ENAE 301 Dynamics of Aerospace Systems, Fall 2024

Department of Aerospace Engineering, University of Maryland
Last updated: August 27, 2024

Description

ENAE 301 is an introduction to engineering dynamics, which comprises the analysis and design of systems in motion. Newtonian methods are presented to study the motion of particles, multi-particle systems, and rigid bodies in two and three dimensions. Major topics include reference frames, coordinate systems, the free-body diagram, the vector derivative, momentum, impulse, work, and energy. Emphasis is placed on solving problems by finding the differential equations of motion of model systems and integrating these equations analytically or numerically in MATLAB.

Instructor

Professor Derek A. Paley, `dpaley@umd.edu`, Pronouns: he, him, his
Office hours (EGR 3164): Thursday 11:00 AM – 11:50 AM

Graduate Teaching Assistants

Christopher Kingsley, `cdking@umd.edu`
Office hours (EGR 3400): 3:30–4:30 Wednesdays

Ryan Mahon `rmahon1@umd.edu`
Office hours (EGR 3400): 7–8 pm Thursdays

Meetings

Lecture (ESJ 2208): Tues., Thurs. 12:30–1:45 PM, no class October 3
Recitation Sessions (JMP 2202): Fridays 1:00–1:50, 2:00–2:50, 3:00–3:50, and 4:00–4:50 PM
Midterm Exam (ESJ 2208): Thursday October 17, 12:30–1:45 PM
Final Exam (ESJ 2208): Monday December 16, 4:00–6:00 PM

Required Textbook

Kasdin & Paley, *Engineering Dynamics: A Comprehensive Introduction.* Princeton, 2011. eBook available at `https://app.knovel.com/s.v?XOlYshyl` and Errata at `http://cdcl.umd.edu/papers/kasdin-paley-errata.pdf`.

Additional Suggested References

Tongue & Sheppard, *Dynamics: Analysis and Design of Systems in Motion.* Wiley, 2005 or newer.
Meriam & Kraige, *Engineering Mechanics: Dynamics.* Wiley, 2006 or newer edition.
Rao, *Dynamics of Particles and Rigid Bodies.* Cambridge, 2006 or newer edition.

Course Materials and Grading

Whenever possible, course materials including homework assignments, discussions, and Zoom links will be made available on ELMS. All assignments and exams should be submitted online unless otherwise notified. Textbooks are on reserve in the Engineering and Physical Sciences Library. The overall course grade will be determined by performance on homework assignments (40%), a midterm exam (20%), a final exam (40%), and attendance/participation.

Course Policies

Attendance and in-class participation are an integral part of this course and are expected. Students are encouraged to discuss homework assignments, but must complete them individually. To obtain a one-week extension, contact the TA for your section by email or ELMS prior to the original deadline. Assignments will not accepted after the original or extended deadline, except with prior permission.

University Policies and Resources

Students should familiarize themselves with the university's Course Related Policies: `http://www.ugst.umd.edu/courserelatedpolicies.html`. It is your responsibility to understand your rights

and responsibilities as expressed in these policies. Topics that are addressed in these various policies include academic integrity, student and instructor conduct, accessibility and accommodations, attendance and excused absences, grades and appeals, copyright and intellectual property.

Academic Integrity

The University of Maryland, College Park has a nationally recognized Code of Academic Integrity. This Code sets standards for academic integrity at Maryland for all undergraduate and graduate students. As a student you are responsible for upholding these standards for this course. It is very important for you to be aware of the consequences of cheating, fabrication, facilitation, and plagiarism. All students are expected to be familiar with the University of Maryland's policy on academic dishonesty and the Code of Academic Integrity administered by the Student Honor Council: `http://www.president.umd.edu/policies/iii100a.html`.

Course Evaluations

Your participation in the evaluation of courses through CourseEvalUM is a responsibility you hold as a student member of our academic community. Your feedback is confidential and important to the improvement of teaching and learning at the University as well as to the tenure and promotion process. CourseEvalUM will be open for you to complete your evaluations for fall semester courses in early December. Please use the website `https://courseevalum.umd.edu`.

UMD Policy Concerning the Use of Self-Authored Course Materials

It is a basic principle of good education that an instructor should prescribe the best instructional materials available. When such materials include books, manuals, or other aids authored by the instructor of the course or by a colleague, great care must be taken to avoid even the appearance of the instructor's improperly profiting by the choice of materials. All orders of instructional materials that entail financial gain for the faculty member teaching the course must be approved by the chair of the department offering the course. The instructor and department are responsible for avoiding abuse of the practice of requiring students to buy course materials authored by the instructor.

