AE8803-ROM Syllabus

Low-Gravity Fluid Mechanics, 3 Graduate Credits

General Information

Description

Introduction to microgravity and partial-gravity science and technology, with an emphasis on the theory and simulation of low-gravity liquid/gas flows. The second part of the semester will focus on the conceptualization, design, and (pending platform availability) development of a microgravity payload.

Pre- &/or Co-Requisites

Pre-requisite: AE4342 / 4321-22 or equivalent space systems engineering course

Others: A strong background in calculus, numerical methods, and fluid mechanics (e.g. AE6009 Viscous Fluid Flows) is highly recommended.

Course Goals and Learning Outcomes

Upon completion of this course, the student should:

- Understand the unique characteristics and operational environment of different microgravity facilities and how different payloads fit in them
- Master the theory behind capillary flow statics and dynamics in low-gravity environments
- Understand the challenges of low-gravity fluid control in key space technologies
- Write and understand detailed aerospace system requirements for microgravity payloads
- Be familiar with the life cycle of a microgravity payload
- Conduct system sizing analyses and trade studies
- Effectively communicate technical information in both oral and written formats
- Apply engineering design to produce solutions that meet specified needs with consideration of safety, technical constraints, and human factors

Course Requirements & Grading

Note: Graded components of a course may vary with each offering. The example below is typical but subject to change.

Assignment	Date	Weight
Homework Assignments	TBD	20%
Quizzes	TBD	10%
Midterm Exam	TBD	25%
Project: Concept Presentation	TBD	5%
Project: Progress Meeting	TBD	10%
Project: Final Presentation & Report	TBD	30%

This class does not have a final exam.

Extra Credit Opportunities

Extra credit assignments will be presented to the class on a case-by-case basis in addition to the regularly assigned work. Examples of possible extra credit assignments would be to conduct a more in-depth study of a particular topic, create new content and present it to the class, etc.

Description of Graded Components

Homework Assignments: Consists of regular assignments scheduled during the first half of the semester. Each assignment is based on the material covered in class.

- Release and due dates are listed on the schedule.
- Any assignment turned in after collection is late. Late assignments may be turned in during the grace period (24 hours) for half credit. Any assignment turned in after this is not counted.
- Completed lab assignments will be submitted via Canvas as a single PDF file written in accordance with the writing guidelines discussed in class. Deductions will be made for improper formatting.

Quizzes: Weekly quizzes will be issued every Thursday, due the following Tuesday throughout the semester. Quizzes cover fundamental concepts from the lectures with support from external resources.

Midterm Exam: A take-home midterm exam will be issued mid-semester. The exam must be completed individually. Lecture materials, books, and MATLAB codes can be consulted as needed.

Group Project: The course content will be applied and expanded on a group project carried out during the second half of the semester. Ideally, the project will build on the group's research interests. The topic is completely up to the group but must be agreed upon with the instructor before the concept presentation. Students are encouraged to scan the literature for ideas. Three graded presentations are scheduled during the semester.

Although, by default, every team member gets the same grade, the instructor may modify individual grades by +-20 pts with respect to the baseline when the individual work carried out by the student exceeds or does not meet the expectations. Every student is required to attend the group presentations from the class.

Grading Scale

At Your final grade will be assigned as a letter grade according to the following scale:

A	90-100%
B	80-89%
C	70-79%
D	60-69%
F	0-59%

Full credit is awarded for solutions that are correct and demonstrate an understanding of the concepts of the problem. Partial credit is given for solutions that, while incorrect, demonstrate some knowledge of the concepts. Final grades may be curved based on overall class performance.

Course Materials

Textbooks

- Recommended:
  - D. Langbein, "Capillary Surfaces – Shape, Stability, Dynamics, in Particular Under Weightlessness", Springer, 2002
  - A.D. Myshkis, V.G. Babskii, N.D. Kopachevskii, L.A. Slobozhanin, A.D. Tyuptsov, "Low-Gravity Fluid Mechanics, Mathematical Theory of Capillary Phenomena", Springer, 1987
  - M. E. Dreyer, "Free Surface Flows under Compensated Gravity Conditions", Springer, 2007
- Key journals: npj Microgravity, Microgravity Science and Technology, Acta Astronautica, AIAA Journal (before 1980s), AIAA Journal of Spacecraft and Rockets
- Specific materials will be recommended with each lecture

Course Website and Other Classroom Management Tools

Course materials will be posted online to Canvas (https://canvas.gatech.edu/). Course materials (e.g. recorded videos) will be available to both in-person and distance learning sections. Important communications to the class will be sent through the Canvas system; please be alert to these messages. Students will be held responsible for any message or announcement that has been posted to the class for more than 24 hours.