

AEM 1905 (Freshmen Seminar) – Spaceflight with Ballooning

2 credits; no prerequisites

Fall 2010

version 4: 11/30/10

Lecture: 3:35 to 5:30 p.m. Tuesdays in Akerman 227
Also reserve Saturday, October 30 for our near-space ballooning mission. This is a required all-day class activity. Weather-delay dates: Sunday, October 31 or else on the weekend of November 6 – 7.

Professor: James Flaten
Associate Director of the MN Space Grant Consortium
Aerospace Engineering and Mechanics Department

Office: Akerman 205C (in the Akerman/Shepherd skyway)
flaten@aem.umn.edu

Office Hours: 612-626-9295 (office) or 651-399-2423 (cell – use sparingly)
12:30 to 1:30 p.m. on Tuesdays (new!)
1 to 2 p.m. Fridays (most weeks – confirm before coming)
or immediately after class on Tuesdays or by appointment

Teaching assistants: Seth Frick frick100@umn.edu 651-494-8923
Kyle Marek-Spartz mare0132@umn.edu 507-313-0193
(informal, Cait Mantych mant0145@umn.edu 847-716-0204)

Openable Lab (Shepherd 394): Mon. 2:30 – 4:30 p.m. (Cait)
Tues. 12:30 – 1:30 p.m. (Dr. Flaten)
Thurs. 4:30 – 5:30 p.m. (Seth)
Fri. 1 – 3 p.m. (Kyle)

Readings: Articles by Paul Verhage and others (distributed or on-line)

Course Web Site: www.aem.umn.edu/courses/aem1905/fall2010

Brief course description:

Outer space, sometimes called the Final Frontier, has always been difficult to reach due to the tremendous expense of rocket launches and the limited number of launch opportunities. In this hands-on course we will design and build mini-spacecraft and use (relatively) inexpensive helium-filled weather balloons to carry them into “near-space” – the upper reaches of the atmosphere which has many of the same physical properties as outer space. The launch and recovery will be a required class activity tentatively scheduled for the last Saturday in October (this activity is weather dependent, so the actual flight day may need to change). The remainder of the semester will involve data analysis from our balloon mission as well as discussions and activities associated with full-fledged (i.e. outer space) spaceflight, including the scientific accomplishments and engineering challenges of past, current, and future missions.

Brief biography of the instructor:

Dr. James Flaten is the associate director of the Minnesota Space Grant Consortium (AKA MnSGC – <http://www.aem.umn.edu/mnsgc>), a NASA Higher Education program whose goals include promoting interest in space science and space exploration. Housed in the Aerospace Engineering and Mechanics department, Dr. Flaten’s academic background is in experimental physics and he has taught many physics, astronomy, and introductory engineering classes in the past. He enjoys using high-altitude ballooning as a low-cost means of giving college students hands-on experience building and flying space hardware.

Latex notice:

High-altitude ballooning involves the use of latex weather balloons. Direct contact with latex is minimal, but students with known latex allergies (or those concerned about possible exposure)

should contact their health care provider about potential risks of participating in such an activity. Launch day assignments can be arranged with the instructor that do not involve any direct contact with latex material.

Course Objectives: In this class the student will –

- Collect tips about succeeding in college and practice putting them into practice.
- Learn about outer space and near-space plus spacecraft and space flight in both regions through class discussions plus locating-then-reading scientific literature. (U of MN Student Learning Outcomes – “Can locate and critically evaluate information” and “Have mastered a body of knowledge (at an introductory level) and a mode of inquiry”)
- Work as a team to build a miniature spacecraft to perform science experiments and fly it on a high-altitude balloon mission to near-space. (U of MN Student Learning Outcome – “Can identify, define, and solve problems”)
- Present design of and results from near-spacecraft, both orally and in writing. (U of MN Student Learning Outcome – “Can communicate effectively”)
- Reflect upon the multitude of disciplines, including but not limited to science and engineering, involved in space programs and spaceflight. (U of MN Student Learning Outcome – “Understand the role creativity, innovation, discovery, and expression across disciplines”)

Scholastic Conduct:

You will be respected and treated as an honest, honorable person and are expected to treat your instructor(s) and classmates in a similar manner. Active participation in class activities is expected, but disrespectful behavior towards anyone or actions that disrupt the supportive learning environment will not be tolerated.

As a student of the University of Minnesota, you are expected to be familiar with the Student Code of Conduct:

http://www1.umn.edu/regents/policies/academic/Student_Conduct_Code.html

In particular, cheating on any assignment, quiz, or exam may result in penalties ranging from receiving a zero on that particular assignment to receiving an “F” for the course and/or being suspended from the University.

In general you will be permitted (indeed, encouraged!!!) to work with your classmates on assignments. When individual work is required, it will be clearly described as such. Any attempt to communicate with another person or view someone else’s work or assist another student improperly during a quiz or an exam constitutes cheating and will be dealt with according to University policy.

