



# Syllabus for MECH 5334/6334: Space System Design

## Instructor

Dr. Afroza Shirin (ashirin@unm.edu)

Policy: Open Door

Office Hours:

- Face-to-Face/Office hours: Tuesday and Thursday: 2 PM – 3 PM  
Monday and Wednesday: 3 PM – 4 PM
- Virtual: By Appointment

Office Location: Engineering Building, Room A315

## Course Information

Time: Monday and Wednesday, 4 pm-5:20 am

Location: College of Business Admin 302

Prerequisites: Aerodynamics, Compressible Flow, CFD, Heat Transfer

## Course Description

The course will describe the following key areas of Space System Design

- Classifications of space systems based on mission and propulsion system.
- Current Status, challenges, failures, and possible causes of Space systems
- Understand the space vehicles' aerodynamics flow features and aerothermodynamic heating and learn the methods to characterize the properties.
- Rocket Staging and Space Payload Design and Sizing
- Space Mission Geometry and Orbit Manuvering
- Some flight control of space vehicle dynamics
- Material Choices for Space Vehicles

## Course Objectives

### 1. Introduction to Hypersonic Vehicles

- Understanding the types of hypersonic vehicles based on mission and propulsion system.
- Science and technological challenges to understand aerothermodynamics, structure and propulsion design issues.
- Historical disasters and failures and the possible causes
- Current status of the space vehicle research, capability of ground testing and sustainable flight demonstration

### 2. Aerothermodynamics

- Understand the aerodynamic flow features of space vehicles and learn the methods to characterize their properties.
- Understand the sources of aerodynamic heating and learn the methods to demonstrate the surface heating
- Understand chemically reacting boundary layer for re-entry vehicles
- CFD solutions for hypersonic flow simulation



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- Open-ended design project development on space vehicles aerodynamics analysis in STAR-CCM+.
  - Open-ended design project development on space vehicles heat transfer analysis in STAR-CCM+
- 3. Flight Dynamics and Control**
- Understand basic flight dynamics and control
  - Learn mission-based hypersonic flight
  - Development of hypersonic flight control from general flight control
- 4. Extreme Environmental Material Choices**
- Understand the definition of ‘extreme environment’
  - The properties of the materials required for the design and analysis for the hypersonic/reentry vehicle
  - A list of materials suitable for this purpose with details of their material properties
  - How to modify the materials' internal structure to enhance properties
  - What measures should be taken to take care of the main deterioration (oxidation) of the material
  - Behavior of composite materials and how different components of the composite affects the overall performance of the material
- 5. Space Propulsion**
- Different types of propulsion
  - Rocket nozzle design
  - High-Speed Wind Tunnel Design

### Course Materials

- There is no required textbook for this course; all required materials will be provided. Book chapters and articles will be provided along with the lectures.

### Grading

The final grade will be computed via the following weighting:

- 30% Surprise quizzes, attendance, class participation & HWs
- 35% Project 1 and Report
- 35% Project II Project and Report
- Extra Credit: Extreme material properties need to be incorporated in the projects

**A (100-90): B (89-80): C (79-70): D (69-60): F (59 and Below)**

**Exams:** There will be two take-home exams. The exam grades will be calculated based on the total test scores. A makeup exam will be provided in case of a documented emergency.

**Homework:** All homework assignments will be through Blackboard.

**Lectures: Slides and Reading Material will be uploaded to the Blackboard and OneNote.**

**Quizzes:** The quizzes will be given in class. No makeup quizzes.

**Class Participation and Attendance:** An 80% attendance is required.



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## TECHNOLOGY REQUIREMENTS

The course content is delivered via the Internet through the Blackboard learning management system. Ensure your UTEP email account is working and you have access to the Web and a stable web browser. Google Chrome and Mozilla Firefox are the best browsers for Blackboard; other browsers may cause complications. When having technical difficulties, update your browser, clear your cache, or try switching to another browser.

You will need to have access to a computer/laptop. You will need to download or update the following software: Microsoft Office, Adobe Acrobat Reader, Windows Media Player, QuickTime, and Java. Check that your computer hardware and software are up-to-date and able to access all parts of the course.

If you do not have word-processing software, you can download Word and other Microsoft Office programs (including Excel, PowerPoint, Outlook, and more) for free via UTEP's Microsoft Office Portal. Click the following link for more information about [Microsoft Office 365](#) and follow the instructions.

**IMPORTANT:** If you encounter technical difficulties beyond your scope of troubleshooting, please contact the UTEP [Help Desk](#), as they are trained specifically in assisting with technological needs of students. Please do not contact me for this type of assistance. The Help Desk is much better equipped than I am to assist you!

## SOFTWARE REQUIREMENTS

- **Matlab:** <https://www.mathworks.com/academia/tah-portal/university-of-texas-at-el-paso-40735445.html#get>.
- **StarCCM+/ANSYS**

Refer to ETC for specific questions. Engineering building E351D (915) 747-5131.

## ATTENDANCE AND PARTICIPATION

Our class meetings are in person at the designated location mentioned above. **An 80% of attendance is required.** Attendance in the course is determined by participation in the course's learning activities. Your participation in the course is important not only for your learning and success but also to create a community of learners. Participation is determined by the completion of the following activities:

- Reading/Viewing all course materials to ensure understanding of assignment requirements
- Participating in class tasks and engaging in discussions with your peers
- Other activities are indicated in the weekly modules or as indicated by the instructor for daily or weekly class participation.

