Syllabus

Course Information

Course Number:	AERO 489
Course Title:	Spacecraft Engineering
Section:	489, 689, 689-700 (Synchronous)
Time:	TBD
Location:	TBD
Credit Hours:	3

Instructor Details

Instructor:	Daniel Selva Valero
Office:	HRBB 620C
Phone:	979-458-0419
E-Mail:	dselva@tamu.edu
Office Hours:	On campus students: F 8-9:30 and by email appointment, in person. Distance education students: F 3-4:30 and by email appointment, on Zoom

Course Description

This course provides a comprehensive treatment of spacecraft engineering, with emphasis on the analysis and design of satellite systems. The course covers all spacecraft subsystems in detail, including propulsion, attitude determination and control, power, communications, structures, thermal control, and on-board data handling. Selected topics in payload design, orbit selection, constellation design, and systems engineering are also covered. Examples and case studies include remote sensing, communications, and navigation satellites covering both scientific, defense, and commercial missions.

Course Prerequisites

Grade of C or better in AERO 321.

Special Course Designation

Design Elective. Undergraduate students complete an individual design project report.

Stacked Course. Graduate students do a final exam instead of the design report.

Distance Education Course. Distance education students follow the course synchronously. Lectures will be streamed live through Zoom. They will also be recorded and posted on Canvas for one week.

Course Learning Outcomes

• Translate mission objectives into spacecraft engineering requirements.

- Evaluate different payload options (e.g., microwave vs optical imagers of different aperture size) and orbit options (e.g., different altitudes and inclinations) and explain the impact on spacecraft subsystem design and key trade-offs involved, including coverage, data quantity and quality, latency, system budgets, cost, risk, etc.
- Design a spacecraft concept starting from a given payload and orbit specification, developing a coherent subsystem architecture, and verifying that the system design satisfies mission requirements.
- Perform first-order analysis and sizing of major spacecraft subsystems, including structures, power, thermal, propulsion, ADCS, communications, and onboard data handling, using established analytical models and assumptions.
- Identify and reason about couplings and interactions between subsystems and assess their implications for overall system performance and design margins.
- Conduct system-level trade studies to compare alternative design options, quantify performance, mass, power, and cost impacts, and justify design decisions based on engineering reasoning.
- **Graduate and distance education students**: Optimize the system-level design of a spacecraft, e.g., to minimize lifecycle cost subject to meeting all performance requirements, using appropriate optimization algorithms and astrodynamics libraries.

Textbook and/or Resource Materials

Recommended: J. Wertz, D. Everett, and J. Puschell, Space Mission Engineering: The New SMAD. Hawthorne CA: Microcosm Press, 2011.

Grading Policy

Homework	*50%*
Mid-Term Exam	*20%*
Design report (undergraduates only)	*30%*
Final Exam (grad students only)	*30%*

Six **homework** assignments on the topics listed below. Homeworks will include questions about system and subsystem requirements, sizing and analysis methods, etc. There will also be some questions related to the design of a spacecraft mission defined by the instructor. Graduate and distance education students will have additional questions in the homeworks regarding more advanced topics and methods such as tradespace exploration and optimization.

The **mid-term exam** will cover all topics from Weeks 1-7.

Undergraduate students will work on an **individual spacecraft design project** in the biweekly homeworks and deliver a written report on the last day of classes. Students will choose their mission objectives, derive spacecraft and subsystem requirements, and design the spacecraft to meet those requirements, going into every subsystem and also providing a lifecyce cost estimate for the mission.

Graduate students will do a final exam on the final exam date set by the University. The exam will cover questions similar to the homeworks.

Approximate Letter Grading Scale
Grading is the same for undergraduate, graduate, and distance education students.

- *A = 90-100*
- *B = 80-89*
- *C = 70-79*
- *D = 60-69*
- *F = <60*

Grading Policy Changes – Faculty must provide grading policies to students by the first class period. As such, faculty cannot change the course grading policy after the second class session. (See Student Rule 10.)

Late Work Policy

Late submission of assigned homework and take-home will incur a penalty according to the following schedule

- *Delay < 24h: -10%*
- *24h < Delay < 48h: -20%*
- *48h < Delay < 72h: -30%*
- *No late work will be accepted after 72h past due*

The policy above applies to undergraduate, graduate, and distance education students.
Work submitted by a student as makeup work for an excused absence is not considered late work and is exempted from the late work policy (Student Rule 7).

