

## Sample Syllabus

## ME 432 - Rocket Propulsion

Spring Semester 2024  
MWF 13:25-14:15 Electrical Engineering West 203

*The syllabus is subject to change. Any changes to the syllabus will be distributed in writing via email and the course Canvas website.*

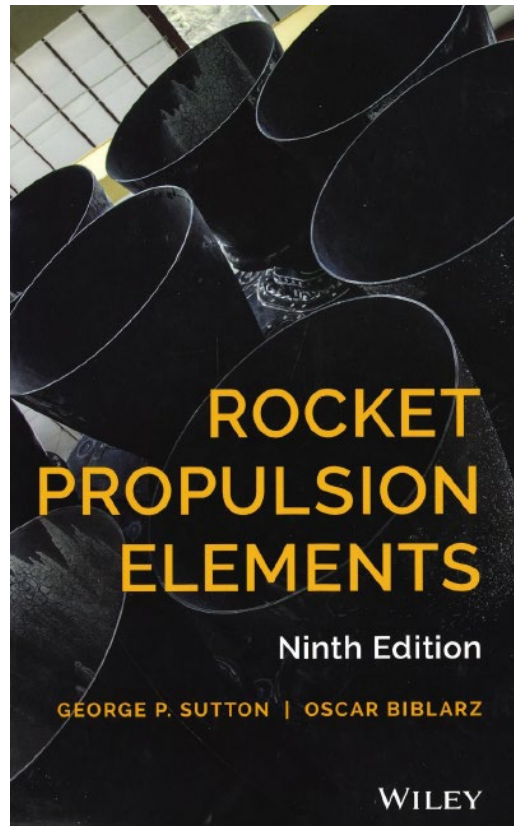
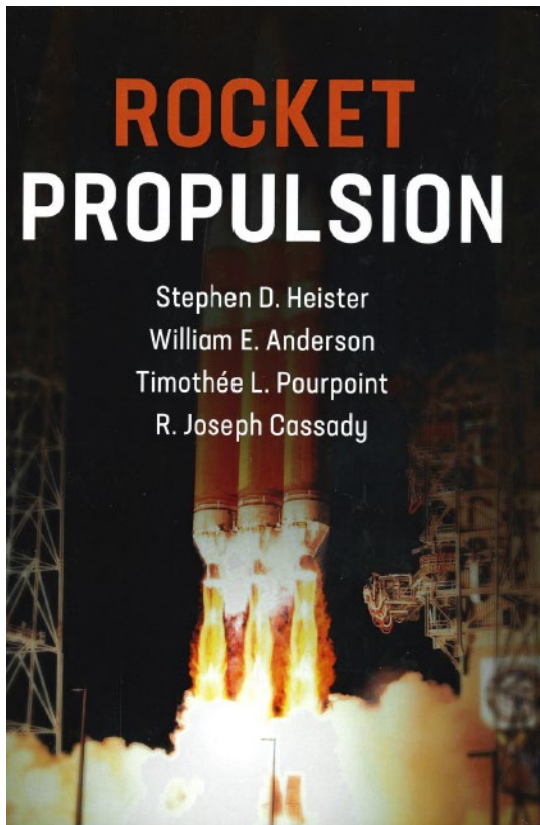
**Instructor:** Prof. Richard Yetter, 104 Research Building East, 3-6375, rayetter@psu.edu

**Course Objective:** Overview of underlying theories and design practices of chemical and non-chemical rocket propulsion systems. The topical areas include basic thermodynamics and gasdynamics, propellant formulation and characterization, component and system designs, and test evaluation.

**Course Outcome:** Fundamental knowledge, understanding, and design rules of various rocket propulsion systems, including solid, liquid, and hybrid rockets, as well as brief descriptions of electric propulsion engines.

**Text:** *Rocket Propulsion*, S.D. Heister, W.E. Anderson, T.L. Pourpoint, R.J. Cassady, Cambridge, 2019

**Reference Text:** G.P. Sutton and O. Biblarz, *Rocket Propulsion Elements*, Ninth edition, John Wiley & Sons, Inc. 2016



**Prerequisites:** ME300; M E320

**Course Outline:** Chapters indicated in bold are from *Rocket Propulsion*. Notes will also cover chapters from *Rocket Propulsion Element*. Weekly topics are tentative and can change during the semester.

