PHY6246-3916(19929) - Classical Mechanics

Graduate Classical Mechanics

PHY6246-3916(19929)

Class Periods: MWF Period 2 (8:30-9:20am EDT)

Location: All lectures and office hours on Zoom

Academic Term: Fall 2020

Instructor:

- Richard Woodard
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- +1-352-392-8744

- Office Hours: R1 (7:25-8:15 am), F6 (12:50-1:40pm), S1 (7:25-8:15am) and S7 (1:55-2:45pm)

Canvas Information

Canvas is the where course content, grades, and communication will reside for this course.

- ufl.instructure.com
- For Canvas, Passwords, or any other computer-related technical support contact the IT Service Desk.
  - 123 123-1234
  - 877 878-8325
  - http://it.myinstitution.edu
  - itsupport@myinstitution.edu

Course Description: **PHY 6246 Classical Mechanics, 3 Credits, Letter Grade**

Review of Lagrangian formulation and special relativity. Hamiltonian mechanics, canonical transforms and Hamilton-Jacobi theories, action angle variables, rigid rotators, normal modes, mechanics of continuous media. Fluid mechanics.

Course Pre-Requisites (if you are not a physics graduate student)

- PHY3221 and PHY4222 - Undergraduate Classical Mechanics

- PHY3323 and PHY4324 - Undergraduate Electromagnetism

Course Objectives

The point of this course is not to study new dynamical systems, although that may happen in some cases. It is rather to make the passage from undergraduate to graduate analysis, to embed classical mechanics within the powerful framework of fundamental theory, and to establish connections with other areas of physics. This will be accomplished by:

- Emphasizing that ``solving'' a system means expressing the dynamical variable as a function of time its initial values.
- Emphasizing that the Heisenberg picture equations of quantum mechanics are identical to the classical equations of motion. Further, solving these equations means the same thing. The only difference is that the initial values of a classical system are arbitrary C-numbers whereas they are non-commuting operators in quantum mechanics.
- Expressing equations of motion as variational derivatives of the action.
- Using the Levi-civita symbol to describe arbitrary rotations.
- Using indicial tensor manipulation in which a tensor is considered as a function of its indices.
- Systematizing the treatment of small oscillations to see its applications in fields as diverse as statistical mechanics, astrophysics, and quantum field theory.
- Seeing perturbation theory as a systematic correction of small oscillations, and understanding the universality of renormalization in all nonlinear systems.
- Understanding the pathologies and limitations of perturbation theory.
- Understanding the restrictions imposed on fundamental theory by symmetry and stability.
- Seeing field theory as the continuum limit of particle theory.

Required Text

- Classical Mechanics
- H. Goldstein, C. Poole and J. Safko
- 3rd Edition, 2002
- ISBN 978-0-201-65702-9

Course Schedule

- Day 1 (Aug. 31) Begin chapter 1. Coordinate systems & what ``solve'' means.
- Day 2 (Sept. 2) Finish chapter 1. Generalized coordinates & Euler-Lagrange equations.
- Day 3 (Sept. 4) Begin chapter 2. Functional techniques.
- Homework #1 due by 8am EDT on Sept. 6
- No class on Labor Day (Sept. 7)
- Day 4 (Sept. 9) Finish chapter 2.
- Day 5 (Sept. 11) Begin chapter 3.

