

**Dr. Rama Balasubramanian (a.k.a) Dr. Bala**

Room No: 266A Trexler

Phone: 540-375-2057

E-mail: [bala@roanoke.edu](mailto:bala@roanoke.edu)

Office Hours:

MWF: 10:30-11:30 am; T Th: 1:30-2:30 pm

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<sup>th</sup> 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.

Homework	Points	Grade	Points	Grade
Midterm Exam 1	<60	F	76-79	C+
Midterm Exam 2	60-62	D-	80-82	B-
Quizzes	63-65	D	83-85	B
In-class Work	66-69	D+	86-89	B+
Enthusiasm + Participa	70-72	C-	90-94	A-
Final Exam	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 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%.

**Quizzes:** These will be short quizzes and will be held during the lecture time, typically every week. The quiz date will be announced during one lecture period prior to the quiz. They will consist of questions from homework and lecture material. There will be no make-up quizzes – if you are absent, you get zero.

**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. These will be part take home/part inclass. 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:** Students are required to attend every class. Attendance will be recorded during every class meeting. Any student who misses a total of three classes will be dropped from the course with a grade of DF. This includes both excused and unexcused absences. A warning email will be sent after the second absence occurs. This will be cc-ed to your academic advisor and registrar. Absences will also include the following: ***If a student shows up for class 10 minutes late/walk out in the middle of the class/caught napping/texting/ checking emails/playing games/browsing internet/watching videos, he/she will be marked absent.*** Unless I authorize, students should refrain from all activities that cause unnecessary distractions. A physical presence alone does not construe as being present in the class. (Cell Phones can happily rest in the happy box or they can take a nice nap in your backpacks)

**Excused Absence:** Any unexpected absence due to health reasons/emergency situation/participation in a conference or sporting 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 best to inform me about your absence in person. Emails and phone voice messages are not very reliable. It is your responsibility to make up for the work that you missed. I will not extend the deadline for turning in homework or other work assigned in the class unless you have my prior approval.

**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. Cell-phones, gaming devices laptop computers or any other electronic communication/entertainment devices must be turned off at all times during the lecture period.

**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.

Course Plan

Week	Date	Chapter	Topic	Chapter Sections
1	30-Aug	Ch 1	Introduction, Scalar and Vector operations, Complex Numbers	
2	4-Sep	Ch 2	Newtonian Mechanics, Equations of Motion	2.1-2.4
	6-Sep		Conservation Principles	
3	11-Sep		Review of Differential Equations	Appendix C
	13-Sep		Applications	
4	18-Sep		Energy, Stability	2.5-2.7
	20-Sep		Applications	
5	25-Sep	Ch 3	Oscillations, SHO	3.1-3.4
	27-Sep		2D Oscillations , Damped oscillations	
6	2-Oct		Driven oscillations	3.5-3.6
	4-Oct		Fourier Series , Applications	
7	9-Oct		Coupled Oscillators	RB-Notes

	11-Oct		Exam 1 (will include all materials covered until Oct 4th)	
8	16-Oct		Fall Break - No Classes	
9	23-Oct	Ch 7	Lagrange's equation of motion	7.1-7.4
	25-Oct		Hamiltonian , Generalized Coordinates (GC)	
10	30-Oct		GC, Undetermined multipliers	7.5-7.11
	1-Nov		Canonical Equations of Motion	
11	6-Nov		Applications	
	8-Nov	Ch 8	Central Forces, Orbits in a central field	8.1-8.5
12	13-Nov		Effective Potential	8.6-8.8
	15-Nov		Kepler's Laws and Applications	
13	20-Nov		Exam 2 ( Will include all materials covered until Nov 6)	
			Thanksgiving Break -No Classes	
14	27-Nov		Special Topics - Gravitation	5.1-5.3
	29-Nov		Angular Momentum and Applications	9.1-9.4
15	4-Dec		Special Topics - Non-linear Oscillations, Chaos	4.1-4.2; 4.4-4.6
	6-Dec		Fluid Mechanics	RB-Notes

16	13-Dec	Thursday	Final Exam (8:30-11:30 am)	

**Disclaimer:** Everything above is subject to change with notice and, where appropriate, your approval.

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](http://www.roanoke.edu/writingcenter), where our staff members and workshops are also posted. Questions? Email [writingcenter@roanoke.edu](mailto:writingcenter@roanoke.edu) or call 3754949. 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](http://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](http://www.roanoke.edu/tutoring) for a longer one-on-one appointment. For questions or concerns, please contact us at 540-3752590 or [subject\\_tutoring@roanoke.edu](mailto: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](mailto: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.”