

Complete List of Unique Questions (from all years in the PDF)

1. Define SHM. Derive the total energy expression and show that KE and PE vary with time.
2. Derive the equation for damped harmonic oscillation and conditions for under, over, and critical damping.
3. Explain forced oscillation. Derive the amplitude of forced oscillation and define sharpness of resonance.
4. Derive the differential equation for LC oscillation and show its energy equivalence.
5. Describe compound pendulum. Derive time period and prove centers of suspension and oscillation are interchangeable.
6. Describe torsional pendulum and derive its time period.
7. Explain the acoustic properties of a good hall and derive Sabine's formula for reverberation time.
8. What is a piezoelectric oscillator? How is ultrasonic sound produced?
9. Describe interference in thin wedge-shaped film. Derive formula for fringe width.
10. What are coherent sources? How to use interference to find refractive index of a liquid?
11. What is diffraction? Explain single slit Fraunhofer diffraction and derive intensity formula.
12. Describe grating. Derive resolving power and dispersive power equations.
13. What are Newton's Rings? How are they used to find refractive index?
14. Define chromatic aberration. Derive condition for achromatic combination.
15. Calculate image distance and nature formed by coaxial lens system.
16. Explain cardinal points in a lens system. How to find them?
17. What is optical fiber? Derive expressions for numerical aperture and acceptance angle.
18. Explain difference between single-mode and multi-mode optical fibers (cost, attenuation, efficiency).
19. What is polarization? Explain linear, circular, and elliptical polarization.
20. Describe Nicol Prism construction and use as polarizer and analyzer.

21. Explain double refraction and how it produces polarized light.
22. Explain population inversion and working of gas lasers like He-Ne.
23. Define electric dipole and dipole moment. Derive field at axial and equatorial points.
24. Define electric quadrupole. Derive potential at axial point.
25. Define electric field vectors E , D , and P and derive their relation.
26. Derive expression for electric field due to:
 - (i) charged ring (axial line),
 - (ii) charged disc,
 - (iii) uniformly charged rod,
 - (iv) non-conducting sphere.
27. State and prove Gauss's law. Apply it to derive electric field of charged sphere.
28. Explain capacitance of:
 - (i) parallel plate capacitor with dielectric,
 - (ii) spherical/cylindrical capacitor.
29. Derive expression for growth and decay of current in:
 - (i) LR circuit,
 - (ii) RC circuit.
30. Define and derive self-inductance of:
 - (i) solenoid,
 - (ii) toroid.
31. Define mutual inductance and derive related equations.
32. Define Hall effect. Derive Hall voltage and Hall coefficient relation with carrier mobility.
33. Derive relation for resistivity from atomic view. Show dependence on temperature.
34. Use Ampere's law to find magnetic field:
 - (i) inside and outside a long wire,

- (ii) on axis of circular coil.

35. Derive expression for magnetic flux density at axial point of circular coil.
 36. Define Poynting vector and prove $S = E \times B / \mu_0$.
 37. State Maxwell's equations and derive wave equation from them.
 38. Derive expression for energy stored in an inductor and energy density.
 39. Define displacement current. Show it equals conduction current using Maxwell's correction.
 40. What is electromagnetic wave? Derive velocity equation in medium.
 41. Discuss significance of wave function. Derive time-independent Schrödinger equation.
 42. Derive Schrödinger equation for infinite potential well and prove energy quantization.
 43. Define tunneling effect. Derive transmission coefficient through a potential barrier.
 44. Calculate acceptance angle and NA from refractive index values of fiber and cladding.
 45. In Newton's ring, prove radius of nth ring $\propto \sqrt{n}$ and explain circular nature.
 46. Find specific rotation from sugar solution length and optical rotation.
 47. Write derivation of reverberation time reduction with increasing absorbing factors.
 48. Explain lens combination that minimizes chromatic and spherical aberration.
 49. Derive energy of SHM when displacement is a fraction of amplitude.
 50. Derive relation between wave energy and wave speed in a progressive wave.
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