B.Sc. (Hons.) GEOLOGY / III Sem.   B

Paper PHCT–402— Physics II

Time : 3 hours   *Maximum Marks* : 100

(Write your Roll No. on the top immediately
on receipt of this question paper.)

Attempt five questions in all.
Q. No. 1 is compulsory.

1. Attempt any *five* of the following:

   (*a*) What are central forces? Give some examples of such forces.

   (*b*) Define acceleration due to gravity and universal gravitational constant. Establish a relation between them.

   (*c*) Derive the differential equation of wave motion.

   (*d*) Define phase space, microstate, macrostate and thermodynamic probability.

   (*e*) Calculate the work done on a particle in moving it from the position $(0, 1, 2)$ to the position $(5, 6, 8)$ under the force $\mathbf{F} = (2xy + z^2)\mathbf{i} + x^2\mathbf{j} + 2xz\mathbf{k}$.

(f) What is the speed of molecule with average energy of $\frac{3}{2}kT$?

(g) A projectile acquires angular momentum about the point of projection during the flight. Does it violate the conservation of angular momentum?

$4 \times 5 = 20$

2. (a) A lightly damped harmonic oscillator has its oscillation maintained by a periodic force $F_0 \cos \omega t$. Formulate the equation of motion of the oscillator and find its steady state solution. Obtain the frequency at which the amplitude is a maximum. 15

(b) Distinguish between free and forced oscillations. Explain the phenomenon of resonance. 5

3. (a) State Kepler's laws of planetary motion. Show that the orbit traced by a planet moving under gravitational force is elliptical. 10

(b) What do you understand by angular momentum of a system of particles? Show that if no external torque is acting on the system, its angular momentum remains conserved. 5

(c) If a force $\mathbf{F} = (y^2 - x^2)\mathbf{i} + 2xy\mathbf{j}$, then show that it is a conservative force. Determine its potential function. 5

4. Derive Maxwell's equations of electromagnetism and give their physical significance.   20

5. (a) Obtain the expression of Maxwell-Boltzmann distribution law.   10

   (b) Derive an expression for the number of molecules with energies between $\in$ and $\in + d\in$ in a sample of an ideal gas containing N molecules at absolute temperature T.   Also calculate the average molecular energy.   10

6. (a) What is Biot-Savart law?   Derive an expression for the magnetic field at the point due to an infinitely long, straight current-carrying conductor.   15

   (b) The horizontal component of the flux density of the Earth's magnetic field is $1 \cdot 7 \times 10^{-5}$ Wb/m^2. What is the horizontal component of the magnetic intensity?   5

7. Write short notes on any *two*:

   (a) Work-energy theorem

   (b) Concept of entropy

   (c) Earth's gravitational field. $2 \times 10 = 20$