Accommodations for Persons with Disabilities

Students who have a documented disability and wish to discuss academic accommodations, please contact the instructor as soon as possible. More information on academic accommodations for students with disabilities can be found at `https://www.counseling.umd.edu/ads`.

Values/Diversity/Inclusion Statement

This course strives to establish a classroom climate that values diverse perspectives and experiences while working toward shared academically rigorous goals. The University's Strategic Plan for Diversity: `https://issuu.com/umaryland/docs/22628`.

Basic Needs Security

Any student who has difficulty affording groceries or accessing sufficient food to eat every day, or who lacks a safe and stable place to live, and believes this may affect their performance in this course, is encouraged to speak to the instructor and/or use the following resources for support: the UMD Campus Pantry distributes emergency food to Terps in need, Counseling and mental health services, the Student Crisis Fund, and Fostering Terp Success, a program supporting students who are homeless, at risk of homelessness, currently in foster care or lacking a supportive family system. Information can be found at `http://go.umd.edu/basic-needs`.

Pronouns

The Clark School of Engineering values diversity, equity, and inclusion and aligns with the University of Maryland Non-Discrimination Policy and Procedures. `https://president.umd.edu/`

administration/policies/section-vi-general-administration/vi-100b. In this course, the facilitators recognize that not all students use their legal names or sex/gender assigned at birth. There will be opportunities in class to inform everyone of your name and pronouns, if you so choose. We are happy to use the name and/or pronouns you use. You are also encouraged to use the ELMS-Canvas tool to list your pronouns and use the name coach tool. This will update your profile for all of your ELMS-Canvas courses and organizations.

Land Acknowledgement

Every community owes its existence and strength to the generations before them, around the world, who contributed their hopes, dreams, and energy into making the history that led to this moment. Some were brought here against their will, some were drawn to migrate from their homes in hope of a better life, and some have lived on this land for more generations than can be counted. Truth and acknowledgement are critical in building mutual respect and connections across all barriers of heritage and difference. At the University of Maryland, we believe it is important to create dialogue to honor those that have been historically and systematically disenfranchised. So, we acknowledge the truth that is often buried: We are on the ancestral lands of the Piscataway People, who are among the first in the Western Hemisphere. We are on indigenous land that was stolen from the Piscataway People by European colonists. We pay respects to Piscataway elders and ancestors. Please take a moment to consider the many legacies of violence, displacement, migration, and settlement that bring us together here today.

Notice of Mandatory Reporting As a faculty member, I am designated as a "Responsible University Employee," and I must report all disclosures of sexual assault, sexual harassment, interpersonal violence, and stalking to UMD's Title IX Coordinator per University Policy on Sexual Harassment and Other Sexual Misconduct. If you wish to speak with someone confidentially, please contact one of UMD's confidential resources, such as CARE to Stop Violence (located on the Ground Floor of the Health Center) at 301-741-3442 or the Counseling Center (located at the Shoemaker Building) at 301-314-7651. You may also seek assistance or supportive measures from UMD's Title IX Coordinator, Angela Nastase, by calling 301-405-1142, or emailing titleIXcoordinator@umd.edu. To view further information on the above, please visit the Office of Civil Rights and Sexual Misconduct's website at http://ocrsm.umd.edu.

Course Outline

1. Introduction to Engineering Dynamics (1 lecture)
2. Review of Newtonian Mechanics (1 lecture)

I. *Particle Dynamics in the Plane*

3. Planar Kinematics and Kinetics of a Particle (3 lectures)
4. Linear and Angular Momentum of a Particle (2 lectures)
5. Energy of a Particle (2 lectures)

II. *Planar Motion of a Multi-Particle System*

6. Linear Momentum of a Multi-Particle System (2 lectures; **midterm**)

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7. Angular Momentum and Energy of a Multi-Particle System (2 lectures)

III. *Planar Rigid Bodies and Motion in Rotating Frames*

8. Particle Kinematics and Kinetics in Rotating Frames (2 lectures)
9. Planar Dynamics of a Rigid Body (3 lectures)

IV. *Dynamics in Three Dimensions*

10. Particle Kinematics and Kinetics in Three Dimensions (4 lectures)
11. Multi-Particle and Rigid Body Dynamics in Three Dimensions (4 lectures)