**Phys 330 Theoretical Mechanics Fall 2020**

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Office Hours:
MW 2- 4pm; Other Hours by appointment

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**Course Overview:** This course presents rigorous mathematical treatment of classical mechanical systems. Students will be able to apply new mathematical treatments to classical Newtonian systems and in the process appreciate both physical nature of systems and mathematical elegance used to describe them.

**Learning objectives**:

By the end of this course, successful students will be able to

1. Apply the underlying concepts in classical mechanics to solve problems of everyday mechanical systems using Newtonian, Lagrangian and Hamiltonian formulations
2. Develop advanced problem solving skills by applying the formalism of the theory to oscillating systems : simple harmonic oscillators, 2D oscillators, damped harmonic oscillators, driven damped oscillators
3. Explain energy requirements and stability criteria for systems with time dependent and time independent forces
4. Understand the dynamics of particles in inertial and non-inertial reference frames

**Prerequisites:** Phys 203

**Required Materials:** Classical Dynamics of Particles and Systems by Jerry B. Marion, 5$^{Th}$ edition, ISBN: 9780534408961, Cengage publishers.

A 2 inch binder for all class notes or a composition book with all class notes. Students are expected to maintain a neat copy of their class notes, and there will be a LOT of writing.

**Philosophy**: My teaching philosophy is not to make you memorize equations but rather help you understand and appreciate physics. I am willing to work with you, if you need extra help. Please talk to me if you have any problems understanding the material. ASK QUESTIONS; GET YOUR DOUBTS CLEARED WITHOUT PROCRASTINATION. Feel free to stop by my office. I believe that questions and clarifications are best addressed in person rather than via emails and phone. I would urge you to take full advantage of my office hours to get your questions answered.

**Grading:** Grades for this course will be based on homework assignments, tests, quizzes, in-class work and student participation. The final grades will be determined at the end of the semester according to the rubric below.

| **Assessment Item** | **Weight** |
|---|---|
| Homework | 20% |
| Midterm Exam 1 | 15% |
| Midterm Exam 2 | 15% |
| In-class Work | 25% |
| Final Exam | 25% |

| Points | Grade | Points | Grade |
|---|---|---|---|
| <60 | F | 76-79 | C+ |
| 60-62 | D- | 80-82 | B- |
| 63-65 | D | 83-85 | B |
| 66-69 | D+ | 86-89 | B+ |
| 70-72 | C- | 90-94 | A- |
| 73-75 | C | ≥95 | A |

**Expectation:** Students are expected to put in a minimum of 12-15 hours/week work outside the class in order to successfully complete this course.

**Homework:** There will be one or two homework set each week, consisting of problems from the lectures given during the week. The homework problems sets are typically due on Tuesdays at the beginning of the class. Any change in the deadline will be announced in class/ posted on *Inquire* site. Any collaboration on homework should only be restricted to discussions, and must be acknowledged in your solutions. Copying of solutions and/or *Mathematica* code from other students/unauthorized resources/online websites/ forum will be in violation of Academic Integrity rules and will result in a severe penalty.

**Policy on Late Submissions:** For this course, I will follow the physics group's policy on late submissions. Unless you have my prior permission, assignments submitted after the deadline will be worth 50% for up to one week. Assignments submitted after two weeks will be worth 0%.

**In-Class Problems and Participation**: You will also be required to complete problems assigned in class. Participation in class discussions is also an important aspect of learning the material. You will not be able to make up the inclass worksheet if you are absent.

**MCSP Colloquium Series:** You are required to attend at least 3 of the several talks as a part of the MCSP colloquia this semester. You should submit a 1 page reflection paper, using turn it in link before the end of last day of classes. Simply regurgitating the talk will get you only ½ the credit. MCSP credits, a maximum of 3 extra points, will be added to your final exam score at the end. This can swing the needle between a + /-. Do not wait till the end of the semester to attend one of these talks, as you may run out of options. A schedule of this semester's talk can be found on MCSP webpage.

**Midterm Tests:** There will be two tests during the semester. Each test will cover the material listed on the syllabus or as informed by the professor in class, prior to the tests.

**Final Exam:** Yes, there will be a final exam at the end, and it is cumulative!

**Attendance:** Since the class is taught remotely, students are required to attend all class meetings. Each class meeting will be on Zoom , and during the live web-conferencing session we will go over the theory, discussions on assignments, work on in class problems and review relevant content from.

**Excused Absence**: Any unexpected absence due to health reasons/emergency situation/participation in events representing the College should be supported by proper documentation such as doctor's note, court order, and schedule of conference/sports events. You will need to inform me prior to the absence or within 48 hours of such an absence to be considered as excused. It is your responsibility to make up for the work that you missed

**Inquire:** Log-in to Inquire program via MyRC web portal on the College website. This will give you access to the syllabus, office hours schedules, lecture notes, any class announcements and a bunch of other stuff. Regular updates will be available posted here. Make sure to check the Inquire website regularly!!! No excuses can be made and no extensions can be granted if you miss a deadline that was posted on Inquire.

