Aerospace Engineering Department

AE112 – Aerospace Structures and Materials I – Fall 2023

Syllabus

Instructor: Dr. Edoardo Rubino **Phone:** 408 924 3126
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OFFICE HOURS:
Tuesday 10:00 am to 12:00 pm

If you need to contact the instructor for any reason, send an email at any time to edoardo.rubino@sjsu.edu with your idea, question, or concern. The students are also strongly encouraged to contact the instructor whenever a question or concern arises, whether related to the class content or not. If you do not receive an answer within 24 business hours, please send a reminder email. Office hours are subject to change weekly due to department college and committee meetings as well as professional and personal commitments.

CLASS DAY/TIME: TBD

CLASSROOM: TBD

UNITS: 4

COURSE FORMAT: In-person

PREREQUISITES: Grade of "C" or better in Physics 50 and Math 31 or 31x

COURSE DESCRIPTION: Aircraft loads, V-n diagram; spacecraft boost loads. Free-body diagrams. 2-D force and moment equilibrium. Centroid and area moment of inertia. Internal loads diagrams (axial and shear forces, torsional and bending moments); cantilevered wings & internal support structures; stress/strain relationships; material properties, microstructure, and imperfections; material selection. Experimental strain measurement, experimental material properties testing.

COURSE GOALS:
1. To review vector algebra and develop the skills of creating a free-body diagram and performing a static equilibrium analysis.
2. To show the application of air loads, inertia loads, mass properties, and materials to aircraft structural analysis and design.
3. To provide fundamental knowledge of the principles of strength of materials.
4. To classify materials according to their mechanical properties.
5. To analyze aircraft and spacecraft structural members in tension, compression, and torsion.
6. To calculate centroids and area (section) moments of inertia.

7. To become familiar with experimental strain measurement and its reconciliation with theoretical stress prediction.

COURSE LEARNING OUTCOMES: Upon successful completion of this course, students will be able to:

1. Estimate forces and moments applied over an aircraft's flight envelope.
2. Create free-body diagrams of an aircraft's internal and external structure; solve with vector algebra.
3. Solve for forces and moments applied to typical internal aircraft members.
4. Construct shear force and bending moment diagrams for a cantilevered wing under constant and triangular distributed loads.
5. Measure strain using strain gauge technology.
6. Compute area properties of a two-dimensional wing and fuselage cross sections: centroid and moments/products of inertia.
7. Describe the stress-strain behaviors of brittle and plastic materials
8. Discuss elastic vs plastic behavior
9. Select materials based on their mechanical properties such as Young's modulus, Poisson's ratio, and shear modulus.
10. Relate the mechanical properties of metals, ceramics, and polymers to their microstructure
11. Describe how imperfections affect the mechanical properties of materials
12. Calculate shear stress and angle of twist along a shaft-type structure in torsion.
13. Work effectively in teams to design, carry out, and analyze results from the Lab Problems.

TEXTBOOK:

1) Beer and Johnston, *Statics and Mechanics of Materials*, Ed. 3

OTHER SUGGESTED TEXTBOOK:

2) Bruhn, *Analysis & Design of Flight Vehicle Structures*
3) Hibbeler, *Mechanics of Materials*
4) Megson, *Aircraft Structures for Engineering Students*
5) Mitiguy, *Statics & Introduction to Solid Mechanics*
6) Niu, *Airframe Structural Design: Practical Design Information and Data on Aircraft Structures*
7) Callister, *Material Science and Technology: An Introduction*

EXAMS POLICIES: These rules are intended to protect the integrity of the assessment of individual student performance that exams provide. They will be applied equally to everyone in the course.

- Exams are to be taken at the scheduled date and time.
- Students who anticipate a conflict with an exam time shall discuss the matter with the instructor before the exam, at the earliest possible time that the student becomes aware of the conflict. At the instructor's discretion, alternative exam dates and times will be allowed. This is the instructor's choice and is not a guaranteed privilege.
- Students who must miss an exam due to illness should provide medical documentation verifying the illness if a make-up exam is expected.
- Make-up exams and exams given at an alternate time will contain equivalent content and rigor but may have different problems than the version given to students during the regular time.
- Once an exam begins, students **may not leave the room** without turning in their exam. This includes restroom breaks. Students may not resume their exam upon returning to the exam room after leaving.
- Students are allowed to bring the following only:
  - One equation sheet: both sides can be filled and there are no limitations about the content of the sheet. The equation sheet is individual and cannot be shared with other students. Also, the equation sheet must be handwritten.
  - Calculator, pencil, pen, eraser.

- Students may not communicate (verbally or by any other method) with each other or with anyone other than the instructor during the time of the exam. Except for asking the instructor a question, talking is not allowed during exams.
- Students should not discuss the exam with each other until everyone in the class has taken the exam.
- The use of cell phones during exams is expressly forbidden. The instructor has the authority to require that cell phones be placed in a non-accessible location or temporally handed over during the duration of the exam.
- Students may not wear hats that obscure their faces or eyes during exams.

Accommodations for exams will not be provided unless a student has obtained permission from the Accessibility Education Center (EAC). Such accommodations will follow the specific requirements of the EAC.

HOMEWORK POLICIES: Homework is considered a tool to become familiar with the topics and make practice. The submission of each homework will be enough to get full credit. After the deadline, the solution will be made available on canvas to let each student check his/her solution process.

