Physics 601 (Fall 2012): Classical Mechanics

Instructor: **Wouter Deconinck**
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Grader: **Valerie Gray**
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Class Meetings

Class hours: Tuesday and Thursday, 9:30am–10:50am in Small Hall 233

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 then briefly go over the material, focusing on the conceptual steps and difficult transition, while skipping some of the more tedious derivations. In class I will also expect that you can begin to apply the material to simple problems. If you would like me to spend some more time on one of the topics in the chapter, please send me an email by 8pm the day before class.

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 in schedule are for 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 (when there will be reading assignments from Goldstein I will provide copies of the relevant pages).

Homework

There will be weekly homework assignments during this course. The assignments will be posted on blackboard on Friday and are due in class the next Thursday. Late submissions will be accepted with a 50% penalty when submitted before the next Friday at 5pm. Deviations from these rules require advance permission from the instructor.

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 (subject to change)

Chapters 1 and 2 are assumed to have been covered in undergraduate courses. You might 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.

Th 8/30	Introduction, Notations F&W Ch 3 Sec 13: Constrained Motion and Generalized Coordinates	p49-52
Tu 9/04	F&W Ch 3 Sec 14: D'Alembert's Principle F&W Ch 3 Sec 15: Lagrange's Equations	p52-58
Th 9/06	F&W Ch 3 Sec 16: Examples	p58-60
Tu 9/11	F&W Ch 3 Sec 17: Calculus of Variations F&W Ch 3 Sec 18: Hamilton's Principle	p60-68
Th 9/13	F&W Ch 3 Sec 19: Forces of Constraint	p68-77
Tu 9/18	F&W Ch 3 Sec 20: Generalized Momenta and the Hamiltonian	p78-82
Th 9/20	F&W Ch 6 Sec 32: Hamilton's Equations F&W Ch 6 Sec 33: Example: Charged Particle in an Electromagnetic Field	p173-181
Tu 9/25	F&W Ch 6 Sec 37: Poisson Brackets	p197-203
Th 9/27	F&W Ch 6 Sec 34: Canonical Transformations	p181-184
Tu 10/02	F&W Ch 6 Sec 35: Hamilton-Jacobi Theory	p184-191
Th 10/04	F&W Ch 6 Sec 36: Action-Angle Variables	p191-196
Tu 10/09	Supp Sec 1: Motivation Supp Sec 7: Example of a Nonlinear Oscillator	p2-8 p52-58
Th 10/11	Supp Sec 8: Phase-Space Dynamics and Fixed Points (~ Pendulum) Supp Sec 13: Perturbation of Periodic Hamiltonian Systems	p58-66 p111-117
Tu 10/16	*Fall Break (take-home midterm)*	
Th 10/18	F&W Ch 4 Sec 21: Small Oscillations: Formulation	p86-89
Tu 10/23	F&W Ch 4 Sec 22: Normal Modes	p89-101
Th 10/25	F&W Ch 4 Sec 23: Example: Coupled Pendulums	p101-108
Tu 10/30	F&W Ch 4 Sec 24: Example: Many Degrees of Freedom	p108-119
Th 11/01	F&W Ch 4 Sec 25: Transition from Discrete to Continuous Systems	p119-130
Tu 11/06	Goldstein Ch 13 Sec 13.2: The Lagrangian Formulation for Continuous Systems	p561-566

Th 11/08	Goldstein Ch 13 Sec 13.5: Relativistic Field Theory Goldstein Ch 13 Sec 13.6: Examples of Relativistic Field Theories	p577-585
Tu 11/13	F&W Ch 5 Sec 26: Rigid Bodies: General Theory	p134-139
Th 11/15	F&W Ch 5 Sec 26: Rigid Bodies: General Theory (cont.) F&W Ch 5 Sec 27: Euler's Equations	p139-144
Tu 11/20	F&W Ch 5 Sec 28: Applications	p144-154
Th 11/22	*Thanksgiving*	
Tu 11/27	F&W Ch 5 Sec 29: Euler Angles F&W Ch 5 Sec 30: Symmetric Top: Torque-Free Motion	p154-161
Th 11/29	F&W Ch 5 Sec 31: Symmetric Top: One Fixed Point in a Gravitational Field	p161-168
Tu 12/04	Chaos in Classical Systems	TBA