ENGS 330-A: Dynamics

Course Information:

Instructor: Dr. Rajesh Vuddandam (Dr. Raj)
Email: vuddandam@roanoke.edu
Office: Trexler 270J; **Phone**: 540-375-2010;
Office Hours: MWF 10:45am -12pm & 1pm to 2pm or by appointment
Lecture time: MWF 2:20 – 3:20 pm; **Lecture Room**: Trexler 273; **Units**: 1

Course Description:

This course introduces principles of engineering dynamics, which elucidate applications of Newtonian principles. This includes an introduction to kinetics of a system of particles subjected to uniform and non-uniform motion.

Course Prerequisites:

ENGS-211 (Statics & Materials Testing) - Must be completed prior to taking this course.
PHYS-270 (Math Methods for Physics) or MATH-331 (Differential Equations) - Must be completed prior to taking this course.

Textbook and/or Resource Materials:

- (Required): Free OER Textbook - Mechanics Map by Moore (Chapters 8 to 16); Alternate source link form LibreTexts bookshelf: Mechanics Map by Moore, 2nd Edition
- (Required): Free Pdf - NCEES Fundamentals of Engineering (FE) Handbook, but you must be registered and logged into your MyNCEES account to access it by visiting https://ncees.org/
- (Required): NCEES exams approved calculator
- (Optional): Free OER Textbook - Introductory Dynamics by Steeneken, from LibreTexts bookshelf.

Inquire:

Inquire Access (required) – Inquire is a learning management system that will be used to post all course activity handouts, assignments, project details, syllabus etc., and can be accessed using Roanoke college's student login credentials using the following link https://inquire.roanoke.edu/

ABET Criteria 3 Student Outcomes:

The learning outcomes for this course are explicitly mapped to ABET Criterion 3 Student Outcomes (1-7). This course contributes predominantly to the achievement of ABET Student Outcomes 1, 2, and 7, preparing students to apply foundational knowledge, solve engineering problems, and engage in lifelong learning.

1. an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.
2. an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, and global, cultural, social, environmental, and economic factors.
3. an ability to communicate effectively with a range of audiences.
4. an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts.
5. an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives.
6. an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.
7. an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

Course Learning Outcomes:

Upon successful completion of this course, students will be able to:

- Understand and apply the laws of motion to a system of particles. *(ABET SO1, SO7)*
- Differentiate between absolute dependent motion and relative motion for a system of particles. *(ABET SO1)*
- Analyze equations of motion in rectilinear and curvilinear coordinate systems. *(ABET SO1, SO2)*
- Understand rigid body dynamics through a study of translation and rotation vectors of planar kinetic motion. *(ABET SO1, SO7)*
- Apply the principles of conservation of linear momentum, angular momentum, and energy to both systems of particles and rigid bodies. *(ABET SO1, SO2, SO7)*
- Understand the 3D kinetics of a rigid body. *(ABET SO1, SO7)*

Student Expectations & Course Format:

This course expects you to spend at least 12 hours of work each week inside and outside of class. This course utilizes a flipped classroom model to maximize active, applied learning during our scheduled class time. Your preparedness and engagement are essential for your success and the success of the class.

- Before Class (Your Responsibility): You are required to prepare for each class session by reviewing the assigned learning materials. These will include - Recorded video lectures and notes from the *Mechanics Map* LibreTexts OER (Open Educational Resource) textbook; Any other assigned readings or multimedia content posted on INQUIRE
- During Class (Our Collaborative Time): Class time will be dedicated to active application and deepening understanding, not passive lecture. Activities will include:
    - Clarifying complex concepts and addressing questions from the prepared material.
    - Collaborative problem-solving and guided practice.
    - Reviewing and discussing homework assignments.

Your consistent preparation is the foundation of this model**.** Coming to class having engaged with the preliminary material allows us to work together to solve challenging problems and master the course content.

Grading Policy:

Class grades will be calculated according to the following distribution

Category	**% Distribution**
Attendance/Class Participation	5%
Handouts (Individual), Chapter-wise	15%
Homework Assignments (Individual), Chapter-wise	10%
Quizzes (4x), 2 before Midterm, 2 after Midterm	30%
Midterm Exam (Individual)	20%
Final Exam (Comprehensive)	20%
Total	**100%**

The final grade will be assigned as follows, although the instructor reserves the right to lower the limits slightly at their discretion considering factors such as student attendance, class participation, and class performance.

