

Course ID and Title: AME-599 Sustainable Aerospace

Units: 4

Term—Day—Time: Fall 2024 – M & W 2:00 – 3:50 pm

Location: [TBD]

Instructor: Dr. Marty Bradley

Office: None or shared office space TBD

Office Hours: 1 hour after each class. 1 hour Zoom office hour on Friday

Contact Info: mbradle@usc.edu (best), (310) 600-3419, class Piazza

Teaching Assistant: None. Grader is TBD depending on enrollment.

Catalogue Description

Developments in sustainable aviation and spaceflight. Energy and fuel options, space debris mitigation, and the environmental impact of aviation, rocket launches, and space debris reentries.

Course Description

This course presents the history and current developments in the field of sustainable aerospace, covering both aviation and space topics. Topics will include alternative fuels (biofuels, synthetic fuels, methane, alcohols, and hydrogen), electric and hybrid electric aircraft, lifecycle environmental impact and analysis, space debris, the environmental impact of rocket launches and space debris reentry, and aerospace technology based ideas to mitigate climate change. The advantages and challenges of each type of potential sustainable aerospace technology will be discussed, evaluated, and compared.

The target audience for this course is undergraduate and graduate students with an interest or background in aerospace engineering or sustainable energy who want to learn about sustainable aviation and spaceflight.

Learning Objectives

The course is intended to familiarize students with the history of sustainable aerospace and provide them with up-to-date sources of information on various aspects of sustainable aviation and the space industry.

By the end of the course students will:

- be able to quantitatively compare aircraft with various technologies that may make aviation more sustainable;
- be able to qualitatively compare advantages and challenges of implementing these various technologies in aircraft, as well as the supporting aviation and energy infrastructure;
- understand the challenges related to space debris and possible interactions with climate change and mitigation schemes
- understand the magnitude of the environmental impact of the increased number of rocket launches with different propellants; and
- demonstrate that they can document study results in a professional presentation format.

Prerequisite(s): None

Co-Requisite(s): None

Concurrent Enrollment: None

Recommended Preparation: Courses in aerospace, astronautics, energy, chemistry, or environmental engineering. Courses in aircraft performance, propulsion, or orbital mechanics are NOT required but would be helpful.

Course Notes

The course will be letter graded and is designed for in-person instruction. Brightspace will be used for distribution of assignments and posting of lecture material. Piazza will be available for discussions outside of class.

Technological Proficiency and Hardware/Software Required

Students are required to have access to a laptop computer with a Brightspace and Piazza-compatible browser, the Microsoft Office suite (PowerPoint, Excel), Zoom, and the tools needed to read and write PDF files.

While not mandatory, students may also utilize other software such as:

- products compatible with Microsoft Office
- MATLAB
- Computer Aided Design (CAD) products
- RDS-Student or any other aircraft performance or design software

It is important to emphasize that use of this other software is neither required nor expected, and all work can be completed using only the required software.

If needed, please refer to additional information for software support and availability with these USC Technology Support Links: [USC Computing Center Laptop Loaner Program](#), [Zoom information for students](#), [Blackboard help for students](#), [Software available to USC Campus](#).

Required Readings and Supplementary Materials

The instructor will provide downloadable material in advance of each lecture. Students will need to refer to this material throughout the class and it will also be needed to complete the final project. Students should review any materials designated as “backup material” as well as any material that was not covered during the class due to time constraints.

Optional Readings and Supplementary Materials

Although not required, students may find these textbooks helpful:

- Farokhi, “Future Propulsion Systems and Energy Sources in Sustainable Aviation”, Wiley, 2020.
- Raymer, “Aircraft Design: A Conceptual Approach, Sixth Edition”, AIAA, 2018.
- Filippone, “Advanced Aircraft Flight Performance, Including Environmental Performance”, Second Edition, AIAA, 2022.
- Anderson, “Introduction to Flight”, Ninth Edition, McGraw Hill, 2021. (any edition is OK)
- Sutton, G and O. Biblarz, “Rocket Propulsion Elements”, 9th edition.

Description of Assignments and How They Will Be Assessed

There are four different types of assignments in this course: “In the News” article summaries, homework assignments, a mid-semester project, and a Final Project Presentation. Each is described briefly below:

- “In the News” article summaries require the students find recent or historical press, media, or technical publications about the required sustainable aerospace technology and summarize it in a single PowerPoint slide suitable for an oral briefing to the class. The slide must contain the following elements: Title, date, author, source, illustration, bullet point summary, relevance to the class. Grading will be based on the inclusion of all required elements. Students will be randomly selected to present their briefing during class. While the briefing itself will not be part of the grade, students may not receive credit for an article if they are not in class and are selected to discuss it.

