

B. N. Bandodkar College of Science, Thane

S. Y. B. Sc. A.T.K.T. Aug. 2011

PHYSICS – III

Duration : 3 Hours]

[Marks : 90

- N.B. (1) All questions are compulsory.
(2) Figures to the right indicate full marks.
(3) Use of non programmable calculator is allowed.

Section-I

1. (a) Attempt any **ONE** of the following: 8
- i) Derive an expression for the efficiency of Carnot's heat engine. Show that the efficiency is function of temperature of Source & temperature of Sink.
- ii) Explain the working of steam engine with the help of diagram. Find the expression for the power of steam engine.
- (b) A Carnot engine, whose temperature of the source is 500K takes 200 calories of heat at this temperature and rejects 100 calories of heat to the sink. What is the temperature of the sink? Calculate the efficiency of the engine. 4
- (c) State the second law of thermodynamics in at least three various forms. 3
2. (a) Attempt any **ONE** of the following: 8
- i) Describe Michelson-Morley experiment and write its conclusion .
- ii) Show that Newton's laws of motion are invariant under Galilean transformation.
- (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 v relative to F. 4
- (c) State the fundamental postulates of special theory of relativity. 3
3. (a) Attempt any **ONE** of the following: 8
- i) Starting from a one dimensional simple harmonic progressive wave, derive classical wave equation.
- ii) What is the importance of De Broglie postulate into Schrodinger's theory.
Derive Schrodinger's time dependent equation.
- (b) If the normalised wave function of an oscillator is given by $\psi=Aye^{-y^2/2}$, $-\infty < y < \infty$. Find A 4
- (c) What are the requirements of well behaved wave function. 3

Section-II

4. (a) Attempt any **ONE** of the following: 8
- i) Show that in reversible process, entropy of the system remains unchanged.
 - ii) Describe Kelvin's thermodynamic scale of temperature.
- (b) When 25 gram of ice at -21°C is converted into water at 0°C , calculate the change in entropy. (Latent heat of ice =80 cal/gram, specific heat of ice=0.5 cal/gram/K) 4
- (c) Write a note on zero point energy.
5. (a) Attempt any **ONE** of the following: 8
- i) Write general properties of metal.
 - ii) .Explain the following: - i) Crystal lattice, ii)lattice point and space lattice.
- (b) Obtain the Millar indices of a plane that intercept at $a/2, b, 2c$ in a simple cubic unit cell. 4
- (c) Write a note on magnetic materials. 3
6. (a) Attempt any **ONE** of the following: 8
- i) Show that energy of particle trapped in a one dimensional rigid box is quantised.
 - ii) Set up the Schrodinger's equation for a free particle. Solve the equation to obtain the eigen function.
- (b) Estimate the zero point energy for a neutron in a nucleus, by treating it as if it were in an infinite square well of width equal to a nuclear diameter of 10^{-14}m . 4
 $m_n=1.67 \times 10^{-27} \text{ kg}$, $h=6.62 \times 10^{-34} \text{ JS}$
- (c) Write a note on barrier penetration. 3

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