Course Schedule

Week	Lecture topics	Deliverables due
1	Introduction, systems engineering process	
2	Space environment, astrodynamics	
3	Orbit selection, constellation design, orbital maneuvers	HW 1 Space environment and orbits
4	Propulsion	
5	Attitude Determination and Control Subsystem	HW 2 Delta V budget and Propulsion
6	Electrical Power Subsystem	
7	Communications Subsystem and Architecture	HW 3 Power and ADCS
8	Tradespace exploration and optimization	HW 4 Comms
9	Observation payloads	**Mid term (Weeks 1-7)**
10	Observation payloads	

11	Thermal control	HW 5 Observation payloads
12	Structures, On board data handling	HW 6 Structures and thermal
13	Flight software, Launch and Ground Segment	
14	Cost, Schedule, Risk	**Design reports (undergrad) due**
15	Regulations, Emerging trends	*Final exam for grad students on final exam date set by the University

University Policies

Attendance Policy

The university views class attendance and participation as an individual student responsibility. Students are expected to attend class and to complete all assignments.

Please refer to Student Rule 7 in its entirety for information about excused absences, including definitions, and related documentation and timelines.

Makeup Work Policy

Students will be excused from attending class on the day of a graded activity or when attendance contributes to a student's grade, for the reasons stated in Student Rule 7, or other reason deemed appropriate by the instructor.

Please refer to Student Rule 7 in its entirety for information about makeup work, including definitions, and related documentation and timelines.

Absences related to Title IX of the Education Amendments of 1972 may necessitate a period of more than 30 days for make-up work, and the timeframe for make-up work should be agreed upon by the student and instructor" (Student Rule 7, Section 7.4.1).

"The instructor is under no obligation to provide an opportunity for the student to make up work missed because of an unexcused absence" (Student Rule 7, Section 7.4.2).

Students who request an excused absence are expected to uphold the Aggie Honor Code and Student Conduct Code. (See Student Rule 24.)

Academic Integrity Statement and Policy

"An Aggie does not lie, cheat or steal, or tolerate those who do."

"Texas A&M University students are responsible for authenticating all work submitted to an instructor. If asked, students must be able to produce proof that the item submitted is indeed the work of that

student. Students must keep appropriate records at all times. The inability to authenticate one's work, should the instructor request it, may be sufficient grounds to initiate an academic misconduct case" (Section 20.1.2.3, Student Rule 20).

You can learn more about the Aggie Honor System Office Rules and Procedures, academic integrity, and your rights and responsibilities at aggiehonor.tamu.edu.

Notice of Nondiscrimination

Texas A&M University is committed to providing safe and non-discriminatory learning, living, and work environments for all members of the University community. The University provides equal opportunity to all employees, students, applicants for employment or admission, and the public regardless of race, color, sex (including pregnancy and related conditions), religion, national origin, age, disability, genetic information, or veteran status. Texas A&M University will promptly, thoroughly, and fairly investigate and resolve all complaints of discrimination, harassment (including sexual harassment), complicity and related retaliation based on a protected class in accordance with System Regulation 08.01.01, University Rule 08.01.01.M1, Standard Administrative Procedure (SAP) 08.01.01.M1.01, and applicable federal and state laws. In accordance with Title IX and its implementing regulations, Texas A&M does not discriminate on the basis of sex in any educational program or activity, including admissions and employment. The following person has been designated to handle inquiries and complaints regarding the non-discrimination policies: Jennifer M. Smith, TAMU Associate VP & Title IX Coordinator at YMCA Ste 108, College Station, TX 77843, 979-458-8407, or email civilrights@tamu.edu. For other reporting options, visit https://ocrcas.ed.gov/contact-ocr to locate the address and phone number of the office that serves your area, or call 1-800-421-3481.

Civil Rights, Free Speech, and Title IX Policies

Texas A&M University is committed to fostering a learning environment that is safe and productive for all. University policies and federal and state laws prohibit discrimination and harassment based on an individual's race, color, sex, (including pregnancy and related conditions), religion, national origin, age, disability, genetic information, veteran status, or any other legally protected characteristic. This includes forms of sex-based violence, such as sexual assault, sexual harassment, sexual exploitation, dating/domestic violence, and stalking.

Students can report discrimination/harassment, access supportive resources, or learn more about their options for resolving complaints on the University's Civil Rights & Title IX webpage.

Students should be aware that all university employees (except medical or mental health providers) are mandatory reporters, which means that if they observe, experience or become aware of an incident that they reasonably believe to be discrimination/harassment alleged to have been committed by or against a person who was a student or employee at the time of the incident, the employee must report the incident to the university.

Americans with Disabilities Act (ADA) Policy

Texas A&M University is committed to providing equitable access to learning opportunities for all students. If you experience barriers to your education due to a disability or think you may have a disability, please contact the Disability Resources office on your campus (resources listed below) Disabilities may include, but are not limited to attentional, learning, mental health, sensory, physical, or chronic health conditions. All students are encouraged to discuss their disability related needs with Disability Resources and their instructors as soon as possible.