- Homework #2 due by 8am EDT on Sept. 13
- Day 6 (Sept. 14) Continue chapter 3.
- Day 7 (Sept. 16) Continue chapter 3.
- Day 8 (Sept. 18) Finish chapter 3.
- Homework #3 due by 8am EDT on Sept. 20
- Day 9 (Sept. 21) Begin chapter 4.
- Day 10 (Sept. 23) Continue chapter 4.
- Day 11 (Sept. 25) Continue chapter 4.
- Homework #4 due by 8am EDT on Sept. 27
- Day 12 (Sept. 28) Finish chapter 4.
- Day 13 (Sept. 30) Begin chapter 5.
- Day 14 (Oct. 2) Continue chapter 5.
- Homework #5 due by 8am EDT on Oct. 4
- Day 15 (Oct. 5) Continue chapter 5.
- Day 16 (Oct. 7) Finish chapter 5
- Day 17 (Oct. 9) Begin chapter 6.
- Homework #6 due by 8am EDT on Oct. 11
- Day 18 (Oct. 12) Continue chapter 6.
- Day 19 (Oct. 14) Continue chapter 6.
- Day 20 (Oct. 16) Finish chapter 6.
- Take-home Exam #1 released at 8am EDT on Oct. 17
- Take-home Exam #1 due by 8am EDT on Oct. 18
- Day 21 (Oct. 19) Special Relativity.
- Day 22 (Oct. 21) Special Relativity.
- Day 23 (Oct. 23) Special Relativity.
- Homework #7 due by 8am on Oct. 24
- Day 24 (Oct. 25) Special Relativity.
- Day 25 (Oct. 27) Special Relativity.
- Day 26 (Oct. 29) Special Relativity.
- United States changes to Standard Time at 2am on Nov. 1
- Homework #8 due by 8am EST on Nov. 1
- Day 27 (Nov. 2) Canonical Transformations.
- Day 28 (Nov. 4) Canonical Transformations.
- Day 29 (Nov. 6) Canonical Transformations.
- Homework #9 due by 8am EST on Nov. 8
- Day 30 (Nov. 9) Perturbation Theory.
- No class on Veteran's Day (Nov. 11)
- Day 31 (Nov. 13) Perturbation Theory.
- Homework #10 due by 8am EST on Nov. 15
- Day 32 (Nov. 16) Perturbation Theory.

- Day 33 (Nov. 18) Perturbation Theory.
- Day 34 (Nov. 20) Perturbation Theory.
- Homework #11 due by 8am EST on Nov. 22
- Day 35 (Nov. 23) Perturbation Theory.
- No class during Thanksgiving Recess (Nov. 25)
- No class during Thanksgiving Recess (Nov. 27)
- Homework #12 due by 8am EST on Nov. 29
- Day 36 (Nov. 30) Field Theory.
- Day 37 (Dec. 2) Field Theory.
- Day 38 (Dec. 4) Field Theory.
- Homework #13 due by 8am EST on Dec. 6
- Day 39 (Dec. 7) Field Theory.
- Day 40 (Dec. 9) Field Theory.
- Take-home Exam #2 released at 8am EDT on Dec. 12
- Take-home Exam #2 due by 8am EDT on Dec. 13

Attendance Policy, Class Expectations, and Make-Up Policy

Because of the visa problem of our 17 international students, the course has been designed for accessibility in China (+12 hours), India (+9.5 hours), Greece (+7 hours) and Egypt (+6 hours). Students are expected to attend the synchronous Zoom lectures but attendance will not be taken, nor is there any penalty for absence. Class notes will be posted under ``Files''. Homework will be assigned weekly, due (by upload to Canvas) on Sundays by 8am and graded by 8am on Mondays. There will be two 24-hour take-home exams, from 8am to 8am Saturday-Sunday, on Oct. 17-18 and Dec. 12-13. Excusing missed assignments must be consistent with university policies in the Graduate Catalog **(Link (https://catalog.ufl.edu/graduate/?catoid=10&navoid=2020#attendance)**) and will require appropriate documentation.

Evaluation of Grades

Assignment	Total Points	Percentage of Final Grade
Homework Sets (13)	15 each	30%
Take-home Exams (2)	227.5 each	70%
Totals	650	100%

Grading Policy (Grade cutoffs may be lowered but they will not be raised)

Percent	Points	Grade	Grade Points
85 - 100	552.5 - 650.0	A	4.00

80 - 85	520.0 - 552.5	A-	3.67
75 - 80	487.5 - 520.0	B+	3.33
70 - 75	455.0 - 487.5	B	3.00
65 - 70	422.5 - 455.0	B-	2.67
60 - 65	390.0 - 422.5	C+	2.33
55 - 60	357.5 - 390.0	C	2.00
50 - 55	325.0 - 357.5	C-	1.67
45 - 50	292.5 - 325.0	D+	1.33
40 - 45	260.0 - 292.5	D	1.00
35 - 40	227.5 - 260.0	D-	0.670
0 - 35	0 - 227.5	E	0.00

Students Requiring Accommodations

Students with disabilities who experience learning barriers and would like to request academic accommodations should connect with the disability Resource Center by visiting **Link (https://disability.ufl.edu/students/get-started/)** . It is important for students to share their accommodation letter with their instructor and discuss their access needs, as early as possible in the semester.

