Mecánica Clásica
Tarea 05: Dinámica Hamiltoniana

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4 Julio 2014

Problema 1 *Particle on a cylinder surface*

We have a a particle of mass m constrained to move on the surface of a cylinder defined by $x^2 + y^2 = R^2$, it is subject to a force directed toward the origin and proportional to the distance of the particle from the origin: $\mathbf{F} = -kr\hat{\mathbf{r}}$.
Find the following:

1. The Hamiltonian, using the Legendre transformation.
2. The canonical equations of motion of the particle.
3. The equation of motion in the z direction.

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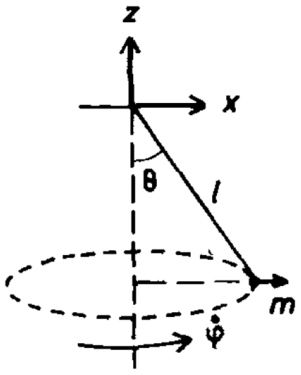
Problema 2 *Spherical pendulum reloaded*

A spherical pendulum consists of a point mass m tied by a string of lenght l to a fixed point, so that it is constrained to move on a spherical surface.

1. Find the Hamiltonian, using the Legendre transformation.
2. Calculate canonical equations of motion.



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Problema 3 *Rotating planes*

A mass point m shall move in a cylindrically symmetric potential $V(\rho, z)$. Determine the Hamiltonian and the canonical equations of motion with respect to a coordinate system that rotates with constant angular velocity ω about the symmetry axis in cylindrical coordinates.

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Problema 4 *Spiral movement*

A particle of mass m moves under the influence of gravity along the spiral $z = k\theta$, with $r = \text{cte}$, where k is a constant and z is vertical. Obtain the Hamiltonian canonical equations of motion.

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Problema 5 *Spring*

A massless spring of lenght b and spring constant k connects two particles of masses m_1 and m_2. The system rests on a smooth table and may oscilate and rotate.

1. Determine the Lagrangian of the system.
2. Does exist cyclic coordinates? If that's the case, what are the conserved quantities?
3. Find the Hamiltonian.
4. Determine Hamilton's canonical equations of motion.

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