Points	Grade	Points	Grade
<60	F	77-79	C+
60-62	D-	80-82	B-
63-66	D	83-86	B
67-69	D+	87-89	B+
70-72	C-	90-92	A-
73-76	C	≥93	A

Attendance Policy:
Regular attendance is required for this course. The instructor records attendance via INQUIRE, and it contributes directly to your final grade as detailed in the grading policy. Attendance is graded using the following point values: full attendance (**P**) = 2 points; late arrival or early departure (**L**) = 1 point; documented, excused absence (**E**) = 1 point; unexcused absence (**A**) = 0 points. Students must notify the instructor promptly of any excused absence and are personally accountable for all missed content and assignments. If you miss class for a college activity, please contact instructor to arrange a make-up plan (e.g., a different deadline or exam time). To protect your learning, the college recommends that total absences, across all reasons, stay below 20% of class meetings; coaches and instructors will work with you to help manage this limit. Also, read the late/make-up work policy section.

Class Participation:
This course emphasizes active, in-class collaboration, requiring thorough preparation before each session and engaged participation during class to succeed. Your grade is directly influenced by this participation and the completion of in-class activities, which cannot be made up without an excuse as defined in the Late/Makeup Work Policy. This approach ensures a deeper, practical understanding that passive consumption of materials cannot provide.

In-Person Quizzes:
To support consistent learning and provide flexibility, the instructor will administer four quizzes throughout the term—two before the midterm exam (Ch 8,12; Ch 9,13) and two after (Ch 10, 14; Ch 11,15). Your final quiz grade will be calculated using your three highest scores; the lowest quiz score will be automatically dropped. This policy is designed to accommodate an unexpected absence or a challenging week. Your performance on these quizzes contributes directly to your final grade, as detailed in the grading breakdown.

Handouts:
This course utilizes handouts to deliver instructional content. Students are responsible for actively completing these handouts during class by adhering to the instructor's guidance and taking notes. Submission of single, legible PDF file to INQUIRE by the due date is required.

Assignments:
Assignments are designed to help you apply and deepen your understanding of course material. All work must be submitted as a single, legible PDF file through the INQUIRE platform by the specified due date. It is essential to follow all instructions carefully and employ critical thinking to fully demonstrate your comprehension.

Exams:
You will take one midterm exam and one comprehensive final exam on the dates listed in the course schedule. Final examinations are scheduled at the times designated by the Registrar's Office. Make-up is only offered for excused reasons and requires advance notice (except in emergencies). Failure to obtain an excuse will result in a zero for the missed exam.

Projects:
While no projects are required for this course, students have the option to undertake a self-motivated

project to deepen their understanding. To propose a project, identify a real-world problem where you can apply course principles. The instructor is available to advise on scope, methodology, and resources. This is an opportunity for comprehensive, applied learning beyond the standard curriculum.

Handwritten Submission Policy:

Applicable to Handouts, Assignments, Quizzes, Exams: To ensure clarity and facilitate accurate grading, all submitted handwritten work must adhere to a structured format. Solutions must clearly present:

1. Given: The known values and conditions from the problem statement.
2. Find: The specific quantity or quantities to be determined.
3. Solution Steps: A logical progression showing all formulae used, substitutions, and intermediate calculations.
4. Final Answer: The final answer, clearly boxed or highlighted.

Applicable to Handouts, Assignments: All assignments must be submitted as a single, legible PDF file. This format is required to ensure the efficient and accurate grading of your work and for the secure storage of student materials, which may be used for official course and program accreditation purposes.

If you need assistance with scanning, compiling, or organizing your work into a single PDF, please do not hesitate to ask for help well before the submission deadline.

Grading Consequence: Solutions that do not follow this prescribed structure and a single, legible pdf file rule will be returned without a grade or will receive zero credit unless student follows the instructions. This policy is in place to develop professional communication skills and ensure fair, efficient evaluation of your work.

Late/Make-up Work Policy:

Late submissions are not accepted without a valid, instructor-approved excuse. Students must proactively communicate in any circumstances that may delay their submission. The approval of any excuse and the granting of a makeup opportunity is solely at the instructor's discretion.

Teamwork:

There are no required team projects that contribute to the final course grade. The option to pursue a self-motivated project is available exclusively for students seeking to deepen their comprehension of the material through applied, real-world problem-solving. Completing such a project will enhance your learning but will not factor in your official grade calculation. The group project achieves two primary objectives:

1. Academic: To develop your ability to collect, analyze, and evaluate real-world physical measurements, including the management of errors and outliers.
2. Professional: To cultivate essential teamwork skills, including sharing ideas, managing responsibilities, resolving conflicts, and providing constructive peer feedback.

Other Policies

Generative AI Usage:

In this course, using AI as a learning tool is **permitted with restrictions**. However, you should consider the following conditions/concerns:

- ✅ Permitted For: Brainstorming (ideation) and learning support.
- ❌ Not Permitted For: Generating content to be submitted as your own work.

- 📚 Citation: Always reference any AI tool you use for assistance.
- 🧠 Accountability: You must be able to explain and defend all your work.
- 📝 Exams: Absolutely no use of AI or any other external resources.

The goal of this course is to assess your understanding, not AI's output.

