PHYS 5310
CLASSICAL MECHANICS - 2023

HOMEWORK 6

Exercise 1.
Prove the conservation of momentum and angular momentum of a system of particles if the Hamiltonian of the system doesn't change:
a) under an infinitesimal translation.
b) under an infinitesimal rotation.

Exercise 2.
Determine the Poisson brackets formed from the Cartesian components of the momentum and the angular momentum of a particle. Show all your calculations.

Exercise 3.
Find the Hamiltonian for a single particle in Cartesian, Elliptical and Parabolic coordinates.

Exercise 4.
Show that $[M_z, \phi] = 0$ where ϕ is a spherically symmetric scalar function of the coordinates and momenta.

Exercise 5.
Show that $[M_z, \vec{f}] = \hat{n} \times \vec{f}$ where $\vec{f}$ is a vectorial function of the coordinates and momenta of a particle and $\hat{n}$ is a unit vector in the direction of z.

Exercise 6.
Following the variational principle

$$\delta \int \sqrt{2m(E - U)} dl = 0$$

derive the differential equation of the path followed by a particle.