

## B. N. Bandodkar College of Science, Thane

First Term Examination, October 2011

S.Y.B.Sc. PHYSICS- Paper III

**Duration : 2 Hrs ]**

**[ Marks : 60**

**N.B. :** (1) All questions are compulsory.

(2) Figures to the right indicate full marks.

(3) Use of non programmable calculator is allowed.

**Q.1) (A) Attempt any THREE. (12)**

(i) How the Clapeyron latent heat equation is used to study the effect of pressure on melting point?

(ii) State reversible & irreversible processes with one example each.

(iii) State and explain the fundamental postulates of relativity.

(iv) Explain briefly with examples, the inertial and non- inertial frames of references.

(v) Show that though wave functions obey the principle of superposition, the corresponding probabilities do not.

(B) Find expectation value of a particle's position if the eigen function describing the particle is given by

$$\begin{aligned} \Psi(x) &= a x \quad ; \quad 0 < x < l \\ &= 0 \quad ; \quad \text{elsewhere} \end{aligned} \quad (3)$$

**Q.2) (A) Attempt any ONE. (8)**

(i) State and prove Carnot's theorem.

(ii) Find the efficiency of internal combustion engine.

(B) A Carnot engine, whose temperature of the source is 500K takes 250 calories of heat at this temperature and rejects 150 calories of heat to the sink. What is the temperature of the sink? Calculate the efficiency of engine. (4)

(C) What is the significance of second law of thermodynamics? (3)

**Q.3) (A) Attempt any ONE. (8)**

(i) Prove that the Newton's laws of motion are invariant under Galilean transformations.

(ii) With the help of a neat diagram, describe Fizeau's experiment and get an expression for the drag coefficient.

(B) Draw a neat diagram of Michelson – Morley experiment . What is the interpretation of Null result? (4)

(C) A 1 metre rod is moving along its length with a velocity equal to 0.6c. Calculate its length as it appears to an observer on the earth. (3)

**Q.4 (A)** Attempt any **ONE**. **(8)**

- (i) If  $\psi_1$  and  $\psi_2$  are the solutions of Schrodinger's time independent equation for two different energy eigen values  $E_1$  and  $E_2$ , then show that

$$\int_{-\infty}^{+\infty} \psi_1^* \psi_2 \, dx = 0$$

- (ii) What is a wave function? Choose a suitable expression for wave function and derive Schrodinger's time dependent equation

**(B)** Find expectation value of Position for a wave function

$$\Psi(x) = \sqrt{\frac{2}{l}} \cdot \sin \frac{\pi x}{l} \quad ; \quad 0 < x < l \quad \text{(4)}$$

**(C)** Prove that  $(x \cdot \hat{P}_x - \hat{P}_x \cdot x) \Psi = i \hbar \Psi$  **(3)**

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