MECH 4395 – Special Topics in Aerospace Propulsion

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Office Hours MW 1:30-3:00 or by appointment
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Course description:
This special topics in aerospace propulsion course will teach you the basics of a wide variety of propulsion systems used in aerospace applications, including air-breathing engines, rotors, rockets, chemical thrusters, electric thrusters, nuclear concepts, and non-propellant and other advanced propulsion concepts. You will be introduced to propulsion system design and testing, vehicle integration of propulsion systems, and mission-based propulsion system selection.

The course structure consists of

1) Lecture style classes to introduce topics and theory
2) Tutorial style classes introducing worked examples and problem solving
3) Homework assignments that build on the class and tutorial content to let you demonstrate your developing knowledge of the subject material
4) Take home exams and projects that build on in-class examples and homework assignments to let you demonstrate your new mastery of the subject material

While you may not currently be familiar with many aerospace propulsion systems and how they work, if you regularly attend lectures, review the material afterwards, and put some effort into the assigned homework problems, you will be by the end of the course!

Course outcomes:
By the end of this course, you should be able to:

1) Compare variations in propulsion system designs for atmospheric and in-space aerospace applications
2) Differentiate methods for converting stored energy to momentum
3) Evaluate propulsion system designs in regards to mission selection
4) Analyze how propulsion systems affect other aerospace vehicle subsystems
**Prerequisites:**
None, but a fundamental understanding of chemical reactions, gas dynamics, and thermodynamics will aid in comprehension of the course material.

**Follow-on Courses (optional):**
N/A

**Textbooks and Other Useful References:**
There is no required textbook for this course; all required materials will be provided. However, you may find the below references useful for deeper understanding or alternate presentation of the course material.

**Air-Breathing Propulsion**
  - Fundamental concepts, broad system overviews. Excellent starter book.
  - Advanced concepts and parametric analysis for in-depth analysis

**Rockets**
  - Best worked examples, especially for engine design
  - Most thorough treatment of all system components

**Electric Propulsion**

**Nuclear Propulsion**

**General Aerospace Materials with Propulsion Sections**
Course Topics:
The following topics will included in this class.

1 History  Historical development of aerospace propulsion systems and concepts
2 Propellers  Blade design, piston engines, electric motors, performance and efficiency
3 Turbines  Turbine engines, components, thermodynamic cycles, converging nozzle theory, thermochemistry, afterburners
4 Hypersonic Engines  Ramjets, scramjets, supersonic and hypersonic flow regimes, shock trains, diverging nozzles,
5 Rockets  Rocket equation, de Laval nozzles, solid rockets, liquid rockets, hybrid rockets, turbomachinery, rocket staging
6 Chemical thrusters  In-space maneuvering, cold gas thrusters, warm gas thrusters
7 Electric Propulsion  Plasma, charged particle motion, electrostatics, electrothermal propulsion, electrostatic propulsion, electromagnetic propulsion
8 Nuclear Propulsion  Nuclear Electric, Nuclear Thermal, Nuclear Ramjets, Environmental Consideration, Safety and Ethics
9 Field Propulsion  Solar sails, Directed energy, Solid-state air-breathing, latest developments in aerospace propulsion
10 Selection  Mission specific selection, sizing, integration, testing

Assessment and Grading:
The following breakdown of assessable items will be used to determine your final grade. For more information and dates related to assessable items, refer to the schedule and Blackboard.