To request academic accommodations, contact the designated ADA office based on your location:

- Texas A&M University, College of Nursing, College of Dentistry, Irma Lerma Rangel College of Pharmacy College Station, College of Medicine, School of Public Health, Institute of Biosciences and Technology, EnMed Program, Bush School in Washington DC, Mays Business School – CityCentre, TAMU Engineering Academies, Texas A&M University Higher Education Center at McAllen and Texas A&M University at Galveston should contact Disability Resources at (979) 845-1637 or disability@tamu.edu.
- Texas A&M University School of Law should contact the Office of Student Affairs at (817) 212-4111 or law-disability@law.tamu.edu to request accommodations.
- Irma Lerma Rangel College of Pharmacy in Kingsville should contact the Disability Resource Center at Texas A&M University - Kingsville at (361) 593-3024 or drc.center@tamuk.edu to request accommodations.
- Texas A&M University College of Veterinary Medicine & Biomedical Sciences in Canyon should contact the Office of Student Accessibility at West Texas A&M University – Canyon at (806) 651-2335 or osa@wtamu.edu.
- Texas A&M University at Qatar (TAMUQ) should contact the campus psychologist, Dr. Steve Wilson +974-4423-0047 or stephen.wilson@qatar.tamu.edu.

If you are experiencing difficulties with your approved accommodations, contact the office responsible for approving your accommodations or the Texas A&M ADA Coordinator Julie Kuder at ADA.Coordinator@tamu.edu or (979) 458-8407.

Pregnancy Accommodations

Texas A&M provides reasonable accommodations to students due to pregnancy and/or related conditions, such as childbirth, recovery and lactation. Students should contact the University's Pregnancy Coordinator as soon as they become aware of the need for accommodation. Depending on the circumstances, accommodations could include extended time to complete assignments or exams, changes in course sequence, or modifications to the physical classroom environment. Texas A&M will also allow a voluntary leave of absence, ensure the availability of lactation space, and maintain grievance procedures to provide for the prompt and equitable resolution of complaints of sex discrimination. For information regarding pregnancy accommodations, email TIX.Pregnancy@tamu.edu.

Statement on Mental Health and Wellness

Texas A&M University recognizes that mental health and wellness are critical factors influencing a student's academic success and overall wellbeing. Students are encouraged to engage in healthy self-care practices by utilizing the resources and services available through University Health Services on its mental health webpage. The TELUS Health Student Support app provides access to professional

counseling in multiple languages anytime, anywhere by phone or chat, and the 988 Suicide & Crisis Lifeline offers 24-hour emergency support at 988 or 988lifeline.org.

Texas A&M College Station
Students needing a listening ear can contact University Health Services (979.458.4584) 24-hour emergency help is also available through the 988 Suicide & Crisis Lifeline (988) or at 988lifeline.org.

Texas A&M at Galveston
Students who need someone to talk to can call (409) 740-4736 from 8:00 a.m. to 5:00 p.m. weekdays or visit tamug.edu/counsel for more information. For 24-hour emergency assistance during nights and weekends, contact the TAMUG Police Dept at (409) 740-4545. 24-hour emergency help is also available through the 988 Suicide & Crisis Lifeline (988) or at 988lifeline.org.

Texas A&M at Qatar
Texas A&M University at Qatar students wishing to discuss concerns in a confidential setting are encouraged to visit the Health and Wellness website for more information.

Statement on the Family Educational Rights and Privacy Act (FERPA)

FERPA is a federal law designed to protect the privacy of educational records by limiting access to these records, to establish the right of students to inspect and review their educational records and to provide guidelines for the correction of inaccurate and misleading data through informal and formal hearings. Currently enrolled students wishing to withhold any or all directory information items can do so within howdy.tamu.edu using the Directory Information Withholding Form. The complete FERPA Notice to Students and the student records policy is available on the Office of the Registrar webpage.
Items that can never be identified as public information are a student's social security number, citizenship, gender, grades, GPR or class schedule. All efforts will be made in this class to protect your privacy and to ensure confidential treatment of information associated with or generated by your participation in the class.

Directory items include name, UIN, local address, permanent address, email address, local telephone number, permanent telephone number, dates of attendance, program of study (college, major, campus), classification, previous institutions attended, degrees honors and awards received, participation in officially recognized activities and sports, medical residence location and medical residence specialization.

Optional Syllabus Statements

Artificial Intelligence Statement

According to the Texas A&M University Definitions of Academic Misconduct, plagiarism is the appropriation of another person's ideas, processes, results or words without giving appropriate credit (aggiehonor.tamu.edu). You should credit your use of anyone else's words, graphic images, or ideas using standard citation styles. Artificial Intelligence (AI) text generators and natural language processing tools (colloquially, chatbots - such as ChatGPT), audio, computer code, video, and image generators should not be used for any work for this class without explicit permission of the instructor and appropriate attribution. This includes, but is not limited to,

i. Creating or revising drafts
ii. Editing your work
iii. Reviewing a peer's work

This excludes pre-existing software additions such as spelling and grammar checkers, which are acceptable.