GRADING:

- Lab reports 15% (G)
- Service learning 5% (G)
- Homework 10% (I)
- Quizzes (canvas/in class) 10% (I)
- Midterm exams (1, 2, 3) 30 % (I)
- Final exam 30 % (I)

I: Individual assignment, **G:** Group assignment

GRADING SCALE:

Grade	*Points*	*Percentage*		*Grade*	*Points*	*Percentage*
A plus	*960 to 1000*	*96 to 100%*		*C plus*	*760 to 799*	*76 to 79%*
A	*930 to 959*	*93 to 95%*		*C*	*730 to 759*	*73 to 75%*
A minus	*900 to 929*	*90 to 92%*		*C minus*	*700 to 729*	*70 to 72%*
B plus	*860 to 899*	*86 to 89 %*		*D plus*	*660 to 699*	*66 to 69%*
B	*830 to 859*	*83 to 85%*		*D*	*630 to 659*	*63 to 65%*
B minus	*800 to 829*	*80 to 82%*		*D minus*	*600 to 629*	*60 to 62%*

TENTATIVE SCHEDULE:

Week	Topic
1	Introduction, units, vector algebra
	Equilibrium of forces in 2D
2	Forces & moments / couples, equivalent loads
	Forces & moments / couples, equivalent loads
3	Equivalent loads
	Free body diagrams for rigid bodies
4	Equilibrium of rigid bodies in 2D
	Distributes forces – V-n diagram
5	Distributes forces
	MIDTERM 1
6	Analysis of trusses
	Analysis of trusses
7	Analysis of frames
	Atomic structure of aerospace materials
8	Structure of metals, ceramics and polymers
	Imperfections in solids
9	Mechanical properties of metals (Stress-strain diagram, Hooke's law, elastic vs plastic deformation)
	Normal stress & strain; Shear stress & strain, Shear stress-strain diagram
10	Mechanical properties of ceramics & polymers
	MIDTERM 2
11	Centroids; area moments of inertia
	Area moments of inertia of complex geometries
12	Beam: relation between bending and shear
	Beam: relation between bending and shear
13	Beam: bending moment and shear force diagram
	Stresses in beams
14	Stresses in beams
	Torsion
15	Torsion
	Review

ATTENDANCE POLICY:
Students are expected to attend all class meetings. Lecture attendance is not mandatory and will not be tracked, but it is considered to be essential for the progress and understanding of the covered material. If a student misses a class, s/he is still responsible for the information covered. Students who are frequently absent from class are rarely successful. However, attendance does not guarantee the successful completion of the course.

NOTES

- **Cheating** of any sort is not tolerated: dishonesty is not accepted in professional engineering practice and will not be tolerated in this classroom. The default penalty for cheating on the homework is a grade of zero on the entire homework. Cheating on the exams will result in failure of the course and potential expulsion from the university. Examples of cheating include but are not limited to using any electronic device (except a scientific calculator), copying/suggesting a solution/procedure from/to another student, use not allowed notes.
- **All announcements** related to homework, exams and any other course component are made either in class, email or canvas.
- **Electronic devices.** The use of cell phones, or other mobile communication devices is disruptive and is therefore prohibited during class. Except in emergencies, those using such devices must leave the classroom for the remainder of the class period.
- **Professionalism:**
    - **Emails/Communications**
        - Use only your official SJSU account. Email received from a non-institutional email address (e.g. Gmail, yahoo, Hotmail, etc..) will be discarded immediately and not taken into account.
        - **Use a clear subject line.** The subject "Rhetorical Analysis Essay" would work a bit better than "heeeeelp!" (and much better than the unforgivable blank subject line).
        - **Use a salutation and signature**. Instead of jumping right into your message or saying "hey," begin with a greeting like "Hello" or "Good afternoon," and then address your professor by appropriate title and last name, such as "Prof. Xavier" or "Dr. Octavius." (Though this can be tricky, depending on your teacher's gender, rank and level of education, "Professor" is usually a safe bet for addressing a college teacher.) Similarly, instead of concluding with "Sent from my iPhone" or nothing at all, include a signature, such as "Best" or "Sincerely," followed by your name.
        - Indicate your **class and section** in the body of the email
        - **Use standard punctuation, capitalization, spelling, and grammar**. Instead of writing "idk what 2 rite about in my paper can you help??" try something more like, "I am writing to ask about the topics you suggested in class yesterday."
        - **Do your part in solving what you need to solve**. If you email to ask something you could look up yourself, you risk presenting yourself as less resourceful than you ought to be. But if you mention that you've already checked the syllabus, asked classmates, and looked through old emails from the professor, then you present yourself as responsible and taking initiative. So, instead of asking, "What's our homework for tonight?" you might write, "I looked through the syllabus and course website for this weekend's assigned homework, but unfortunately, I am unable to locate it."
        - **Be aware of concerns about entitlement.** Rightly or wrongly, many professors feel that students "these days" have too strong a sense of entitlement. If you appear to demand help, shrug off absences or assume late work will be accepted without penalty because you have a good reason, your professors may see you as irresponsible or presumptuous. Even if it is true that "the printer wasn't printing" and you "really need an A in this class," your email will be more effective if you take responsibility: "I didn't plan ahead well enough, and I accept whatever policies you have for late work."

- **Attitude**
  - In keeping with SJSU's strategic priority to foster a community of achievement and respect, this class strives to be an inclusive learning community, respecting those of differing backgrounds and beliefs.