- Quizzes – 30%
- Air Breathing Project – 20%
- Rockets Project – 20%
- Nuclear Project – 10%
- Space Mission Project – 20%

Through this course ALL assessment items will be graded as follows:
- Half the points are for your technical answer - the working
- Half the points are for your accompanying description - the process

Overall grades will be awarded based on the following scale:

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<thead>
<tr>
<th>Grade Scale</th>
<th>Grade</th>
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<tbody>
<tr>
<td>100-90%</td>
<td>A</td>
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<tr>
<td>89-80%</td>
<td>B</td>
</tr>
<tr>
<td>79-70%</td>
<td>C</td>
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<tr>
<td>69-60%</td>
<td>D</td>
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<td>&lt;60%</td>
<td>F</td>
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</tbody>
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Extension Requests and Assessment Excusals
Extensions for assessable item due dates, and excusal for assessable activities or exams
will only be granted for University approved reasons as outlined in the catalog. These include participation in University-recognized activities, Religious Holy days, Military Leave. http://catalog.utep.edu/undergrad/academic-regulations/curriculum-and-classroom-policies/

**Attendance and Participation:**
Attendance in class is not required, but is strongly encouraged. Occasionally there will be assessable items in-class that require attendance. You will be notified of these in advance. Those seen regularly attending class will receive priority during office hours. Participation in class discussions and activities is expected as this is part of the learning process.

**Inclusion**
My goal for the classroom is to have an engaging, intellectual, and safe learning environment. I aim to foster communication and discussion and due to the diversity of individual beliefs, backgrounds, and experiences, I expect every member of this class (myself included) to show respect for every other member of this class. If you feel that you are not being respected in this course or our department in anyway, please come see me, another mechanical faculty/staff member, or the Student Engagement and Leadership Center.

**Course Communication:**
Relevant course information will periodically be sent to the entire class via your UTEP email address. Please be sure to check your email on a regular basis.

All course content, assessment details, announcements, and other course information will be available on the Blackboard course page. Please make Blackboard your first stop for course information, and be sure to check it regularly for updates.

Please post your questions regarding the course material and assessment on the forums provided on Blackboard. I will do my best to answer your questions within one working day of the post. Questions about course content asked through email will not be answered.

Please use only in-person or email interaction for questions on grading and/or personal issues. Do not post these to the forums on Blackboard, I will do my best to answer your questions within one working day of the email.

**University Support Services:**
The following services are just some of many offered by the department and UTEP. Please make use of them to improve your educational experience.

**ACES & Tutoring Center:**
Please note there are tutoring services available in the ACES center. Tutoring is provided free to you by the Department. If tutors are not used, the Department may stop funding them. Check the schedule of the tutors and make use of the services. For more details visit ME Advising
Blackboard -> cc mech acadav: MECH Academic Advising -> Tutoring & Resources. At the link you can find tutor schedules, location of the ACES center and the list of tutors available. For more information send email to METutors@utep.edu

Reasonable Accommodation Policy:  
If you have a disability and need classroom accommodations, please contact the Center for Accommodations and Support Services (CASS) at 747-5148, or by email to cass@utep.edu, or visit their office located in UTEP Union East, Room 106. For additional information, please visit the CASS website at www.sa.utep.edu/cass.

Mental Health Concerns  
A recent American College Health Survey found stress, sleep problems, anxiety, depression, interpersonal concerns, death of a significant other and alcohol use are among the top ten health impediments to academic performance.

The University of Texas at El Paso (UTEP) offers students, including veterans and active duty, a wide range of mental-health related resources on and off campus. The on campus resources include counseling and treatment when there is a need, to support for recovery. For a list of all support services available visit https://www.utep.edu/student-affairs/resources/Mental-Health-Resources-for-UTEP-Students.html

Course and University Policies:  
Complete University academic policies and regulations can be found In the UTEP catalog. http://catalog.utep.edu/undergrad/academic-regulations/

Academic Integrity  
The University of Texas at El Paso prides itself on its standards of academic excellence. In all matters of intellectual pursuit, UTEP faculty and students must strive to achieve excellence based on the quality of work produced by the individual. In the classroom and in all other academic activities, students are expected to uphold the highest standards of academic integrity. Any form of academic dishonesty is an affront to the pursuit of knowledge and jeopardizes the quality of the degree awarded to all graduates of UTEP. It is imperative, therefore, that the members of this academic community understand the regulations pertaining to academic integrity and that all faculty insist on adherence to these standards.