**Class Disruption**: All students are entitled to a professional learning environment. Students should not act in a manner which will distract and disrupt the class learning experience. Such practices will not be tolerated. Appropriate clothing and behavior is expected.

**Academic Integrity**: Policies of Academic Integrity of Roanoke College are enforced in all aspects of this course. It is the responsibility of the student to strictly adhere to the policies of Academic Integrity of Roanoke College. If you are unsure of AI policies, please come and see me.

**Student Support Services:** Students are encouraged to visit the Center of Learning and Teaching for additional services. See below for a list of services offered by the CLT.

**The Writing Center @ Roanoke College**, located on the Lower Level of Fintel Library, offers tutorials focused on writing projects and oral presentations for students working in any field. Writers and presenters at all levels of competence may visit the Writing Center at any point in their process—including brainstorming, drafting, organizing, editing, or polishing presentation skills—to talk with trained peer tutors in informal, one-on-one sessions. The Writing Center is open Sunday through Thursday from 4 to 9 pm. Simply stop in, or schedule an appointment by going to www.roanoke.edu/writingcenter, where our staff members and workshops are also posted. Questions? Email writingcenter@roanoke.edu or call 375-4949. Like our Facebook page for hours and event updates!

**Subject Tutoring**, located on the lower level of Fintel Library (Room 5), is open 4 pm – 9 pm, Sunday – Thursday. We are a Level II Internationally Certified Training Center through the College Reading and Learning Association (CRLA). Subject Tutors are highly trained Roanoke College students who offer one-on-one tutorials in a variety of general education and major courses such as: Business, Economics, Mathematics, INQ 240, Modern Languages, Lab Sciences, INQ 250, and Social Sciences (see all available subjects at www.roanoke.edu/tutoring). Tutoring sessions are available in 15, 30, or 45-minute

appointments. Feel free to drop by for a quick question or make an appointment at www.roanoke.edu/tutoring for a longer one-on-one appointment. For questions or concerns, please contact us at 540-375-2590 or subject_tutoring@roanoke.edu.

**Accessible Education Services (AES)** is located in the Goode-Pasfield Center for Learning and Teaching in **Fintel Library**. AES provides reasonable accommodations to students with documented disabilities. To register for services, students must self-identify to AES, complete the registration process, and provide current documentation of a disability along with recommendations from the qualified specialist. Please contact Laura Leonard, Assistant Director of Academic Services for Accessible Education, at 540-375-2247 or by e-mail at aes@roanoke.edu to schedule an appointment. If you have registered with AES in the past and would like to receive academic accommodations for this semester, please contact Laura Leonard at your earliest convenience to schedule an appointment.

**Diversity and Preferred Name/Pronoun Statement:**
" I consider this classroom to be a place where you will be treated with respect, and I welcome individuals of all ages, backgrounds, beliefs, ethnicities, genders, gender identities, gender expressions, national origins, religious affiliations, sexual orientations, ability – and other visible and nonvisible differences. All members of this class are expected to contribute to a respectful, welcoming and inclusive environment for every other member of the class."

Course Plan:

| Week | Date | Chapter | Topic | Chapter |
|---|---|---|---|---|
| 1 | 20-Aug | Ch 1 | Introduction, Review of Scalar and Vector operations, Complex Numbers | |
| 2 | 25-Aug | Ch 2 | Newtonian Mechanics, Equations of Motion | 2.1 |
| | 27-Aug | | Coordinate systems | |
| 3 | 1-Sep | | Forces | 2.2-2.4 |
| | 3-Sep | | Resistive Forces | |
| 4 | 8-Sep | | Projectile Motion | |
| | 10-Sep | | Motion equations | |
| 5 | 15-Sep | | 2D Oscillations | 3.1-3.3 |
| | 17-Sep | | Damped Oscillations | |
| 6 | 22-Sep | | Applications | |
| | 24-Sep | | Exam 1 (will include all materials covered until Sep 17) | |
| 7 | 29-Sep | Ch 7 | Lagrange's equation of motion | 7.1-7.3 |
| 8 | 1-Oct | | Generalized Coordinates | |
| | 6-Oct | | Undetermined Multipliers | 7.4 |
| 9 | 8-Oct | | Applications | |
| | 13-Oct | | Hamiltonian dynamics | 7.5-7.9 |
| 10 | 15-Oct | | Canonical Equations of Motion | 7.10 |
| | 20-Oct | | Applications | |
| 11 | 22-Oct | | Lagrangian, Hamiltonian and Newtonian Approaches | 7.11 |
| | 27-Oct | | Applications | |
| 12 | 29-Oct | | Exam 2 (will include all materials covered until Oct 22) | |
| | 3-Nov | | Central Forces, Orbits in a central field | 8.1-8.2 |
| 13 | 5-Nov | | Effective Potential | 8.3-8.4 |
| | 10-Nov | | Kepler's Laws | 8.7 |
| | 12-Nov | | Applications | |
| 14 | 17-Nov | | Review | |
| 15 | 24-Nov | Tues | Final Exam (1:00-4:00 pm) | |