



Shirpur Education Society's  
**R. C. PATEL INSTITUTE OF TECHNOLOGY, SHIRPUR**  
An Autonomous Institute

( Affiliated to Dr. Babasaheb Ambedkar Technological University, Lonere )

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**Programme: B.TECH (COMP)/B.TECH (EXTC)/B.TECH (ELECT)/B.TECH (Data Science)**

**Year: I/Semester I (Exam Year: 2024-2025)**

**Subject:** Physics

**Time:** 10:00 am - 12:00 pm (02:00 Hrs.)

**Date:** 24 Jan 2025

**Max Marks:** 60

**END SEMESTER EXAMINATION ODD SEM-I (2024-2025)**

**Instructions:** 1. This question paper contains 2 pages

**PRN:-**

2. All Questions are Compulsory
3. Figure in right hand side indicates full marks
4. Assume suitable data wherever required
5. Support your answers with neat labelled diagrams, wherever necessary
6. The use of a non-programmable scientific calculator is allowed

1. 15

A. . 8  
 i. What is phase velocity? Derive the expression for phase velocity in terms of angular frequency and propagation constant? Prove that the phase velocity of a de Broglie wave exceeds the speed of light. 8

----- OR -----

ii. Prove the group velocity of the wave packet is equal to the velocity of the particle. What is Superposition of states and entanglement in quantum computing? 8

B. . 7

i. A quantum particle confined to one dimensional box of width 'a' is in its first excited state. What is the probability of finding the particle over an interval of  $(a/2)$  marked symmetrically at the centre of the box? 4  
 ii. An electron is bound in a one-dimensional potential well of width 2 Å but of infinite height. Find its energy values for the ground state and first two excited states in joules. 3

2. 15

A. . 8

i. . 8  
 a. 1. In Newton's ring experiment for reflected rays prove that the diameter of  $n^{th}$  bright ring is proportional to square root of odd ring number. 6  
 b. 1. Define resolving power and dispersive power of grating. 2

----- OR -----

ii. . 8  
 a. Why the central spot appears dark in Newton's rings interference pattern when viewed in reflected light? 3  
 b. 1. Explain the single slit diffraction with suitable diagram. Write the expression of resultant intensity and derive the condition for maxima and minima. 5

B. . 7

i. Newton's rings are observed in reflected light of wavelength  $5896 \text{ Å}^\circ$ . The diameter of the  $12^{th}$  dark ring is 0.6 cm. Find the radius of curvature of the lens and the thickness of the corresponding air film. 4

	ii. Find the angular separation between the second order visible spectrum of wavelength $4500 \text{ A}^\circ$ and $6500 \text{ A}^\circ$ produced by a plane grating of lines 5500 lines/cm.	3
3.	A. .	15
	i. .	8
	a. Derive the ratio of spontaneous to stimulated emission coefficients (Einstein's A to B ratio)	6
	b. Derive the relation between the numerical aperture and fractional Refractive index change of a step index optical fibre.	2
	----- OR -----	
	ii. .	8
	a. What is meant by population inversion and meta stable state in LASER. Explain the importance of both for LASER operation.	4
	b. Write four distinct differences between step index and graded index optical fibres.	4
	B. .	7
	i. A light ray is entering in an optical fibre at an angle $6^\circ$ with the fibre axis. If the refractive index of core is 1.51, calculate (i) cladding refractive Index and (ii) critical angle.	4
	ii. What is meant by active medium in LASER. Name the active medium in Helium-Neon LASER and Nd-YAG LASER.	3
4.		15
	A. .	10
	i.State divergence theorem and Stoke's theorem along with the mathematical equations. State physical significance of divergence theorem and Stoke's theorem.	6
	ii. If $\vec{V} = (x^2 - y^2)\vec{i} + 2xy\vec{j} + (y^2 - xy)\vec{k}$ , is vector function. Prove that, $\text{div}(\text{curl } \vec{V})$ is zero.	4
	B. Write working principle of LDR. State any four applications of LDR.	5