M.Sc.

2011

2nd Semester Examination

PHYSICS

PAPER—PH-202

Full Marks : 40

Time : 2 Hours

The figures in the right-hand margin indicate full marks.

Candidates are required to give their answers in their own words as far as practicable.

Illustrate the answers wherever necessary.

Group—A

(*Marks : 20*)

1. Answer any *two* of the following : 2×2

(a) The mutual potential energy V of two particles depends on their mutual distance r as,

$$V = \frac{a}{r^2} - \frac{b}{r} \qquad a > 0,\ b > 0$$

for what separation, r, are the paticles in static equilibrium?

(b) If F be a generating function depends on p_k, P_k, t then prove that

$$q_k = \frac{\partial F}{\partial p_k} \text{ and } Q_k = \frac{\partial F}{\partial P_k}$$

(c) Prove that a generalised coordinate cyclic Lagrangian is also cyclic in the Hamiltonian.

2. Answer any *two* of the following : 3

(a) The Hamiltonian of a charged particle moving in electromagnetic field is given by

$$H = \frac{1}{2m}\left[(p_x - qA_x)^2 + (p_y - qA_y)^2 + (p_z - qA_z)^2\right] + q$$

Derive the equations of motion.

(b) Starting from time dependent Schrodinger equat obtain the Hamilton – Jacobi equation.

(c) A particle of mass 'm' is moving in a plane under inverse square law attractive force. Set up Lagrangian and hence obtain the equati describing its motion.

3. Answer any *one* of the following :

(a) Obtain the Euler-Lagrange differential equation variational method.

Drive Lagrange equation of motion from Hamilt principle.

Use the variational principle to show that shortest distance between two points in space i straight line joining them.

$3\frac{1}{2}+2\frac{1}{2}$

(b) On the basis of the Lagrangian, discuss sn oscillations of a system in the neighbourhood of sta equilibrium.

Find the normal modes of vibration of freely vibrat linear triatomic molecules. (Neglect the interact between the end atoms). 5

Group—B

(*Marks : 20*)

Answer *Q. No. 1 & 2* and any *one* from the rest.

1. Answer any *two* of the following : 2×2

(a) Find the average energy of an electron considering 2-D fermi gas at T = 0 K.

(b) What is meant by effective mass? What is negative effective mass?

(c) Prove that Fermi level lies at halfway between conduction band and valence band for an intrinsic semiconductor at T = 0 K.

2. Answer any *two* bits : 3×2

(a) Find the depletion temperature corresponding to extrinsic to intrinsic transition in a p-type semiconductor.

(b) Prove that effective number of free carriers in the band is maximum when a band is half-filled.

(c) Explain-how can you determine experimentally Fermi temperature and Debeye temperature of a metal.

3. (a) Find an expression for carrier concentration of n-type nondegenerate semiconductor in the extremely low temperature region.

(b) Clearly distinguish nondegenerate and degenerate characteristics of a semiconductor.

7+3

4. (a) Describe in details the essential features of Kronig Penny model.

   (b) Clearly explain 'Extended Zone Scheme' and 'Reduced Zone Scheme'. 8+2
