Examination Roll No……….

S.No of Question Paper : …………

Name of the Department : **Physics**

Question paper Set number : **B**

Unique Paper Code : **32227626**

Name of Paper : **Classical Dynamics**

Name of the Course : **B.Sc (Hons) Physics-DSE**

Semester : **VI**

Duration :3 Hours Maximum Marks : 75

Instructions for Candidates

All questions carry equal marks.

Attempt four questions in all.

Q 1. Define D'Alembert principle. Find Lagrangian, Hamiltonian and Hamilton equation of motion for compound pendulum also find its time period.

Q 2. Obtain the expression of Lagrangian for two masses m_1 and m_2 moving under a central potential V(r). Reduce it into a one body problem and show that angular momentum remains conserved. According to Yukawa's theory of nuclear forces, the attractive force between two nucleons inside a nucleus is given by the potential

$$V(r) = k\,[e^{-ar} / r], \; a= \text{constant.}$$

If the particle moves in a circle of radius r_0 , determine (I) total energy, E (ii) angular momentum J and (iii) period of circular motion.

Q3. Discuss the principle of conservation of four momentum. Show that when an energetic proton collides with a proton at rest, a proton-antiproton will be produced only when the least kinetic energy of incident proton is 6 Mc^2, where M is the mass of the proton.

Q4 Discuss the normal mode frequencies of oscillations of a linear triatomic molecule. Explain its various modes with the help of the diagram.

Q5. Show that $E^2 - p^2c^2$ is Lorentz invariant quantity. The photon energy in the frame S is equal to E. Derive the expression for energy E' in frame S', moving with a velocity v relative to the frame S in the photon's motion direction. At what value of v is the energy of the photon is equal to E' =E/2.

Q 6. Derive the Euler's equation of fluid dynamics and from it deduce Bernoulli's equation. A pipe is of length 'l' and has slowly tapering cross section. It is inclined at an angle 'α 'to the horizontal. Water flows steadily through it from upper end to the lower end. The section at the upper end has twice the radius of the lower, where water is delivered at atmospheric pressure. If the pressure at upper end is twice atmospheric pressure, find the velocity of delivery.