Week 1	Classification and History ( <b>Chap. 1</b> ) <i>Definition and Fundamentals (Chaps. 1 and 2)</i>
Week 2	Mission Analysis Fundamentals ( <b>Chap. 2</b> ) <i>Flight Performance (Chap. 4)</i>
Week 3	Trajectory Analysis and Rocket Design ( <b>Chap.3</b> )
Week 4	Rocket Nozzle Performance ( <b>Chap. 4</b> ) <i>Nozzle Theory and Thermodynamic Relations (Chap. 3)</i>
Week 5	Combustion and Thermochemistry ( <b>Chap. 5</b> ) <i>Chemical Rocket Propellant Performance Analysis (Chap. 5)</i>
Week 6	Heat Transfer in Chemical Rockets ( <b>Chap. 6</b> )
Week 7	Solid Rocket Motors ( <b>Chap. 7</b> ) <i>Solid Propellant Rocket Motor Fundamentals (Chap. 12)</i> <i>Solid Propellants and Combustion of Solid Propellants (Chaps. 13 and 14)</i>
Week 8	Solid Rocket Motors ( <b>Chap. 7</b> ) <i>Solid Rocket Motor Components and Design (Chap. 15)</i>
Week 9	Liquid Rocket Engines ( <b>Chap. 8</b> ) <i>Liquid Propellant Rocket Engine Fundamentals (Chap. 6)</i>
Week 10	Liquid Rocket Propellants ( <b>Chap.9</b> ) <i>Liquid Propellants (Chap. 7)</i>
Week 11	<i>Thrust Chambers and Combustion of Liquid Propellants (Chaps. 8 and 9)</i>
Week 12	Rocket Turbomachinery Fundamentals ( <b>Chap 10</b> ) <i>Turbopumps and Their Gas Supplies and Engine Systems, Controls, and Integration (Chaps. 10 and 11)</i>
Week 13	Hybrid Rocket Motors ( <b>Chap 11</b> ) <i>Hybrid Propellants Rocket Propulsion (Chap. 16)</i>
Week 14	Combustion Instability ( <b>Chap 12</b> )
Week 15	Electric Propulsion ( <b>Chap 13</b> ) <i>Other Propulsion Systems [Rotating Detonation Engine, Electric Propulsion (Chap. 17), etc.]</i>

**Homework:** Due every Wednesday or specified otherwise.

<b>Grades:</b>	1st semester exam	25%
	2nd semester exam	25%
	3 <sup>rd</sup> semester (final) exam	25%
	homework	25%

<b>GRADING</b>	<b>SCALE</b>
A	93
A-	90
B+	87
B	83
B-	80
C+	77
C	70
D	60

## Evaluation

- Homework: It is expected that you solve these problems on your own; copying of problem solutions may lead to disciplinary action and obviously no credit will be given. **NO LATE HOMEWORK.**
- Exams: Exams are closed book/notes unless otherwise stated.  
**ABSENCE FROM AN EXAM:** Makeup exams will be given only under extremely unusual circumstances. A written request for a makeup exam must be presented one week (or earlier) to be excused. It is possible that the makeup exam is oral. In addition, you must apply to the Registrar for a conflict final exam.  
**GRADE APPEAL:** Within one week after returning a graded exam, you may appeal the grading by briefly describing the points of disagreement and then hand in the exam to me.  
**CHEATING ON EXAMS AND QUIZZES:** Students caught cheating will be dealt with according to University Policy.

## Class Attendance

It is required that you attend all classes. To encourage attendance, I often incorporate specific material on the Exams that has been covered during the lectures. Thus, you stand a better chance of obtaining a better grade by attending class.

## Homework Preparation

In engineering, a clear organized solution of a problem can be more important than the final numerical answer. On the job, coworkers will often review your work and an organized solution allows others to quickly understand what you have done. For a clear presentation, all important steps and assumptions must be included in the solution. A statement about the method of solution may also be included for clarity.

Engineering quality solutions are expected for all homework assignments. Both the solution presentation and the final results will be graded on homework. Each homework assignment will be equally weighted throughout the semester. The homework assignment will be graded on a scale of 0 to 100. All important steps in the solutions must be included and must be easily understood. The following guidelines should be followed when preparing homework assignments:

- Begin each problem on a new piece of paper. You can use the back side of the page to continue the problem solution if necessary.
- Briefly state the problem by indicating the unknowns to be solved.
- Draw a diagram when possible. Indicate the control volume being used.
- List all assumptions.
- Start the solution from the basic governing equations. State the equation number beside any equation from the text.
- Problems should be solved using variables. As a last step, numbers are substituted and the final numerical result is obtained. The equation with numerical values substituted must be written before the final numerical result is found. ½ point will be taken off on each problem if this step is omitted.
- Before substituting material properties, list the material name, temperature, the value of each property, and table number which was used. ½ point will be taken off on each problem where the properties and table used were not referenced.
- If a table or graph was used, state the figure number and the values of the input and output parameters.
- Include units in the final result.
- Box the final result.