- Homework Assignments are designed to demonstrate understanding of the lecture material and the ability to make correct quantitative calculations. Grading will be based on completing all required elements including making reasonable assumptions, performing accurate calculations, interpreting numerical results, and forming a conclusion.
- Mid-Semester Project will use the Boeing Cascade Sustainable Aviation Tool (available to the public) to allow each student to make their own projections about the application and effectiveness of various sustainable aviation technologies discussed in the first half of the class. Each student will develop their own independent Mid-Semester Project presentation slides. The slides will be used to measure that the student has mastered the material in the first half of the course. The slides will also demonstrate the student's ability to document their work in a format typical of industry and academia. Grading will be based on completing all required sections in the required format, making reasonable assumptions, interpreting numerical results, and forming a conclusion and recommendation.
- Final Project will be done during the last four weeks of the course and each week will focus on a different aspect of the project. Each student will have a different topic for the project and develop their own independent Final Project Presentation. The presentation will be used to measure that the student has mastered the material in the course and can use it compare specific sustainable aerospace technologies in a quantitative and consistent way, while also understanding energy infrastructure considerations. The presentation will also demonstrate the student's ability to document their work in a format typical of industry and academia. Grading will be based on completing all required sections in the required format, making reasonable assumptions, performing accurate calculations, interpreting numerical results, and forming a conclusion and recommendation.

Participation [if applicable]

Students are expected to actively participate in in-class discussions. There is no "participation" grade; however, students should be prepared to discuss their "In the News" assignments in class. One or more students will be randomly called upon to brief the class on their particular summarized article, and failure to be in attendance may result in a zero score for that "In the News" assignment.

Grading Breakdown

The grading breakdown is listed in the table below. Some homework assignments will receive slightly higher or lower weighting (compared to the other homework assignments) due to the anticipated effort needed for the assignment.

Table 1 Grading Breakdown

Assessment Tool (assignments)	Number	% of Grade
In the News Articles	10	15
Homework Assignments	8	40
Mid-Semester Project Slides	1	15
Final Project Presentation	1	30
TOTAL		100

Grading Scale

Course final grades will be determined using the following scale:

Table 2 Course Grading Scale

Letter grade	Corresponding numerical point range
A	93-100
A-	90-92
B+	87-89
B	83-86
B-	80-82
C+	77-79
C	73-76
C-	70-72
D+	67-69
D	63-66
D-	60-62
F	59 and below

The instructor has the option to make minor adjustments to the numerical ranges to ensure an appropriate distribution of student grades.

Assignment Submission Policy

Assignments will be submitted using Brightspace.

Course-Specific Policies

- Each student is allowed to turn in one “In the News” assignment late (before the end of the scheduled final exam time). Note that this policy does not eliminate the penalty associated with absence from class on the day you were selected to present your summary in front of the class. If the late assignment is one you were selected to present to the class on a day you were absent, you may still be assigned a 0 for that particular assignment.
- Each student is allowed to turn in one “Homework” up to 3 days late.
- Otherwise, late assignments are not accepted without a documented medical excuse or prior permission from the instructor.

Attendance

Attendance in all lectures is expected. Although attendance will not be taken, students should always be prepared to discuss their “In the News” assignments in class since one or more students will be randomly called upon, and failure to be in attendance will result in a zero score for that “In the News” assignment.

Students may ask to be excused from class in advance for valid medical, religious, or University-related travel reasons and request instructions for making up the missed class.

Academic Integrity

Unless otherwise noted, this course will follow the expectations for academic integrity as stated in the [USC Student Handbook](#). The general USC guidelines on Academic Integrity and Course Content Distribution are provided in the subsequent “Statement on Academic Conduct and Support Systems” section.

Collaboration: In this class, you are expected to submit work that demonstrates your individual mastery of the course concepts.

Group work: Unless specifically designated as a ‘group project,’ all assignments are expected to be completed individually.

Computer programs: Plagiarism includes the submission of code written by, or otherwise obtained from someone else.

If found responsible for an academic violation, students may be assigned university outcomes, such as suspension or expulsion from the university, and grade penalties, such as an “F” grade on the assignment, exam, and/or in the course.

