



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 are standing waves? Explain the formation of stationary waves in a stretched string and arrive at the equation of their eigen frequencies.
2. (a) Derive the expression for the velocity of a transverse wave along a stretched string and discuss the solution of wave equation. [5]
(b) Calculate the speed of transverse waves in a wire of 1 mm^2 cross-section under the tension produced by 0.1 kg weight (specific density of the wire material = 9.81 gram/cm^3 and $g = 9.8 \text{ m/sec}^2$). [5]
3. List the differential form of Maxwell's equation. Using this deduce the equation for electric and magnetic field of an electromagnetic waves passing through free space.
4. Discuss the experiment which proved the wave nature of electrons.
5. (a) Obtain Schrodinger time independent equation from Schrodinger time dependent equation for a particle of mass m with energy E under a potential of U . [5]
(b) Two stars A and B emits radiation at 350 nm and 490 nm peak wavelength, find ratio of temp T_A/T_B . [5]
6. (a) What is quantum confinement? Explain different types of quantum confinement with the energy diagram. [5]
(b) A particle is moving in 1-D box of infinite potential the width of the box is 2.5 nm. Calculate the probability of finding the particle at it's least energy state within an interval 1.0 nm to 1.5 nm. [5]
7. Obtain an Eigen value and Eigen function of Schrodinger time independent wave equation for a particle confined in a one-dimensional box of width L . sketch the energy level, wave function and particle density for allowed first three states.
8. Discuss different modes of vibration in a CO_2 molecule with the help of an energy level diagram. Explain the working principle of CO_2 laser.
9. (a) What processes occur when light interacts with matter? Using Einstein's relationship for A and B coefficients show that it is very difficult to get a lasing mechanism at higher frequencies of the electromagnetic spectrum. [5]

- (b) Compare the coherence length of conventional and laser radiation sources as follows. [5]

If the radiation emitted from a low-pressure sodium lamp with a typical linewidth of sodium D lines at $\lambda = 589 \text{ nm}$ is $5.1 \times 10^{11} \text{ Hz}$, and if the laser radiation at $\lambda = 633 \text{ nm}$ emitted from a He Ne laser operating in a single mode with linewidth of 1 MHz .

10. Distinguish between step index and graded index fiber. Derive the expression for the pulse widening in intermodal dispersion for step index fiber.
11. (a) Explain the advantages of optical fiber communication system over other systems. Briefly explain one of its applications in the medical field. [5]
- (b) The velocity of light in the core of a step index fiber is $2.01 \times 10^8 \text{ m/sec}$, and the critical angle at the core-cladding interface is 80° . Determine the numerical aperture and the acceptance angle for the fiber in air, assuming it has a core diameter suitable for consideration by ray analysis. The velocity of light in a vacuum is $2.998 \times 10^8 \text{ m/sec}$. [5]
12. Draw a neat sketch of a P-I-N photodetector. Discuss its construction and working principle.

