



KEEPING MOBILE PHONE/SMART WATCH, EVEN IN 'OFF' POSITION, IS TREATED AS EXAM MALPRACTICE

Answer any **TEN** Questions
(10 X 10 = 100 Marks)

1. What is transverse impedance while we consider the propagation of waves in a string? Further, illustrate the equations for transmitted and reflected wave amplitudes at a boundary, when a wave is propagating from a lower density to a higher density medium. Also, elaborate the case when both the densities are equal. Representative figures are required to explain.
2. a) Define and give example of a transverse wave and a longitudinal wave. [5]
Graphically represent the direction of disturbance and propagation of wave in each case.
b) A wire of density of $\rho = 8.98 \text{ g/cc}$, diameter of 2.40 mm, and a length L is held under a tension of 10.00 N. Transverse waves are sent down the wire. [5]
(i) What is the linear mass density of the wire? (ii) What is the speed of the waves through the wire?
3. "Light is a form of EM wave" - verify on the light of Maxwell's equation using suitable mathematical arguments.
4. Discuss an experiment that shows the wave nature of a moving particle, with proper mathematical evidence from both theoretical and experimental perspectives.
5. a) Why the wave nature of matter is not apparent to us in our daily observations. [5]
Explain it with an example.
b) An electron remains in an excited state of an atom for typically $3 \times 10^{-8} \text{ s}$. What is the minimum uncertainty in the energy of the state (in eV)? [5]
6. Derive the energy eigen values and eigen function expressions for a particle continued in one dimensional infinite potential well from Schrodinger's equation with relevant diagrams.
7. Explain why nanomaterials behave differently from bulk materials. How nanomaterials are classified based on quantum confinement? Give example for each case with suitable diagrams.
8. Design an Nd-YAG laser specifying the various components using a neat diagram. Discuss its working using energy level diagram.
9. a) Explain how can we achieve population inversion in laser. [5]
b) A CO_2 laser emits light of wavelength of $10.6 \times 10^{-6} \text{ m}$. If the output power is 20 W, then how many photons are emitted in 10 minutes when the laser is in operation? [5]
10. How does the optical fiber communication system work? Explain with necessary block diagram. Also, with the help of a diagram, state the differences between a step-index fiber and graded index fiber.

11. a) Reason out why output signal received at the output end is not equal to the input signal in an optical fibre. [5]
- b) A silica glass optical fiber has a core refractive index of 1.50 and the cladding refractive index 1.46. Calculate critical angle of incidence, acceptance angle and numerical aperture? [5]
12. With neat schematic diagrams explain the construction and working of a light emitting diode (LED).