Any student who commits an act of academic dishonesty is subject to discipline. Academic dishonesty includes, and is not limited to cheating, plagiarism, collusion, the submission for credit of any work or materials that are attributable in whole or in part to another person, taking an examination for another person, and any act designed to give unfair advantage to a student or the attempt to commit such acts. Proven violations of the detailed regulations, as printed in the Handbook of Operating Procedures (HOP), and available in the Office of Student Life and on the homepage of the Office of Student Life at www.utep.edu/dos, can result in sanctions ranging from disciplinary probation, to a failing grade on the work in question, to a failing grade in the course, to suspension or dismissal, among others.
While I encourage collaboration between students in order to understand the course material, assignments submitted for grading MUST be done by each student independently.

Inappropriate collaboration (also known as cheating) includes:

- Using all or parts of assignments, exams, or projects from this year or any previous year that were not created by you personally;
- Talking, passing information, or using inappropriate materials during an in-class exam.

Anyone found to be participating in inappropriate collaboration may be immediately failed from the course and subject to disciplinary action.

You must show your work for all problems submitted for grading. The instructor may require you to explain how you solved a problem on an assessable item at any time after submission. If you refuse or cannot explain your work you may be subject to disciplinary action.

If you are suspected of scholastic dishonesty you may or may not be directly confronted about your conduct by the instructor or proctor. You will however, be reported to the Office of Student Conduct and Conflict Resolution (OSCCR). Your grade in the class may not be available until OSCCR makes a final ruling, this may adversely impact your ability to enroll in other classes.

**Harassment Policy**

The University (see Handbook of Operating Procedures 1.2.2.4) has a zero-tolerance policy for harassment. Engagement in any behavior considered harassment will be reported to the proper authorities. In addition to generally understood forms of harassment, the department also treats the following behavior as harassment:

- Repeated emails and/or calls regarding subjects that have already been addressed. Once a decision has been made or a question answered, a student who continues to ask the same question will be given a warning by the recipient of the email/call. If the student continues, the behavior will be reported. Questions that seek understanding of course material are not harassment; but repeated questions about a grade or an administrative decision are.
- Grades are NOT negotiable, ever. If you believe a grading mistake has been made, you must follow the process described in the UTEP catalog. Any request for a grade elevation that is NOT based on a mistake is considered harassment and will be reported immediately.
- Remaining in an office after the occupant requests you leave is considered harassment and potentially threatening. You will be reported immediately without warning and depending on the severity, may be reported to law enforcement.
- Similar behavior towards department staff, and student advisors will also be treated as harassment, including persistent phone calls, emails, and badgering. Department staff and student advisors are there to help students, and should be treated with due respect.
Student Conduct
While enrolled at the University, a student neither loses the rights nor escapes the responsibilities of citizenship. Any student who engages in conduct that is prohibited by the Board of Regents' Rules and Regulations or University rules or by federal, state, or local law is subject to discipline whether such conduct takes place on or off campus or whether civil or criminal penalties are also imposed for such conduct. All students are expected and required to obey the law, to show respect for properly constituted authority, and to observe correct standards of conduct.

The University of Texas at El Paso administers student discipline according to established procedures of due process. Procedures are defined and described in the Rules and Regulations of the Board of Regents, Rule 50101, and in the Handbook of Operating Procedures (HOP). Students should check with appropriate departments whose policy or regulation is of concern. If necessary, students need to refer to the rules in the Regents' Rules and Regulations (http://www.utsystem.edu/bor/rules) and the HOP. The Office of Student Life can assist on this matter. This set of rules is available at https://www.utep.edu/vpba/hoop/.

Family Educational Rights and Privacy Act (FERPA)
The Family Educational Rights and Privacy Act (FERPA), 20 U.S.C. §1232g and the Texas Public Information Act, Texas Government Code, § 552.001, et seq., are federal and state laws that provide students the following rights with respect to their student educational records. The University of Texas System and The University of Texas at El Paso have implemented a student records policy that adheres to these laws. For more information regarding the University’s implementation of these laws, please review the Handbook of Operating Procedures.