the plane of the ring.
4.	Derive an expression for the moment of inertia of a thin circular disc. (i) About an axis through its centre and perpendicular to its plane. (ii) About a diameter.
5.	Derive an expression for the moment of inertia of a solid sphere. (i) About a diameter. (ii) About a tangent
6.	Derive an expression for the moment of inertia of a thin ring. (i) About an axis through its centre and perpendicular to its length (ii) About the axis of cylinder.
7.	Describe the principle, construction and working of gyroscope and also mention its applications in various field.
8.	Derive an expression for time period of torsion pendulum. Explain how it is used to find rigidity modulus of a wire.
9.	Infer the definition for double pendulum. Discuss its theory and characteristic behavior exhibited by this system.
10.	Write a note on non-linear oscillations and its importance.

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UNIT II – ELETROMAGNETIC WAVES

S.NO	PART A – UNIT II (2Mark)
1.	Give the Maxwell's equations in differential form.
2.	Give the Maxwell's equations in Integral form.
3.	Write down the Maxwell's equations for free space.
4.	Write down the Maxwell's equations for conducting medium.
5.	What is intrinsic or characteristic impedance of free space?
6.	What is pointing vector?
7.	What is skin depth?
8.	What are the characteristics of Maxwell's first and second equations?
9.	What are the characteristics of Maxwell's third and fourth equations?
10.	Write down the expression for velocity of EM wave in free space.
11.	Define intensity of EM wave.
12.	Define radiation pressure.
13.	Mention the properties of Electromagnetic waves.
14.	Define the polarization of the wave.
15.	Write down a relation between the electric field vector and magnetic field vector.
16.	Write down the general wave equation for the electric vector in an EM wave in conducting medium.
17.	Write down the general wave equation for the magnetic vector in an EM wave in conducting medium.
18.	Write down the general electromagnetic waves equation in terms of electric field vector for free space.
19.	Write down the general electromagnetic waves equation in terms of magnetic field vector for free space.
20.	Write down the general solution of wave equation for plane polarized EM wave.
21.	Why electromagnetic wave is transverse in nature?

S.NO	PART B – UNIT II (8 Marks)
1.	Deduce the equation of conduction current density, displacement current density and prove that electromagnetic waves are transverse.
2.	Write Maxwell's equations and explain the characteristics of each equation.
3.	Discuss the source of electromagnetic waves and also mention the properties of electromagnetic waves.
4.	Deduce the equation of propagation of EM wave through a dielectric medium.
5.	Discuss the Phase and orientation of EM wave in matter.

6.	Explain reception and transmission of cell phone.
7.	Discuss the electromagnetic energy flow and pointing vector.
8.	Deduce the equation of intensity of an EM wave in Vacuum.
9.	Write a short note on Momentum and Radiation Pressure.

S.NO	**PART C – UNIT II (16 Marks)**
1.	Derive Maxwell's equations in differential and integral form.
2.	Give an account of Maxwell's equation in free space. Apply the equations to deduce the electromagnetic wave equation and also determine the velocity in vacuum and conditions on the wave field.
3.	Derive wave equation for conducting medium using Maxwell's equations and also determine skin depth in a conducting medium.
4.	Discuss polarization in electromagnetic waves and also describe the production of EM waves.
5.	Discuss the propagation of EM wave from vacuum to a non-conducting medium.
6.	Write a short note on (i) Intensity of an EM waves. (ii) Momentum and Radiation Pressure.

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UNIT III – OSCILLATIONS, OPTICS AND LASERS

S.NO	PART A – UNIT III (2 Mark)
1.	Define Simple Harmonic Motion.
2.	What are the characteristics of Simple Harmonic Motion?
3.	Mention the types of oscillations.
4.	What is resonance?
5.	Define standing waves.
6.	Distinguish between progressive waves and stationary waves.
7.	State Doppler effect.
8.	State laws of refraction.
9.	What is total internal reflection?
10.	Give conditions of total internal reflection.
11.	What is interference?
12.	What is air wedge?
13.	Write the differences between spontaneous emission and stimulated emission.
14.	What is meant by population inversion and how is it achieved?
15.	Compare the characteristics of laser with ordinary light.
16.	What is pumping method? What are the methods commonly used for pumping action?
17.	What is the function of resonator cavity in laser?
18.	What is the principle of laser action?
19.	What are the conditions required for laser action?
20.	What is laser material processing?
21.	What is heat treatment of laser?

