B. N. BANDODKAR COLLEGE OF SCIENCE, THANE - 400 601.

FIRST TERM EXAMINATION OCT. - 2010

S. Y. B. Sc.

TIME : 2 Hrs.

SUBJECT : PHYSICS - III **MARKS :** 60

N. B. : 1. All questions are compulsory.
2. Figures to the right indicate full marks.
3. Non programmable calculators is allowed.

Q.1 a) Attempt ANY THREE : [12]

i) What is the principle of working of a refrigerator ? Define coefficient of performance. Is it greater than 1 ?

ii) An eigen function of the operator $\left(2\frac{d^2}{dx^2}\right)$ is $\Psi = e^{3x}$. Find the corresponding eigen value.

iii) State and explain the fundamental postulates of special theory of relativity.

iv) State the various forms of second law of thermodynamics.

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

$\Psi = ax \quad ; \quad 0 < x < 1$

$= 0 \quad ; \quad$ elsewhere

b) Write a short note on : Stellar aberration. [3]

Q.2 a) Attempt ANY ONE of the following : [8]

i) Derive Clapeyron's Latent heat equation. How it explains the effect of pressure on the melting point of solids and boiling point of liquids.

ii) Explain with necessary theory, the construction and working of an Otto engine.

b) A Carnot engine has its source at 100°C and its sink is maintained at a constant temperature by means of ice at 0°C. If it is working at the rate of 100 watts, how much ice will melt in two minutes ? [4]

c) Distinguish between an Otto engine and Diesel engine. [3]

P.T.O.

Q.3 a) Attempt ANY ONE : [8]

i) In Michelson - Morley experiment, compute the phase difference between the beams coming from mirrors M_1 & M_2 causing fringes. Hence deduce an expression for the number of fringes crossed for the light of wavelength l and period T.

ii) Explain Fizeau experiment with its Schematic view.

b) Show that the circle $x^2 + y^2 = a^2$ in a frame F appears to be an ellipse in frame F′, which is moving with velocity ϑ relative to F along x-x′ axis [4]

c) A 2.0 m long rod is moving along its length with velocity 0.5c. Calculate its length as it is measured by an observer on the earth. [3]

Q.4 a) Attempt ANY ONE of the following : [8]

i) Derive Schrodinger's time independent equation.

ii) What is meant by normalization of a wave function ? How to normalize a wave function ? State the important conditions of a well-behaved wave function.

Normalize the wave function defined by

$$\Psi_n = \sin \frac{n\pi x}{l} \quad ; 0 < x < l, n \in I$$

b) Show that $\langle p_x.x \rangle - \langle x.p_x \rangle = \frac{\hbar}{i}$ [4]

c) Using time dependent form of the wave function, $\Psi = A.\ e^{\frac{-i}{\hbar}(Et - px)}$, deduce operators for momentum and energy. [3]

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