

# Optimal Spacecraft Trajectories (AE 508)

## Spring 2025

### Instructor

Robyn Woollands, PhD ([rmw@illinois.edu](mailto:rmw@illinois.edu))  
Assistant Professor

### Teaching Assistants

Bryan Cline

### Lectures

Monday & Wednesday 11:00am-12:20pm  
106B3 Engineering Hall  
Lectures will be recorded and posted on MediaSpace.  
Lecture slides/notes will be posted on Canvas.

### Office Hours

Monday:	Woollands	(12:20-1:15 pm CST, <b>Talbot 319M</b> & <a href="#">Zoom</a> )
Tuesday:	Bryan	(9:30-10:30 am CST, <a href="#">Zoom</a> )
Wednesday:	Woollands	(12:20-1:15 pm CST, <b>Talbot 319M</b> & <a href="#">Zoom</a> )
Thursday:	Bryan	(4:00-5:00 pm CST, <a href="#">Zoom</a> )

### Grading

Homework:	15% * 5 = 75%
Project proposal:	5%
Project report:	10%
Project presentation:	8%
Peer Evaluation:	2%

More details regarding the project proposal, project report, final presentation and peer evaluation can be found on canvas. For the peer evaluation, students will each grade about 4 other student project reports and presentations. The final project/presentation grade for each student will be weighted at 85% instructor evaluation and 15% peer evaluation.

**Homework** Official deadlines will be posted in Gradescope. Homework submitted late will be penalized at 5% per day late for the first 5 days. If the assignment is submitted any time during the first 24 hours after the deadline, the student will lose 5%, if it is submitted any time from 24-48 hours late, the student will lose 10% and so on. Assignments submitted more than 5 days late will not be graded and the student will receive a zero grade for that assignment. Students may study/discuss/work together when solving the assigned problems, but each student must submit their own work and code.

### Piazza

Piazza will be used for all class communication.

## Gradscope

Gradscope will be used for all assignments.

## Recommended Textbooks

[John E. Prussing, "Optimal Spacecraft Trajectories", Oxford University Press, 2018.](#)

[Arthur Bryson, Yu-Chi Ho, "Applied Optimal Control", Taylor and Francis Group, 1975.](#)

## Course Content

Orbital Mechanics (quick review of relevant material)  
Parameter Optimization  
State Transition Matrix  
Single-shooting, Multiple-shooting, Numerical Derivatives  
Indirect Optimization  
Indirect Optimization with Constraints  
Rocket Trajectories  
Improving a Nonoptimal Impulsive Trajectory  
Continuous-Thrust Trajectories  
Cooperative Rendezvous  
Second-Order Conditions  
Heuristic Optimization  
Special Topic Applications

## Letter Grades

98.00 – 100.00	A+
92.00 – 97.99	A
90.00 – 91.99	A-
88.00 – 89.99	B+
82.00 – 87.99	B
80.00 – 81.99	B-
78.00 – 79.99	C+
72.00 – 77.99	C
70.00 - 71.99	C-
68.00 – 69.99	D+
62.00 – 67.99	D
60.00 - 61.99	D-
below 60	F

## Academic Integrity

The University of Illinois at Urbana-Champaign Student Code should also be considered as a part of this syllabus. Students should pay particular attention to Article 1, Part 4: Academic Integrity. Read the Code at the following URL: <http://studentcode.illinois.edu/>.

## Anti-Racism and Inclusivity Statement

The Grainger College of Engineering is committed to the creation of an anti-racist, inclusive community that welcomes diversity along a number of dimensions, including, but not limited to, race, ethnicity and national origins, gender and gender identity, sexuality, disability status, class,

age, or religious beliefs. The effectiveness of this course is dependent upon each of us to create a safe and encouraging learning environment that allows for the open exchange of ideas while also ensuring equitable opportunities and respect for all of us. Everyone is expected to help establish and maintain an environment where students, staff, and faculty can contribute without fear of personal ridicule, or intolerant or offensive language. If you witness or experience racism, discrimination, micro-aggressions, or other offensive behavior, you are encouraged to bring this to the attention of the course director if you feel comfortable. You can also report these behaviors to the Bias Assessment and Response Team (BART) (<https://bart.illinois.edu/>). Based on your report, BART members will follow up and reach out to students to make sure they have the support they need to be healthy and safe. If the reported behavior also violates university policy, staff in the Office for Student Conflict Resolution may respond as well and will take appropriate action.

### **Family Educational Rights and Privacy Act (FERPA)**

Any student who has suppressed their directory information pursuant to Family Educational Rights and Privacy Act (FERPA) should self-identify to the instructor to ensure protection of the privacy of their attendance in this course. See <https://registrar.illinois.edu/academic-records/ferpa/> for more information on FERPA.

### **Disability-Related Accommodations**

To obtain disability-related academic adjustments and/or auxiliary aids, students with disabilities must contact the course instructor and the Disability Resources and Educational Services (DRES) as soon as possible. To contact DRES, you may visit 1207 S. Oak St., Champaign, call 333-4603, e-mail [disability@illinois.edu](mailto:disability@illinois.edu) or go to <https://www.disability.illinois.edu>. If you are concerned you have a disability-related condition that is impacting your academic progress, there are academic screening appointments available that can help diagnose a previously undiagnosed disability. You may access these by visiting the DRES website and selecting “Request an Academic Screening” at the bottom of the page.

### **Religious Observances**

Illinois law requires the University to reasonably accommodate its students' religious beliefs, observances, and practices in regard to admissions, class attendance, and the scheduling of examinations and work requirements. You should examine this syllabus at the beginning of the semester for potential conflicts between course deadlines and any of your religious observances. If a conflict exists, you should notify your instructor of the conflict and follow the procedure at <https://odos.illinois.edu/community-of-care/resources/students/religious-observances/> to request appropriate accommodations. This should be done in the first two weeks of classes.

### **Sexual Misconduct Reporting Obligation**

The University of Illinois is committed to combating sexual misconduct. Faculty and staff members are required to report any instances of sexual misconduct to the University's Title IX Office. In turn, an individual with the Title IX Office will provide information about rights and options, including accommodations, support services, the campus disciplinary process, and law enforcement options. A list of the designated University employees who, as counselors, confidential advisors, and medical professionals, do not have this reporting responsibility and can maintain confidentiality, can be found here: [wecare.illinois.edu/resources/students/#confidential](http://wecare.illinois.edu/resources/students/#confidential). Other information about resources and reporting is available here: [wecare.illinois.edu](http://wecare.illinois.edu).