**Because these activities are designed to contribute to your learning each week, they cannot be made up after their due date has passed.**

## ILLNESS PRECAUTIONS



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Please stay home if you have symptoms of a communicable illness. If you feel unwell, please let me know as soon as possible so we can work on appropriate accommodation.

### **EXCUSED ABSENCES AND/OR COURSE DROP POLICY**

According to UTEP Catalog, "At the discretion of the instructor, a student can be dropped from a course because of excessive absences or lack of effort. A grade of "W" will be assigned before the course drop deadline and a grade of "F" after the course drop deadline." See Policies and Regulations in the UTEP Undergraduate Catalog for a list of excuse absences. Therefore, if I find that, due to non-performance in the course, you are at risk of failing, I will drop you from the course. I will provide 24-hour advance notice via email.

#### **OR**

I will not drop you from the course. However, if you feel that you are unable to complete the course successfully, please let me know and then contact the [Registrar's Office](#) to initiate the drop process. If you do not, you are at risk of receiving an "F" for the course.

### **MAKEUP WORK**

Makeup work will be given *only* in the case of a *documented* emergency. Note that makeup work may be in a different format than the original work, may require more intensive preparation, and may be graded with penalty points. If you miss an assignment and the reason is not considered excusable, you will receive a zero. It is therefore important to reach out to me—in advance if at all possible—and explain with proper documentation why you missed a given course requirement. Once a deadline has been established for makeup work, no further extensions or exceptions will be granted.

### **ALTERNATIVE MEANS OF SUBMITTING WORK IN CASE OF TECHNICAL ISSUES**

I strongly suggest that you submit your work with plenty of time to spare in the event that you have a technical issue with the course website, network, and/or your computer. I also suggest you save all your work (answers to discussion points, quizzes, exams, and essays) in a separate Word document as a backup. This way, you will have evidence that you completed the work and will not lose credit. If you are experiencing difficulties submitting your work through the course website, please contact the UTEP Help Desk. You can email me your backup document as a last resort.

### **INCOMPLETE GRADE POLICY**

Incomplete grades may be requested only in exceptional circumstances after you have completed at least half of the course requirements. Talk to me immediately if you believe an incomplete is warranted. If granted, we will establish a contract of work to be completed with deadlines.

### **ACCOMMODATIONS POLICY**

The University is committed to providing reasonable accommodations to students with documented disabilities. Students who become pregnant may also request reasonable accommodation, in accordance with state and federal laws and regulations and University policy. Accommodations that constitute undue hardship are not reasonable. To make a request, please



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register with the UTEP Center for Accommodations and Support Services (CASS). Contact CASS at 915-747-5148, email them at [cass@utep.edu](mailto:cass@utep.edu), or apply for accommodations online via the CASS portal.

### SCHOLASTIC INTEGRITY

Academic dishonesty is prohibited and is considered a violation of the UTEP Handbook of Operating Procedures. It includes, but is not limited to, cheating, plagiarism, and collusion. Cheating may involve copying from or providing information to another student, possessing unauthorized materials during a test, or falsifying research data on laboratory reports. Plagiarism occurs when someone intentionally or knowingly represents the words or ideas of another as ones' own. Collusion involves collaborating with another person to commit any academically dishonest act. Any act of academic dishonesty attempted by a UTEP student is unacceptable and will not be tolerated. All suspected violations of academic integrity at The University of Texas at El Paso must be reported to the Office of Student Conduct and Conflict Resolution (OSCCR) for possible disciplinary action. To learn more, please visit [HOOP: Student Conduct and Discipline](#).

### GUIDANCE ON ARTIFICIAL INTELLIGENCE

#### AI prohibited

Use of A.I. technologies or automated tools, particularly generative A.I. such as [ChatGPT](#) or [DALL-E](#), is ***not allowed*** for assignments in this class. Each student is expected to use critical and creative thinking skills to complete tasks and not rely on computer-generated ideas. Any direct use of AI-generated materials submitted as your own work will be treated as plagiarism and reported to the Office of Student Conduct and Conflict Resolution (OSCCR).

#### A.I. allowed with proper acknowledgement

Use of A.I. technologies or automated tools, particularly generative A.I. such as [ChatGPT](#) or [DALL-E](#), is ***only allowed with proper attribution given for its use***.

Students must properly cite and give full credit to the program used upon submission of every relevant assignment. For example, text generated using ChatGPT must be cited:

Chat-GPT(version). Date of query (year/month/day). "Text of your query."

Generated using OpenAI. <https://chat.openai.com/>

A short paragraph describing how the tool(s) was/were used for the assignment must be included.

#### Using AI for brainstorming

Some AI technologies or automated tools, particularly generative AI such as [ChatGPT](#) or [DALL-E](#), can be beneficial during the early brainstorming stages of an activity, and you are welcome to explore them for that purpose. However, keep in mind that AI-generated ideas are not your own and may hinder your ability to think critically and creatively about a problem. It is also important to remember that these technologies often “hallucinate” or produce materials and information that are inaccurate or incomplete—even providing false citations for use.



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That said, you are not allowed to submit any AI-generated work in this course as your own. If you use any information or materials created by AI technology, you are required to cite it like you would any other source. Consider how this will affect your credibility as a writer and scholar before doing so. Any direct use of AI-generated materials submitted as your own work will be treated as plagiarism and reported to the Office of Student Conduct and Conflict Resolution (OSCCR).

### **ACES & Tutoring Center from the College of Engineering**

Please note there are tutoring services available in the ACES center.

<https://www.utep.edu/engineering/student-resources/student-resources-aces-tutoring.html>