PHYSICS 331 Advanced Classical Mechanics

Test 2 Preparation

In preparation for Test 2, you should be able to:

- Understand and be able to show whether motion is oscillatory and exhibits simple harmonic motion–and be able to extract oscillation frequencies.
- Understand the conditions characteristic of non-linear motion; phase plots, Poincare sections, etc.
- Know what is meant by 'attractor,' 'limit cycles,' 'stable,' 'self-limiting,' etc.
- Be familiar with mappings of the form $x_{n+1} = f(\alpha, x_n)$, logistic mapping, bifurcation, etc.
- Be able to identify the characteristics of chaotic motion: sensitivity to initial conditions, Luapunov exponents, etc.
- Be comfortable working with gravitational potential: $\mathbf{g} = -\nabla\Phi$ and $d\Phi = -G\frac{dM}{r}$. Be able to compute the gravitational potential for various mass distributions.
- Be able to use 'Gauss' law for gravitation' to determine the gravitational potential for various mass arrangements.
- Understand the concept of field lines and equipotential surfaces.
- Appreciate the basic ideas behind tides and their causes.
- Understand how Euler's equation arises from seeking the stationary value of an integral.
- Be able to implement Euler's equation to solve problems involving minima and maxima–including cases when auxiliary conditions (constraints) are imposed.
- Understand how Hamilton's principle is a special case extension of Euler's equation and how it relates to Newton's second law, i.e., the principle of least action.
- 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 equations describing constraints on a system and be able to use the Lagrangian multiplier approach to obtain equations of motion.