## Office Hours

Professor Yetter: M & W 4–5 p.m., 104 Research East Bldg. (863-6375, e-mail: [rayetter@psu.edu](mailto:rayetter@psu.edu)). Check the syllabus during the semester for office hour changes. Please let me know in advance if you plan on attending office hours.

## **DISABILITIES**

Penn State welcomes students with disabilities into the University's educational programs. If you have a disability-related need for reasonable academic adjustments in this course, contact the Office for Disability Services (ODS) at 814-863-1807 (V/TTY). For further information regarding ODS, please visit the Office for Disability Services Web site at <http://equity.psu.edu/ods/>. In order to receive consideration for course accommodations, you must contact ODS and provide documentation (see the documentation guidelines at <http://equity.psu.edu/ods/guidelines/documentation-guidelines>). If the documentation supports the need for academic adjustments, ODS will provide a letter identifying appropriate academic adjustments. Please share this letter and discuss the adjustments with your instructor as early in the course as possible. You must contact ODS and request academic adjustment letters at the beginning of each semester.

## **LATE DROP:**

As a reminder, you may drop a course (late drop) up to Friday April 7. However, a WP (passing), WF (failing) or a WN (no grade) symbol will be entered on your academic record. Whether you obtain a WP, WF or WN will depend on your performance; usually, a 70% average on the quizzes, homework and the Exams is sufficient to obtain a WP.

## **DEFERRED GRADES:**

My concurrence of a deferred grade is given only if you cannot complete the course within the prescribed time for "reasons beyond your control". Consult policy 48-40 in "Policies and Rules for Students 2015-16" for further information.

## **ACADEMIC DISHONESTY:**

Academic dishonesty will not be tolerated at all. I hope that everyone can develop enough pride in his or her own work and abilities that this will never be a problem. When you earn an Engineering degree from Penn State, the University is certifying that you are capable of performing engineering duties at a professional level. Course grades are the sole basis on which the College of Engineering certifies your degree with the assumption that your course grades are a valid assessment of your own knowledge and abilities. If you have cheated, you have falsified that credential. Therefore, we must have academic integrity expectations to ensure the validity of your grade and your degree. It is encouraged, however, to discuss problems solving techniques with classmates in study groups and during office hours. Evidence of academic dishonesty will be dealt with by University Policy 49-20, described at: <http://www.psu.edu/ufs/policies/47-00.html#49-20>. Unauthorized use of a solutions manual is a deliberately dishonest act. For additional University & College policies on academic integrity see <http://www.psu.edu/ufs/policies> and <http://www.engr.psu.edu/CurrentStudents/acadinteg.asp>.

Academic integrity is the pursuit of scholarly activity in an open, honest and responsible manner. Academic integrity is a basic guiding principle for all academic activity at The Pennsylvania State University, and all members of the University community are expected to act in accordance with this principle. Consistent with this expectation, the University's Code of Conduct states that all students should act with personal integrity, respect other students' dignity, rights and property, and help create and maintain an environment in which all can succeed through the fruits of their efforts.

Academic integrity includes a commitment by all members of the University community not to engage in or tolerate acts of falsification, misrepresentation or deception. Such acts of dishonesty violate the fundamental ethical principles of the University community and compromise the worth of work completed by others.

## **COURSE COPYRIGHT:**

All course materials students receive or to which students have online access are protected by copyright laws. Students may use course materials and make copies for their own use as needed, but unauthorized distribution and/or uploading of materials without the instructor's express permission is strictly prohibited. University Policy AD 40, the University Policy Recording of Classroom Activities and Note Taking Services addresses this issue. For example, uploading completed labs, homework, or other assignments to any study site constitutes a violation of this policy. Students who engage in the unauthorized distribution of copyrighted materials may be held in violation of the University's Code of Conduct, and/or liable under Federal and State laws.

