PHYSICS 331 Advanced Classical Mechanics

Test 3 Preparation

In preparation for Test 3, you should be able to:

- Know how/why the Lagrangian was introduced to analyse mechanical systems.
- Be able to select appropriate generalised coordinates and apply the Lagrangian approach to extract (and solve for) equations of motion.
- Be able to write down Hamilton's equations and use them to extract the equations of motion for a system.
- Appreciate the differences between the Hamiltonian and Lagrangian approach and understand when there are advantages to each.
- Have a very general appreciation for Louiville's Theorem.
- Understand what is meant by a central force and know the characteristics associated with a central force.
- Understand how the transformed radial equation comes from the equation of motion for a central force and be familiar with the nature of its solutions, i.e., conic sections dependent on the eccentricity.
- Be familiar with the characteristics of elliptic orbits; know that the equation of an ellipse is given by $x^2/a^2 + y^2/b^2 = 1$ and that $r_{min} = a(1-\epsilon)$ and $r_{max} = a(1+\epsilon)$.
- Be able to convert between $\mathbf{F}$ and U via $\mathbf{F} = -\nabla U$.
- Understand the origin and nature of the centrifugal potential.
- Know, be able to quote, and possibly derive, Kepler's laws.
- Appreciate the simplifications that arise from circular orbits.
- Know and be able to implement the mechanics of the Hohnmann Manœvre.
- Be able to calculate the centre-of-mass of a system and appreciate the nature of the centre-of-mass frame when investigating systems of particles.
- Understand the implications of working in a non-inertial reference frame and the resulting 'inertial forces.'
- Be familiar with inertial forces arising from both linearly-accelerated frames and rotating reference frames (centrifugal and Coriolis).
- Be familiar with the characteristics of the Foucault pendulum and be able to explain the origin of its behaviour.