Physics 601 (Fall 2013): Classical Mechanics

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Class Meetings

Class hours: Tuesday and Thursday, 9:30am–10:50am in Small Hall 126

I expect you to read and understand the material in the sections that are assigned by the time you come to class. In class I will go over the material, focusing on the conceptual steps and difficult transition, adding interesting digressions, and skipping some of the more tedious derivations. In class I will also expect that you can begin to apply the material to simple problems.

Textbook

- Required: Alexander L. Fetter & John Dirk Walecka, *Theoretical Mechanics of Particles and Continua*, Dover Publications (2003), ISBN 978-0-486-43261-8 (BN W&M Bookstore: $34.95; Amazon.com: $22.95).
- Required: Alexander L. Fetter & John Dirk Walecka, *Nonlinear Mechanics: A Supplement to Theoretical Mechanics of Particles and Continua,* Dover Publications (2006), ISBN 978-0486450315 (Amazon.com: $6.78).
- Supplementary: Herbert Goldstein, Charles P. Poole & John L. Safko, *Classical Mechanics*, 3rd ed., Addison-Wesley (2001), ISBN: 978-0-201-65702-9 or 978-0-321-18897-7 (BN W&M Bookstore: $167.90; Amazon.com: $118.00). Note: page numbers of the readings in the schedule are for the international edition.

Goldstein is the *de facto* standard of graduate level classical mechanics courses, so you will not regret having it in your book case as a reference. However, Fetter & Walecka is comparable, and at a more affordable cost. Fetter & Walecka will be the source of the majority of the reading assignments.

Homework

There will be weekly homework assignments during this course. The assignments will be posted on blackboard on Friday evening and are due in class the next Thursday. *Late submissions will not be accepted.* Deviations from these rules require *advance permission from the instructor*.

I strongly encourage you to discuss the problems with your fellow students. However, I will not tolerate mindless copying of solutions that someone else has obtained. Copying solutions without intellectual effort on your behalf will be considered a violation of the William & Mary honor code.

Grading

There will be a take-home midterm and an in-class final exam. The total grade will be calculated from your homework grades (40%), the midterm exam (30%), and the final exam (30%).

Schedule and Readings

Chapters 1 and 2 are assumed to have been covered in undergraduate courses. You will benefit from reading F&W Ch 1, Sec 1–4, and Ch 2, Sec 6–11, if you have not been exposed to this material recently. This material may be covered in homework assignments.

Th 8/29	Introduction, Notations F&W Ch 3 Sec 13: Constrained Motion and Generalized Coordinates	p49-52
Tu 9/03	F&W Ch 3 Sec 14: D'Alembert's Principle F&W Ch 3 Sec 15: Lagrange's Equations	p52-58
Th 9/05	F&W Ch 3 Sec 16: Examples	p58-60
Tu 9/10	F&W Ch 3 Sec 17: Calculus of Variations F&W Ch 3 Sec 18: Hamilton's Principle	p60-68
Th 9/12 *	F&W Ch 3 Sec 19: Forces of Constraint	p68-77
Tu 9/17	F&W Ch 3 Sec 20: Generalized Momenta and the Hamiltonian	p78-82
Th 9/19	F&W Ch 6 Sec 32: Hamilton's Equations F&W Ch 6 Sec 33: Example: Charged Particle in Electromagnetic Field	p173-181
Tu 9/24	F&W Ch 6 Sec 37: Poisson Brackets	p197-203
Th 9/26	F&W Ch 6 Sec 34: Canonical Transformations	p181-184
Tu 10/01 *	F&W Ch 6 Sec 35: Hamilton-Jacobi Theory	p184-191
Th 10/03 *	F&W Ch 6 Sec 36: Action-Angle Variables	p191-196
Tu 10/08	Supp Sec 1: Motivation Supp Sec 7: Example of a Nonlinear Oscillator	p2-8 p52-58
Th 10/10	Supp Sec 8: Phase-Space Dynamics and Fixed Points (~ Pendulum) Supp Sec 13: Perturbation of Periodic Hamiltonian Systems	p58-66 p111-117
Tu 10/15	*Fall Break (a.k.a. take-home midterm)*	
Th 10/17	F&W Ch 4 Sec 21: Small Oscillations: Formulation	p86-89
Tu 10/22	F&W Ch 4 Sec 22: Normal Modes	p89-101
Th 10/24	F&W Ch 4 Sec 23: Example: Coupled Pendulums	p101-108
Tu 10/29	F&W Ch 4 Sec 24: Example: Many Degrees of Freedom	p108-119
Th 10/31	F&W Ch 4 Sec 25: Transition from Discrete to Continuous Systems	p119-130
Tu 11/05	*Election Day (a make-up lecture can be offered to voters if desired)* Goldstein Ch 13 Sec 13.2: The Lagrangian Formulation for Continuous Systems	p561-566

Th 11/07	Goldstein Ch 13 Sec 13.5: Relativistic Field Theory Goldstein Ch 13 Sec 13.6: Examples of Relativistic Field Theories	p577-585
Tu 11/12	F&W Ch 5 Sec 26: Rigid Bodies: General Theory	p134-139
Th 11/14	F&W Ch 5 Sec 26: Rigid Bodies: General Theory (cont.) F&W Ch 5 Sec 27: Euler's Equations	p139-144
Tu 11/19	F&W Ch 5 Sec 28: Applications	p144-154
Th 11/21	F&W Ch 5 Sec 29: Euler Angles F&W Ch 5 Sec 30: Symmetric Top: Torque-Free Motion	
Tu 11/26	F&W Ch 5 Sec 31: Symmetric Top: One Fixed Point in Gravitational Field	p154-161
Th 11/28	*Thanksgiving*	p161-168
Tu 12/03	Chaos in Classical Systems	TBA
Th 12/06	*Hurricane/travel contingency day*	

* indicates days of possible instructor travel. Details to follow if we deviate from this schedule.