

**AE434
Rocket Propulsion
Spring 2024**

SUMMARY of Important E-Platforms for this Course

- Gradescope - <https://www.gradescope.com/> - for downloading and uploading homework and exams, post-class quizzes, and tracking your grades and performance in the course. Entry Code: EJG348
- CANVAS - <https://canvas.illinois.edu/> - for announcements and course handouts
- Media Space – <https://mediaspace.illinois.edu/channel/channelid/329302152> - lecture videos

Pre-Requisite: AE 312

Credit: 3 undergraduate hours. 4 graduate hours

Instructor: J.L. Rovey, 302B Talbot Lab, Phone: 217-300-7092, email: rovey@illinois.edu

Class Time and Location: MW, 10:00-11:20 a.m., 103 Transportation Bldg

Office hours: Weds 3-4pm in my office and on ZOOM, and Tues. 4-5pm ZOOM-only

Meeting URL: <https://illinois.zoom.us/j/88938752457?pwd=bnI4amdpQnNjWnlINGdDV2tWdzBJUT09>

Meeting ID: 889 3875 2457

Password: 834110

Teaching Assistants (all office hours on zoom and in-person):

Hussein Al-Rashdan halras3@illinois.edu Fri 2-3PM 319M Talbot

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Meeting ID: 889 3875 2457

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Course Assistant: Advait Bongu bongu2@illinois.edu - grading assistance

Course Description: Basic principles of chemical rocket propulsion and performance, rocket component design, liquid rockets, solid rocket motors, combustion processes, combustion instability.

Course Objectives:

The purpose of this course is to develop a mastery of the fundamental concepts of the mechanics and thermodynamics of propulsion devices focusing on the analysis of chemical rocket engines.

This is a Note-Intensive Class!

Much of the material is given only in lecture notes.

YOU are responsible for attending class and taking notes.

The text is important but only supplementary to the notes.

Recommended Text: Rocket Propulsion Elements, George P. Sutton & Oscar Biblarz

Other Useful References: Mattingly, Elements of Propulsion: Gas Turbines and Rockets, AIAA Education Series, Modern Compressible Flow, 3rd Edition, John D. Anderson, Mechanics and Thermodynamics of Propulsion, Philip Hill & Carl Peterson, Aerothermodynamics of Gas Turbine and Rocket Propulsion, 3rd Edition, Gordon Oates.

Grading:

Letter Grade	Score
A	93 and above
A-	90-93
B+	87-90
B	83-87
B-	80-83
C+	77-80
C	73-77
C-	70-73
D	60-70
F	<60

Weighting:

80min Midterm Exam	25%
Homework (5 assignments)	35%
3hr Final Exam	40%

There are NO make-up exams. The final exam is cumulative (it covers everything). Homework will be due at the beginning of class. Late Homework will NOT be accepted. If I cannot read it, I will not grade it. This applies to both homework & exams. Homework is available on and turned in through Gradescope.

Exams:

Exams will be in-person on the dates given in the course outline. The exam location may not be the same as the course lecture location (exact location(s) TBD). Midterm exam is 80 minutes and the final exam is max 3 hours. Exams are typically structured with a closed-book, closed-notes section first (multiple choice), followed by an open-book, open-notes section. There is no lecture class on exam days. Final Exam is cumulative, covers the entire course.