### **REPORTING BIAS-MOTIVATED INCIDENTS:**

Penn State takes great pride to foster a diverse and inclusive environment for students, faculty, and staff. Acts of intolerance, discrimination, or harassment due to age, ancestry, color, disability, gender, gender identity, national origin, race, religious belief, sexual orientation, or veteran status are not tolerated (Policy AD29 Statement on Intolerance) and can be reported through Educational Equity via Report Bias.

### **COUNSELING AND PSYCHOLOGICAL SERVICES:**

Many students at Penn State face personal challenges or have psychological needs that may interfere with their academic progress, social development, or emotional wellbeing. The university offers a variety of confidential services to help you through difficult times, including individual and group counseling, crisis intervention, consultations, online chats, and mental health screenings. These services are provided by staff who welcome all students and embrace a philosophy respectful of clients' cultural and religious backgrounds, and sensitive to differences in race, ability, gender identity and sexual orientation. Services include the following:

Counseling and Psychological Services at University Park (CAPS): 814-863-0395

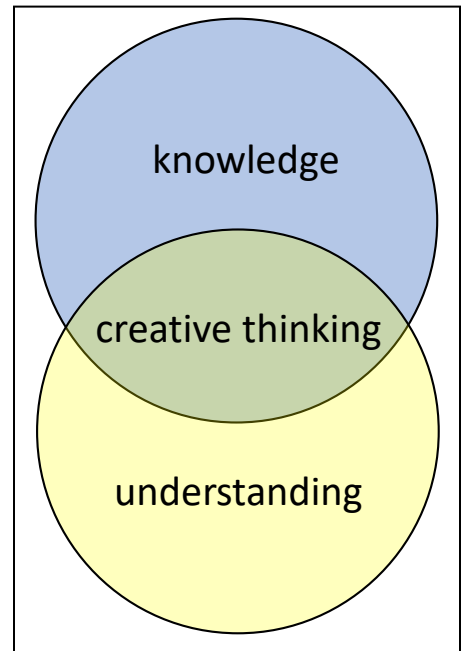
Penn State Crisis Line (24 hours/7 days/week): 877-229-6400

Crisis Text Line (24 hours/7 days/week): Text LIONS to 741741

### **STATEMENT ON ACCOMODATIONS FOR STUDENTS WITH DISABILITIES:**

Penn State welcomes students with disabilities into the University's educational programs. Every Penn State campus has an office for students with disabilities. The Office for Disability Services (ODS) Web site provides contact information for every Penn State campus: <http://equity.psu.edu/ods/dcl>. For further information, please visit the Office for Disability Services Web site: <http://equity.psu.edu/ods>. To receive consideration for reasonable accommodations, you must contact the appropriate disability services office at the campus where you are officially enrolled, participate in an intake interview, and provide documentation: <http://equity.psu.edu/ods/doc-guidelines>. If the documentation supports your request for reasonable accommodations, your campus's disability services office will provide you with an accommodation letter. Please share this letter with your instructors and discuss the accommodations with them as early in your courses as possible. You must follow this process for every semester that you request accommodations. Penn State welcomes students with disabilities into the University's educational programs. Every Penn State campus has an office for students with disabilities. Student Disability Resources (SDR) website provides (<http://equity.psu.edu/sdr/disability-coordinator>). For further information, please visit Student Disability Resources website (<http://equity.psu.edu/sdr/>). In order to receive consideration for reasonable accommodations, you must contact the appropriate disability services office at the campus where you are officially enrolled, participate in an intake interview, and provide documentation: See documentation guidelines (<http://equity.psu.edu/sdr/guidelines>). If the documentation supports your request for reasonable accommodations, your campus disability services office will provide you with an accommodation letter. Please share this letter with your instructors and discuss the accommodations with them as early as possible. You must follow this process for every semester that you request accommodations.

*There is a difference between knowing something and understanding it. Those who “know” make good Jeopardy contestants and those who “understand” become the creative thinkers—engineers, scientists, professors, active business people, and others—who create the most for society.*



### The Prophet by K. Gibran, 1923

#### On teaching

*No man can reveal to you aught but that which already lies half asleep in the dawning of your knowledge.*

*If he (the teacher) is wise he does not bid you to enter the house of his wisdom but leads you to the threshold of your mind.*

*The astronomer may speak to you of his understanding of space, but he cannot give you his understanding.*

*And he who is versed in the science of numbers can tell of the regions of weight and measures, but he cannot conduct you hither.*

*For the vision of one man lends not its wings to another man.*