Please ask the instructor if you are unsure about what constitutes unauthorized assistance on an assignment, or what information requires citation and/or attribution.

You may not record this class without the express permission of the instructor and all other students in the class. Distribution of any notes, recordings, exams, or other materials from a university class or lectures — other than for individual or class group study — is prohibited without the express permission of the instructor.

Use of Generative AI in this Course

Generative AI permitted but limited as follows: In this course, you are permitted to use artificial intelligence (AI)-powered programs to help you, but only on assignments that explicitly indicate a permitted use of AI. However:

- You should also be aware that AI text generation tools may present incorrect information, biased responses, and incomplete analyses; thus, their answers may not meet the standards of this course.
- To adhere to our university values, *you must cite any AI-generated material (e.g., text, images, and other content) included or referenced in your work and provide the prompts used to generate the content.* Using an AI tool to generate content without proper attribution will be treated as plagiarism and reported to the Office of Academic Integrity.

Please review the instructions in each assignment for more details on how and when to use AI Generators for your submissions.

Course Evaluations

Course evaluation occurs at the end of the semester university-wide. It is an important review of students' experience in the class. The process and intent of the end-of-semester evaluation should be provided. In addition, a [mid-semester evaluation](#) may also occur.

Course Schedule

Week	Topics	Preparation: In the News Article*	Homework Assigned**
1	Introduction, Noise, and Sonic Boom		#1 Introduction
2	Energy and Emissions	Energy or Emissions	#2 Energy and Emissions
3	Climate Modeling	Climate Change	#3 Climate Modeling
4	Contrails and Sustainable Aviation Fuel (SAF)	Contrails or SAF	#4 Contrails
5	SAF, Alcohol, and Methane	Alcohol or Methane	#5 SAF
6	Hydrogen and Nuclear	Hydrogen	#6 Alternate Fuels
7	Life Cycle Analysis (LCA)	Life Cycle Analysis	Mid-Semester Project
8	Electric Aircraft I	Electric Aircraft	
9	Electric Aircraft II		#7 Electric
10	Propulsion Review		
11	Advanced Configurations, Project Description	Advanced Configurations	#8 Configurations Project Topic Selection
12	Aerospace Solar Radiation Management (SRM) and Stratospheric Aerosol Injection (SAI), Advanced Sustainable Aerospace Concepts	SRM or SAI	
13	Space Sustainability - Impact of Rocket Launches and Re-entries		
14	Space Sustainability - Space Debris and Space Traffic Management	Space Debris	
15	Project Questions and Discussion		
Final	Final Project Presentation Due ***		

* In the News Article due at beginning of class. Students can be asked to show & discuss their article.

** Homework is generally due 9 days after lecture when it is assigned

*** Project is due at the beginning of the scheduled Final Exam time slot

Statement on Academic Conduct and Support Systems

Academic Integrity:

The University of Southern California is a learning community committed to developing successful scholars and researchers dedicated to the pursuit of knowledge and the dissemination of ideas. Academic misconduct, which includes any act of dishonesty in the production or submission of academic work, comprises the integrity of the person who commits the act and can impugn the perceived integrity of the entire university community. It stands in opposition to the university's mission to research, educate, and contribute productively to our community and the world.

All students are expected to submit assignments that represent their own original work, and that have been prepared specifically for the course or section for which they have been submitted. You may not submit work written by others or "recycle" work prepared for other courses without obtaining written permission from the instructor(s).

Other violations of academic integrity include, but are not limited to, cheating, plagiarism, fabrication (e.g., falsifying data), collusion, knowingly assisting others in acts of academic dishonesty, and any act that gains or is intended to gain an unfair academic advantage.

The impact of academic dishonesty is far-reaching and is considered a serious offense against the university. All incidences of academic misconduct will be reported to the Office of Academic Integrity and could result in outcomes such as failure on the assignment, failure in the course, suspension, or even expulsion from the university.

For more information about academic integrity see [the student handbook](#) or the [Office of Academic Integrity's website](#), and university policies on [Research and Scholarship Misconduct](#).

Please ask your instructor if you are unsure what constitutes unauthorized assistance on an exam or assignment, or what information requires citation and/or attribution.

Course Content Distribution and Synchronous Session Recordings Policies

USC has policies that prohibit recording and distribution of any synchronous and asynchronous course content outside of the learning environment.