Course Schedule:*

Week	Topic	Reading
15-Jan	Introduction	
22-Jan	Rocket Analysis, Rocket Equation	O Ch. 3, M Ch. 3, HP Ch. 10
29-Jan	Multi-stage Rockets	O Ch. 3, M Ch. 3.2.4, HP Ch. 10.4
5-Feb	Thermodynamics & Conservation Eqns. Review	O Ch. 1&2, M Ch. 1&2, A 1.4 &2
12-Feb	Conservation Eqns. and Thrust Eqn	O Ch. 2, M Ch. 2, A Ch. 2
19-Feb	Combustion	M Ch. 2.11, HP Ch. 2.4
26-Feb	Combustion and Thrust Chamber Analysis	O Ch. 3, M Ch 3.4, A Ch. 5.4, S Ch. 3
MIDTERM EXAM March 6, 2024 In Class		
4-Mar	Quasi-1-D Nozzle Flow, Equilibrium/Frozen flow	O Ch. 3, M Ch 3.4, A Ch. 5.4, S Ch. 3
11-Mar	SPRING BREAK	
18-Mar	Heat Transfer	S Ch. 8.5
25-Mar	Heat Transfer	S Ch. 8.5
1-Apr	Liquid Propellant Rockets - Propellants and Thermochemistry (again)	S Ch. 5 & 7
8-Apr	Liquid Propellant Rockets - Tanks, Delivery, Pumps	S Ch. 6 & 10
15-Apr	Liquid Propellant Rockets - Injection, Nozzles, Instability	S Ch. 8 & 9
22-Apr	Solid Propellant Rockets - Fundamentals	S Ch. 12
29-Apr	Solid Propellant Rockets - Combustion, Stability, Components	S Ch. 13, 14, 15
FINAL EXAM May 10th, 2024 Location TBD 1:30-4:30 PM		

* N = Notes, O = Oates, M = Mattingly, A = Anderson, HP = Hill & Peterson, S = Sutton, Ch = chapter

Post-class Quizzes:

The post-class quiz is designed to help you raise your grade. After each lecture, I will post a short (usually 1 question) quiz on GradeScope. Each quiz will be worth 3 points. Each quiz becomes available to you immediately after class and must be completed within 24hrs. Since there are roughly 28 lectures (30 class days – 1 exam day – 1 day instructor absence = 28 lectures), you can obtain a maximum of 84 pts with the quizzes. At the end of the semester, I add these points to your earned homework points (numerator) without adjusting the total possible points (denominator). It is possible to have >100% on homework. What does this mean in terms of your final grade? Let's assume you have a 75% on every assignment and exam throughout the semester. If you got all 84 pts from the quizzes, your final grade is not 75% = C, it's 81% = B-.

4 Credit Hour Students:

Some of you may be enrolled for 4 credit hours. Students enrolled in 4 credit hours will complete 2 additional homework assignments (in addition to the 5 assignments). Your score on these additional homeworks is added to your overall earned homework points (numerator). The total possible points for these additional homeworks is also added to your total possible homework points (denominator). Therefore 4-credit and 3-credit hour students have different total possible homework points available.

Communication:

Please check your email daily. I plan to use CANVAS to post HW, handouts, announcements, etc.

<https://canvas.illinois.edu/>

Academic Dishonesty: Violations of academic integrity are unacceptable. Review the University of Illinois student code section on Academic Integrity and Procedure for more information.

<https://studentcode.illinois.edu/>

Emergency Response:

Emergency response recommendations are provided by the University of Illinois Police Department.

Review those procedures at: <http://police.illinois.edu/safe>

- <http://police.illinois.edu/safe> for more information on how to prepare for emergencies, including how to run, hide or fight and building floor plans that can show you safe areas.
- <http://emergency.illinois.edu> to sign up for Illini-Alert text messages.
- Follow the University of Illinois Police Department on Twitter and Facebook to get regular updates about campus safety

COVID:

Following University policy, all students are required to engage in appropriate behavior to protect the health and safety of the community. Students are also required to follow the campus COVID-19 protocols.

<https://covid19.illinois.edu/> Face coverings are not required in classrooms or any campus spaces.

Belonging statement:

A feeling of belonging and inclusion is critical to the success and health of our community. The Aerospace Engineering department has a committee called Aero's Space to Belong. They offer office hours, one-on-one discussion, and a reporting process. If you experience conflict that undermines your or someone else's feelings of belonging, please consider using these resources:

<https://aerospace.illinois.edu/diversity/reporting>