Course Evaluation

Students are expected to provide feedback on the quality of instruction in this course by completing online evaluations at **Link (https://gatorevals.aa.ufl.edu/)** . Evaluations are typically open during the last two or three weeks of the semester, but students will be given specific times when they are open. Summary results of these assessments are available to students at **Link (https://gatorevals.aa.ufl.edu/)** .

University Honesty Policy

UF students are bound by The Honor Pledge which states, ``We, the members of the University of Florida community, pledge to hold ourselves and our peers to the highest standards of honor and integrity by abiding by the Honor Code. On all work submitted for credit by students at the University of Florida, the following pledge is either required or implied: ``On my honor, I have neither given nor received unauthorized aid in doing this assignment." The Honor Code **(Link (https://sccr.dso.ufl.edu/process/student-conduct-code/)**) specifies a number of behaviors that are in violation of this code and the possible sanctions. Furthermore, you are obligated to report any condition that facilitates academic misconduct to appropriate personnel. If you have any questions or concerns, please consult with the instructor.

Software Use

All faculty, staff, and students of the University are required and expected to obey the laws and legal agreements governing software use. Failure to do so can lead to monetary damages and/or criminal penalties for the individual violator. Because such violations are also against University policies and rules, disciplinary action will be taken as appropriate. We, the members of the University of Florida community, pledge to uphold ourselves and our peers to the highest standard of honesty and integrity.

Student Privacy

Our class sessions may be audio visually recorded for students in the class to refer back and for enrolled students who are unable to attend live. Students who participate with their camera engaged or utilize a profile image are agreeing to have their video or image recorded. If you are unwilling to consent to have your profile or video image recorded, be sure to keep your camera off and do not use a profile image. Likewise, students who un-mute during class and participate orally are agreeing to have their voices recorded. If you are not willing to consent to have your voice recorded during class, you will need to keep your mute button activated and communicate exclusively using the "chat" feature, which allows students to type questions and comments live. The chat will not be recorded or shared. As in all courses, unauthorized recording and unauthorized sharing of recorded materials is prohibited. Also, there are federal laws protecting your privacy with regards to grades earned in courses and on individual assignments. For more information, please see **Link . (https://registrar.ufl.edu/catalog0910/policies/regulationferpa.html)**

Health and Wellness

- **U Matter, We Care:** If you or a friend is in distress, please contact umatter@ufl.edu or 352 392-1575 so that a team member can reach out to the student.
- **Counseling and Wellness Center:** **http://www.counseling.ufl.edu/cwc (http://www.counseling.ufl.edu/cwc)** , and 392-1575; and the University Police Department: 392-1111 or 9-1-1 for emergencies.
- **Sexual Assault Recovery Services (SARS)** Student Health Care Center, 392-1161.
- **University Police Department** at 392-1111 (or 9-1-1 for emergencies), or **http://www.police.ufl.edu/ (http://www.police.ufl.edu/)** .

Academic Resources

- **E-learning technical suppor***t*, 352-392-4357 (select option 2) or e-mail to Learning-support@ufl.edu. **https://lss.at.ufl.edu/help.shtml (https://lss.at.ufl.edu/help.shtml)** .
- **Career Resource Center**, Reitz Union, 392-1601. Career assistance and counseling. **https://www.crc.ufl.edu/ (https://www.crc.ufl.edu/)** .
- **Library Support**, **http://cms.uflib.ufl.edu/ask (http://cms.uflib.ufl.edu/ask)** . Various ways to receive assistance with respect to using the libraries or finding resources.

- **Student Complaints Campus***:* **https://www.dso.ufl.edu/documents/UF_Complaints_policy.pdf (https://www.dso.ufl.edu/documents/UF_Complaints_policy.pdf)** .
- **On-Line Students Complaints***:* **http://www.distance.ufl.edu/student-complaint-process (http://www.distance.ufl.edu/student-complaint-process)** .