EP-205 Assignment-4. Dr. R. Sharma

1. A particle is constrained to move in a circle in the vertical plane xy. Using the D'Alembert's principle show that for equilibrium,

$$\ddot{x} y - \ddot{y} x - g x = 0$$

2. A particle of mass 'm' can move without friction on the inside surface of a paraboloid of revolution

$$\phi = x^2 + y^2 - z = 0$$

under the action of a uniform gravitational field in the $-ve$ z dir^n. Obtain the equation of motion using D'Alembert's principle.

3. For Lagrangian $L = \frac{1}{2} m (\dot{x}^2 + \dot{y}^2 + \dot{z}^2) + \frac{\omega}{2} L_z$, where L_z is the z-component of angular momentum. Obtain the Hamiltonian.

4. Lagrangian is given by $L = T - e\phi + \frac{e}{c} \vec{A} \cdot \vec{v}$ if $\vec{A}$ and ϕ are independent of time t. Obtain Hamiltonian.

5. From the Lagrangian $L = \frac{1}{2} m (\dot{r}^2 + r^2 \dot{\theta}^2) - \frac{1}{2} k (r - r_0)^2$ obtain the conserved quantities.

6. Obtain Langrange's equations from Hamilton's principle.

7. Show that a two body problem can be reduced to one body problem for the conservative central forces.