

Phys 2513: Dynamical Systems, Fall 2023

Class: MWF 10-10:50a, Allen 106

Professor: Andrew Mugler (he/him), Allen 206, andrew.mugler@pitt.edu

Grader: Swapnil Dutta, Allen 500 desk 9, swd20@pitt.edu

Tutor: Ryan LeFebre, Allen 200 desk 9, rwl23@pitt.edu

Books: Goldstein, Poole, Safko, *Classical Mechanics*, 3rd Ed.
 (all on reserve) [Optional] Helliwell, Sahakian, *Modern Classical Mechanics*
 [Optional] Strogatz, *Nonlinear Dynamics and Chaos*

Office Hours: Andrew: W 2-3p, Allen 206 or 219
 Ryan: Th 1-3p, Allen 200

Credit: 40% Homework quizzes* | 15+15% Midterms | 30% Final
 *Last 15 min on Fri, random HW problem, possibly modified
 *Makeup quiz must be excused in advance and taken within 1 week

	Mon	Wed	Fri
Aug 28	Introduction	Lagrangian mechanics: Lagrange eq 1.4, constraints 1.3 4.2,4.8, Lagrange multipliers 2.4 6.1, *	
Sep 4	Labor Day		
Sep 11	central forces 3 4.4,7.1, two-body problem 3.1 7.2, orbits 3.5-3.8 7.4-7.6, *		
Sep 18	virial theorem 3.4 7.7	Oscillations: normal modes 6.1-6.3 13.1, *	
Sep 25	vibrations 6.4 13.3, continuum waves 13.1 13.4	Midterm 1	
Oct 2	Perturbation theory 12.1-12.3 14.5 7.6	Fall Break	
Oct 9	Variational calc: Hamilton's principle 2.1,2.3 4.3, applications 2.2 3.1-3.5		*
Oct 16	Seeds of quantum: paths 5, Hamiltonian mechanics 8.1 4.6,11.1-11.3,		*
Oct 23	Hamilton-Jacobi theory 10.1-10.3 15.1,15.2, Schrödinger eq 15.6,15.7		*
Oct 30	Hints of chaos: pendula 6.6,11.7 14.2,14.3		Midterm 2
Nov 6	Nonlinear dynamics: bifurcations 3, flows on the circle 4.4,4.6, phase		*
Nov 13	portraits 11.3 5.1,5.2,6.1,6.3,6.7, limit cycles 7.5,8.5, applications		*
Nov 20	Thanksgiving Break		
Nov 27	Chaos: Lorenz eqs 9, maps 11.8 14.4 10, fractals 11.9 11		*
Dec 4	Special topics: stochastic dynamics 10.7, ...		*
Dec 11	Final exam (day/time TBD)		

(Topics and schedule subject to change.)

Learning Objectives:

- Demonstrate understanding of the concepts, principles, and problem-solving techniques of classical mechanics and dynamical systems.
- Identify how dynamical systems underpin and connect multiple branches of physics and areas of current research.
- Describe a physical situation using multiple representations (such as conceptual statements, equations, diagrams, and graphs) and translate among them.
- Use physical reasoning and units to obtain order-of-magnitude estimates.

Academic Integrity is of paramount importance. Violations will not be tolerated.

Disability Resources and Services are available for accommodations.

Title IX mandatory reporters include professors. I am required to report violations.