S.NO	PART B – UNIT III (8 Marks)
1.	Explain Simple Harmonic Motion and discuss its characteristics.
2.	Discuss the phenomenon of sharpness of resonance.
3.	Derive the wave equation for standing waves.
4.	Discuss analogy between electrical and mechanical oscillating system.
5.	Deduce the differential equation for forced oscillations.
6.	For atomic transitions, derive Einstein relations and hence deduce the expressions for the ratio of spontaneous emission rate to be stimulated emission rate.
7.	Describe the different pumping mechanisms used in lasers?

8.	Discuss the applications of Lasers in industry.

S.NO	PART C – UNIT III (16 Marks)
1.	Deduce the wave equation for progressive wave.
2.	State and explain Doppler's effect. Calculate the apparent pitch of a note due to the motion of source and the listener.
3.	Discuss the energy transfer of a wave through the vibration of the string and also deduce the expression for the same.
4.	Explain the formation of interference fringes in an air-wedge shaped film. How is the thickness of the wire determined by this method?
5.	Describe Michelson interferometer and explain how the fringes from in it. How can this be used for measuring the wavelength of monochromatic light. And also derive the formula.
6.	Explain the construction and working of Nd-YAG laser with neat diagram.
7.	Explain the modes of vibration of CO_2 molecule. Describe the construction and working of CO_2 laser with necessary diagrams.
8.	Explain the principle, construction and working of a semiconductor diode laser with necessary diagrams.

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UNIT IV –BASIC QUANTUM MECHANICS

	PART A – UNIT IV (2 Mark)
1.	State Compton effect.
2.	What are matter waves?
3.	How De-Broglie justified his concept?
4.	What is de-Broglie's wave equation?
5.	Write an expression for the de-Broglie wavelength associated with electrons.
6.	What is Compton wavelength?
7.	What is quantum hypothesis?
8.	State the properties of the matter waves.
9.	Mention the physical significance of the wave function.
10.	Write down the Schroedinger time independent and dependent wave equations.
11.	What is a wave function?
12.	Define correspondence principle.
13.	What is a wave function?
14.	Mention some of the physical significance of the wave function.
15.	State the significance of correspondence principle.
16.	Define degenerate state.
17.	Define non-degenerate state.
18.	What are Eigen values and Eigen function?

	PART B – UNIT IV (8 Marks)
1.	Derive the expression for de-Broglie wavelength for matter waves. Express the de-Broglie Wavelength in terms of energy and voltage.
2.	Describe the experimental part of Compton effect with necessary diagrams.
3.	Derive Eigen value and Eigen energy function for 2D dimensional box.

4.	Derive Eigen value and Eigen energy function for 3D dimensional box.
5.	Discuss free particle problem starting from Schrodinger wave equation Eigen.

	PART C – UNIT IV (16 Marks)
1.	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.
2.	(i) Derive Schrodinger's time independent wave equation. (ii) Derive Schrodinger's time dependent wave equation.
3.	Derive an expression for energy levels of a particle enclosed in one-dimensional potential box of width a and inifinite height.
4.	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.
5.	Derive Schrodinger's wave equation for a particle in a rectangular three dimensional infinite well. Solve it to obtain Eigen function and also explain probability density.
6.	State and prove Bohr's correspondence principle.

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UNIT V – APPLIED QUANTUM MECHANICS

	PART A – UNIT IV (2 Marks)
1.	What is harmonic oscillator?
2.	Give examples for harmonic oscillator.
3.	What is the significance of zero point energy is a harmonic oscillator?
4.	Define barrier penetration.
5.	What is quantum tunneling?
6.	What is the significance of tunneling effect?
7.	Define magnification power.
8.	Define resolving power.
9.	What is scanning tunneling microscope?
10.	What is the principle behind scanning tunneling microscope?
11.	What is resonant diode?
12.	Define resonant tunneling.
13.	State Bloch's theorem.
14.	What is energy band?
15.	What is valance band?
16.	What is conduction band?
17.	What is forbidden gap?
18.	What is an Electron Microscope
19.	What are the types of Electron Microscope?
20.	Draw the energy bands for conductor and insulator.

	PART B – UNIT V (8 Marks)
1.	Describe barrier penetration and quantum tunneling.
2.	Explain the concept of resonant tunneling.
3.	Explain Bloch's theorem for particles in a periodic potential.

4.	Explain Band theory of solids.

	PART C – UNIT V (16 Marks)
1.	Obtain an expression for the energy levels of the harmonic oscillator by applying Schrodinger wave equation.
2.	Explain the principle, construction and working of scanning tunneling microscope with suitable diagram and also mention the advantages, disadvantages and applications.
3.	Explain the construction and working of resonant diode.
4.	Discuss a particle in a finite potential well starting from schrodinger wave equation.
5.	Discuss Kronig penny model.
6.	Describe origin of energy bands in solids.
7.	Explain the construction and working of resonant diode.