

PHY420 Mechanics

Fall 2018

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Time and Location: MWF 04:10-05:00 LL 514

Course website <http://athena.physics.lehigh.edu/>

Course Contents

- 1. Fundamentals of Mechanics.** Newton's laws. Momentum, Energy and Work. One and Many-Particle Systems. Velocity Phase Space.
- 2. Lagrangian Mechanics.** Lagrange's equations. Central Force Motion. The Variational Principle. Symmetry and Conservation. Dissipative Forces in the Lagrangian Formalism.
- 3. Scattering and Linear Oscillations.** Scattering by Central Forces. Chaotic scattering, Cantor Sets and Fractal Dimension. Linearized Linear Oscillations. Chain of Coupled Oscillators. Forced and Damped Oscillators.
- 4. Hamiltonian Formulation of Mechanics.** Hamilton's Canonical Equations. Legendre Transforms. Poisson Brackets. Canonical Transformations. Generating Functions.
- 5. Topics in Hamiltonian Dynamics.** The Hamilton-Jacobi Method. Separation of Variables. Action-angle Variables. Liouville's Integrability Theorem. Elements of Perturbation Theory.
- 6. Nonlinear Dynamics.** Nonlinear Oscillators. Driven Quartic Oscillator. Chaotic Dynamics. The Circle Map. The Kicked Rotator.

Initial Competences

- Undergraduate course on classical mechanics, good knowledge of multivariable calculus.

Final Competences

- Ability to apply the methods of Lagrange, Hamilton, and Hamilton-Jacobi (including action-angle variables) to solve problems in mechanical systems consisting of particles.
- Ability to apply canonical transformations and Poisson bracket formulation.

- Understand of the origin of conservation laws in mechanics and the relationship between symmetry and conservation.
- Ability to perform a linear expansion of mechanical systems into normal modes.
- Qualitative understanding of requirements for integrability and onset/characteristics of chaotic behavior.

Textbooks

Required: J. V. José and E. J. Saletan, “Classical Dynamics. A Contemporary Approach,” Cambridge University Press, 1998

Recommended: H. Goldstein, C. Poole and J. Safko, “Classical Mechanics,” third edition, Addison-Wesley, 2002

Recommended: S. T. Thornton, J. B. Marion, “Classical Dynamics of Particles and Systems,” fifth edition, Brooks-Cole, 2003

Grading

Upon satisfactory attendance, the course grade will be based on:

- 1. Weekly homework problems (25%).** Assignments are due before Friday’s class. Solutions to homework problems will be discussed on Friday. No late homework submissions will be accepted.
- 2. Two one-hour exams (25%).**
- 3. Final exam (50%).**

Office Hours

MW 5:00-6:00

Accommodations for Students with Disabilities: If you have a disability for which you are or may be requesting accommodations, please contact both your instructor and the Office of Academic Support Services, University Center C212 (610-758-4152) as early as possible in the semester. You must have documentation from the Academic Support Services office before accommodations can be granted.

The Principles of Our Equitable Community:

Lehigh University endorses The Principles of Our Equitable Community

(http://www.lehigh.edu/inprv/initiatives/PrinciplesEquity_Sheet_v2.032212.pdf). We expect each member of this class to acknowledge and practice these Principles. Respect for each other and for differing viewpoints is a vital component of the learning environment inside and outside the classroom.