Department of Physics and Astronomy
Physics 705 (Fall 2020) - Classical Mechanics

Instructor: Dr. Paul So

Last Modified: August 11, 2020

Lecture: Remote Format via Collaborate Ultra, Monday 4:30-7:10p **Office Hours**: virtual via Ultra or Zoom **Phone**: 993-4377 **email**: paso at gmu dot edu Office Hours: • Thursday 10:00a-noon (or email instructor) **Text Book**: Classical Mechanics *3rd Edition*, by Herbert Goldstein, Charles P. Poole, and John L. Safko	Grading: • Final Exam (Dec 14 Monday 4:30a-7:10p) 30% • Homeworks: 70% Home Page: • http://complex.gmu.edu/www-phys/phys705

This is a graduate-level course in classical mechanics. We will be using Classical Dynamics by Goldstein, Poole and Safko. The class will include the following chapters in Goldstein:

- General formulation of classical mechanics (chapters 1, 2, 8, 9 and supplemental material)
- Applications (chapters 3-6)
- Generalizations and modern topics, if time permits (chapters 9-13 and supplemental material)

Other Notes:

- Errata web page for Goldstein
- An amusing central force integrator from the University of Maryland

Recommended books - (the bulk of the course will be drawn from the first two books listed below, with supplemental material from the last two):

- Classical Dynamics by Goldstein, Poole and Safko. A classic, very good in some areas, not so good in others. Watch out for the typos.
- Classical Dynamics of Particles and Systems by Marion and Thornton. An advanced undergraduate textbook with lots of examples and some very useful mathematical tables in the appendices. This book covers much of the material in the earlier chapters of Goldstein, but in a more didactically effective way, in my opinion.
- Classical Dynamics - A Contemporary Approach by José and Saletan. A very nice but rather wordy book that presents a more modern approach using fancier mathematics.
- Mechanics by Landau and Lifschitz. A very very concise book, very elegant, but it is most useful and best appreciated after you already know the material.

Honor Code: It is expected that students adhere to the George Mason University Honor Code as it relates to integrity regarding coursework and grades. The Honor Code reads as follows: **To promote a stronger sense of mutual responsibility, respect, trust, and fairness among all members of the George Mason University community and with the desire for greater academic and personal achievement, we, the student members of the University Community have set forth this: Student members of the George Mason University community pledge not to cheat, plagiarize, steal and/or lie in matters related to academic work.** More information about the Honor Code, including definitions of cheating, lying, and plagiarism, can be found at the Office of Academic Integrity website at http://oai.gmu.edu.

If you are a student with a disability and you need academic accommodations, please see me and contact the Disability Resource Center (DRC) at 993-2474. All academic accommodations must be arranged through the DRC.

This table describes what is planned for the lectures and where you can read more about the material.

The content of future lectures is subject to change depending on how things go.
G = Goldstein; J&S = José & Saletan; T&M = Thornton & Marion.

Lecture 1 08/24	Review of Newtonian Mechanics Constraints Geometric argument for D'Alembert's principle	G 1.1, 1.2 G 1.3 J&S 2.1.1, 2.1.2
08/31	**Last Day to Add**	
Lecture 2 08/31	Virtual work argument for D'Alembert's principle Derivation of Lagrange's equations from D'Alembert's principle Examples	G 1.4 G 1.5 G 1.6; T&M example 7.5; classnotes
09/07	**Labor Day (no class)**	
Lecture 3 09/14	Calculus of Variations, examples Hamilton's principle Generalization, constraints, Lagrange multipliers, examples	G 2.2 (but watch out!); T&M 6.1-6.4; classnotes G 2.1 2.3; T&M 6.5-6.6
Lecture 4 09/21	Examples, continued (constraints & Lagrange multipliers) Symmetries and conservation laws, conservation of energy	G 2.6, 2.7
Lecture 5 09/28	Start the central force problem	G 3.1-3.3, 3.5 T&M 8.1-8.6
Lecture 6 10/05	Three solutions to the Kepler problem	G 3.6-3.9 T&M 8.7 classnotes
10/12	**Fall Break (class meet on Tuesday (10/13) instead)**	
Lecture 7 10/13	Hamilton's Equations of Motion	G 8.1-8.3 T&M Chapter 7.10
Lecture 8 10/19	Hamilton's Equations of Motion (cont), Canonical Transformation, and Poisson Brackets	G 8.5-8.6 G 9.1-9.5 T&M Chapter 7.10
Lecture 9 10/26	Generating Functions, Equations of Motion & Canonical Invariants, Hamilton-Jacobi Equation & Hamilton Principal Function	G 9.1-9.6 G 10.1-10.2
Lecture 10 11/02	Oscillations	G 6.1-6.4 T&M Chapter 12
	Depending on progress of the class and available time, other lecture topics might also be including in the remaining lectures.	
Lecture 11	Math review for rigid body motion Non-iniertial reference frames, Euler Angles	Classnotes G 4.1-4.4

11/09		T&M Chapter 10
Lecture 12 11/16	Coriolis force, Rigid body motion, angular momentum	G 4.6-4.10 G Chapter 5 T&M Chapter 11
Lecture 13 11/23	Moment of inertia tensor, Euler equations of motion; motion of a torque-free rigid body	G Chapter 5 T&M Chapter 11
Lecture 14 11/30	Motion of a torque-free rigid body and a symmetric top in gravity	G Chapter 5 T&M Chapter 11
Reading Day 12/07	Reading Day	
Final Exam 12/14	Final Exam	