Recording a university class without the express permission of the instructor and announcement to the class, or unless conducted pursuant to an Office of Student Accessibility Services (OSAS) accommodation. Recording can inhibit free discussion in the future, and thus infringe on the academic freedom of other students as well as the instructor. ([Living our Unifying Values: The USC Student Handbook](#), page 13).

Distribution or use of notes, recordings, exams, or other intellectual property, based on university classes or lectures without the express permission of the instructor for purposes other than individual or group study. This includes but is not limited to providing materials for distribution by services publishing course materials. This restriction on unauthorized use also applies to all information, which had been distributed to students or in any way had been displayed for use in relationship to the class, whether obtained in class, via email, on the internet, or via any other media. ([Living our Unifying Values: The USC Student Handbook](#), page 13).

Students and Disability Accommodations:

USC welcomes students with disabilities into all of the University's educational programs. [The Office of Student Accessibility Services](#) (OSAS) is responsible for the determination of appropriate accommodations for students who encounter disability-related barriers. Once a student has completed the OSAS process (registration, initial appointment, and submitted documentation) and accommodations are determined to be reasonable and appropriate, a Letter of Accommodation (LOA) will be available to generate for each

course. The LOA must be given to each course instructor by the student and followed up with a discussion. This should be done as early in the semester as possible as accommodations are not retroactive. More information can be found at osas.usc.edu. You may contact OSAS at (213) 740-0776 or via email at osasfrontdesk@usc.edu.

Support Systems:

[Counseling and Mental Health](#) - (213) 740-9355 – 24/7 on call

Free and confidential mental health treatment for students, including short-term psychotherapy, group counseling, stress fitness workshops, and crisis intervention.

[988 Suicide and Crisis Lifeline](#) - 988 for both calls and text messages – 24/7 on call

The 988 Suicide and Crisis Lifeline (formerly known as the National Suicide Prevention Lifeline) provides free and confidential emotional support to people in suicidal crisis or emotional distress 24 hours a day, 7 days a week, across the United States. The Lifeline is comprised of a national network of over 200 local crisis centers, combining custom local care and resources with national standards and best practices. The new, shorter phone number makes it easier for people to remember and access mental health crisis services (though the previous 1 (800) 273-8255 number will continue to function indefinitely) and represents a continued commitment to those in crisis.

[Relationship and Sexual Violence Prevention Services \(RSVP\)](#) - (213) 740-9355(WELL) – 24/7 on call

Free and confidential therapy services, workshops, and training for situations related to gender- and power-based harm (including sexual assault, intimate partner violence, and stalking).

[Office for Equity, Equal Opportunity, and Title IX \(EEO-TIX\)](#) - (213) 740-5086

Information about how to get help or help someone affected by harassment or discrimination, rights of protected classes, reporting options, and additional resources for students, faculty, staff, visitors, and applicants.

[Reporting Incidents of Bias or Harassment](#) - (213) 740-5086 or (213) 821-8298

Avenue to report incidents of bias, hate crimes, and microaggressions to the Office for Equity, Equal Opportunity, and Title for appropriate investigation, supportive measures, and response.

[The Office of Student Accessibility Services \(OSAS\)](#) - (213) 740-0776

OSAS ensures equal access for students with disabilities through providing academic accommodations and auxiliary aids in accordance with federal laws and university policy.

[USC Campus Support and Intervention](#) - (213) 740-0411

Assists students and families in resolving complex personal, financial, and academic issues adversely affecting their success as a student.

[Diversity, Equity and Inclusion](#) - (213) 740-2101

Information on events, programs and training, the Provost's Diversity and Inclusion Council, Diversity Liaisons for each academic school, chronology, participation, and various resources for students.

[USC Emergency](#) - UPC: (213) 740-4321, HSC: (323) 442-1000 – 24/7 on call

Emergency assistance and avenue to report a crime. Latest updates regarding safety, including ways in which instruction will be continued if an officially declared emergency makes travel to campus infeasible.

[USC Department of Public Safety](#) - UPC: (213) 740-6000, HSC: (323) 442-1200 – 24/7 on call

Non-emergency assistance or information.

[Office of the Ombuds](#) - (213) 821-9556 (UPC) / (323-442-0382 (HSC)

A safe and confidential place to share your USC-related issues with a University Ombuds who will work with you to explore options or paths to manage your concern.

[Occupational Therapy Faculty Practice](#) - (323) 442-2850 or otfp@med.usc.edu

Confidential Lifestyle Redesign services for USC students to support health promoting habits and routines that enhance quality of life and academic performance.