

Physics 2513: Dynamical Systems, Fall 2024

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

Professor: Andrew Mugler (he/him), Allen 216, andrew.mugler@pitt.edu

Grader: Mahdi Sedighi Jafari (he/him), mas1371@pitt.edu

Tutor: Ryan LeFebre (he/him), rwl23@pitt.edu

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

Office Hours: Andrew: W 1:30-2:30p, Allen 216
 Tutor: T/Th 2-3p, Allen 517

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 26	Introduction	Lagrangian mechanics: Lagrange eq 1.4, constraints 4.2,4.8 1.3, Lagrange multipliers 6.1 2.4,			*
Sep 2	Labor Day				
Sep 9	central forces 4.4,7.1 3,	two-body problem 7.2 3.1, orbits 7.4-7.6 3.5-3.8,			*
Sep 16	virial theorem 7.7 3.4	Oscillations: normal modes 13.1-13.3 6.1-6.4,			*
Sep 23	waves 13.4 13.1, perturbation theory 7.6 14.5	Midterm 1			
Sep 30	Variational calculus 3.1-3.5,4.3 2.1-2.3	Seeds of quantum:			*
Oct 7	Hamiltonian mech. 4.6,11.1-11.3 8.1, paths 5, Hamilton-Jacobi 15.1,15.2				
Oct 14	Fall Break	Schröd. eq 15.6,15.7	Hints of chaos: pen-		*
Oct 21	dula 14.2,14.3 6.6,11.7	Nonlinear dynamics: 1D flows 2.1-2.4,			*
Oct 28	1D bifurcations 3.1-3.6, 2D stability 5.1,5.2,	Midterm 2			
Nov 4	phase portraits 6.1,6.3,6.7 11.3, limit cycles 7.5,8.5, 2D bifurcations 8,				*
Nov 11	applications	Chaos: Lorenz equations 9,			*
Nov 18	1D maps 10.1-10.4, 14.4, Liapunov exponents 10.5, universality 10.6,				*
Nov 25	Thanksgiving Break				
Dec 2	renormalization 10.7, fractals 11	Special topics		*	
Dec 9	Review	Dec 11-17: Final exam (day/time TBD)			

(Topics and schedule subject to change.)

Pre-recorded

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.