Academic Integrity:
Your learning and integrity are at the core of your RC education. For this reason, you must follow the rules outlined in the College AI policies. See www.roanoke.edu/academicintegrity

Writing Center:
The Writing Center Roanoke College, located on the Lower Level of Fintel Library (Room 5), offers free 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 at www.roanoke.edu/writingcenter. Questions? Email writingcenter@roanoke.edu or call 540-375-4949.

Subject Tutoring:
Subject Tutoring, located on the lower level of Fintel Library (Room 5), is open 4-9 PM, Sunday-Thursday. Subject Tutors are highly trained, current students who offer free, one-on-one (and small group) tutorials in over 80 courses taught at Roanoke College, including: Business, Economics, Mathematics, INQ 240, Modern Languages, Lab Sciences, and Social Sciences. Check out all available subjects and schedule 30- or 60-minute appointments at www.roanoke.edu/tutoring. If you have a question, feel free to stop by, or contact us at subject_tutoring@roanoke.edu or 540-375-2590.

Accessible Education Services (AES):
AES is located on the first floor of the Bank Building. AES provides reasonable accommodation to students with documented disabilities. To register for services, students must self-identify to AES, complete the registration process, and provide current documentation of disability along with recommendations from the qualified specialist. Please contact Dustin Persinger, Assistant Director of Academic Services for Accessible Education, at 540-375-2248 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 accommodation for this semester, please contact Dustin Persinger at your earliest convenience to schedule an appointment and/or obtain your accommodation letter for the current semester. The testing center, also located on the first floor of the Bank Building, can be reached at 540-375-2247. https://www.roanoke.edu/inside/aes

Student Health and Counseling Services (SHCS):
Student Health & Counseling Services supports students through in-person health appointments. Please see https://www.roanoke.edu/shcs for more information and to access services.

Tentative Course Schedule:

The following schedule is tentative and may be adjusted. The official course schedule, assignments, and announcements will be maintained on the Inquire LMS platform, which students are responsible for monitoring regularly.

Week	Dates	Primary Topic / Reading Material (Chapter)	Key Subtopics (Sections)
Part A - The Geometry of Motion: Kinematics			
1	Jan 12 – 16	Particle Kinematics (Ch. 8)	8.1-8.3: 1D & 2D (Rectangular) Motion
2	Jan 19 – 23	Particle Kinematics (Ch. 8)	8.4-8.7: Normal-Tangential, Polar, Dependent & Relative Motion Jan 19: No Class (MLK Jr. Day).
3	Jan 26 – 30	Rigid Body Kinematics (Ch. 12)	12.1-12.4: Fixed Axis Rotation, Absolute Motion
4	Feb 2 – 6	Rigid Body Kinematics (Ch. 12)	12.5-12.8: Relative Motion, Instantaneous Center, Rotating Frames
Part B - The Cause of Motion: Kinetics			
5	Feb 9 – 13	Newton's 2nd Law for Particles (Ch. 9)	9.1-9.4: Equations of Motion in Various Coordinates
Feb 11 (Wed) - Quiz 1 (Chapters 8, 12)			
6	Feb 16 – 20	Newton's 2nd Law for Rigid Bodies (Ch. 13)	13.1-13.4: Translation, Rotation, General Planar Motion
7	Feb 23 – 27	Quiz 2, Midterm Exam & Review	Cumulative Exam (Ch. 8, 9, 12, 13)
Feb 23 (Mon): Quiz 2 (Chapters 9, 13); Feb 27 (Fri) Midterm Exam – (Chapters 8, 9, 12, 13)			
Part C - Analyzing Motion: SCALAR Approach			
8	Mar 1 – 8	Spring Break – No Classes!!	
9	Mar 9 – 13	Work & Energy in Particles (Ch. 10)	10.1-10.5: Work-Energy Principle, Power, Systems
10	Mar 16 – 20	Work & Energy in Rigid Bodies (Ch. 14)	14.1-14.4: Work-Energy Principle for Rigid Bodies
Part D - Analyzing Motion: VECTOR Approach			
11	Mar 23 – 27	Impulse & Momentum in Particles (Ch. 11)	11.1-11.6: Impulse-Momentum Principle, Collisions
Mar 25 (Wed) - Quiz 3 (Chapters 10, 14)			
12	Mar 30 – Apr 3	Impulse & Momentum in Rigid Bodies (Ch. 15)	15.1-15.4: Impulse-Momentum Theorem, Rigid Body Collisions
13	Apr 6 – 10	Vibrations (Ch. 16) – Optional Topic	16.1-16.3: Free Vibrations (Undamped & Damped)
Apr 10 (Fri) - Quiz 4 (Chapters 11, 15)			
14,15	Apr 13 – 21	Review & Catch-Up	Comprehensive Course Review
Final Exam (Comprehensive): April 23 (Thursday) – 2pm to 5pm			