University of Minnesota Course Policies:

Policies in the following document also apply to this course:

<http://www.aem.umn.edu/teaching/syllabi.shtml>

Graded aspects of the class:

In this class 50% of your grade will be based on individual effort (40% for written assignments, both in-class (including occasional quizzes) and homework, and 10% for individual participation in your team (as assessed by instructor and TA observations, plus peer reviews)) and 50% of your grade will be based on the quality of your team’s work (20% for your miniature spacecraft (designed, built (quality, on-time), tested, flown), 15% for written documentation (3.25 revisions), and 15% for 3 oral team presentations (conceptual, flight readiness, final)).

Point values for specific assignments will be announced as we go, but at the end of the semester all the points in each category will be weighted according to the percentages listed above.

Final Exam:

There will not be a final exam in this class. However there will be a final oral presentation, as a team, a semester-end public exhibit, and a final written report on your ballooning mission.

Class absence/make-up work policy:

Make-up work will not be allowed for unexcused absences. In the case of excused absences, in-class activities that cannot effectively be made up will simply not count towards your grade. Make-up quizzes and exams will only be offered if all the following conditions are met.

- You have a valid reason for a class absence according to University policy: health issue, family emergency, sanctioned University event, religious observance
- You contact the professor by phone or e-mail as soon as you know about the absence (nearly always before the class you miss, unless it is a genuine last-minute emergency – you may even know about impending absences at the start of the semester) to explain your situation and make an appointment to see the professor (definitely before the next week’s class) to discuss what you missed.
- You provide valid documentation of your excused absence, such as a note from a doctor, when you next see the professor.

Late assignment submission policy:

All assignments will have specific due dates and deductions will be made if they are submitted late. These penalties are stiff, so don’t turn in things late!

- -10% for assignments received (hard copy or electronically) on the due date but later than the due time (e.g. after class, if due at the beginning of class)
- -20% for assignments received on the following business day (e.g. things turned in on Wednesday if due Tuesday; things turned in on Monday if due Friday, etc.)
- -50% for assignments received later than the following business day but within 1 week of the original due date
- No credit for assignments more than 1 week late

Checking Scores Online:

You can check your scores for the class in the AEM Student Record System at www.aem.umn.edu/srs

It is a good idea to check to make sure that each of your scores has been correctly entered in the system – errors in data entry do occur! *Questions or comments about grading must be raised within one week of scores being posted, after which grades will be considered final.*

Letter grades:

Letter grades will be assigned according to the following cutoffs.

93.00 – 100 %	A	77.00 – 79.99 %	C+
90.00 – 92.99 %	A-	73.00– 76.99 %	C
87.00 – 89.99 %	B+	70.00 – 72.99 %	C-
83.00 – 86.99 %	B	67.00 – 69.99 %	D+
80.00 – 82.99 %	B-	60.00 – 66.99 %	D
		00.00 – 59.99 %	F

These cut-offs should be considered tentative. I reserve the right to lower (but not raise) one or more of these cut-offs at the end of the semester.

Feedback about this class, delivered in person or sent by e-mail, is always welcome.

< The contents of this syllabus are subject to modification if the need arises.>

Tentative Calendar for AEM 1905: Spaceflight with Ballooning

Fall 2010
version 4: 11/30/10

Tuesday, Sept. 7

Introduction to class and pre-instruction survey

Discussion of space (& near-space), spacecraft (& near-spacecraft), spaceflight (...), etc.

Tuesday, Sept. 14

BalloonSat mission overview: atmosphere, experiments, construction, tracking

Discussion of sample student payloads

Team-forming activities

Preliminary payload planning

(Possible assembly of stairwell exhibit for Space Grant Midwest Regional Conference)

Tuesday, Sept. 21

Demonstration of HOBOS, flight computers, sensors, cameras

Discussion of main payload-building assignment, documentation, and design review

Introduction to Author/Peer Reviewer assignment

Discussion of electronics then learn-to-solder activity and begin building heater circuit

[Movie Night 1!](#)

Tuesday, Sept. 28

Discussion of Spacecraft Systems and Systems Engineering

Distribution and discussion of Team Project Documentation template

Team Project Documentation – Rev 0: Section assignments, hardcopy due in class

Class time to work on Proposal/Conceptual Design Review (CDR)

Begin building weather station and flight computer

Tuesday, Oct. 5 (*Slides due at noon – (i.e. BEFORE class)*)

Proposal/Conceptual Design Reviews (CDR) (8-10 minutes per team, oral with slides)

Feedback on design and Authority to Proceed (ATP); equipment checkout

Begin payload body construction

Essay A1: first draft due (electronically) by midnight to peer reviewer (copy to instructor)

Friday, Oct. 8

[Essay A1: peer reviewer comments due \(electronically\) by midnight to author \(copy to instructor\)](#)

Tuesday, Oct. 12

Class time to work on construction, integration, and testing (esp. mechanical testing)

Tips about camera use and about programming flight computers and HOBOS

Essay A1: final draft due (electronically) by midnight to instructor

Friday, Oct. 15

[Team Project Documentation – Rev A: Design sections, due electronically, 4 p.m.](#)

Tuesday, Oct. 19

Class time to work on construction, integration, and testing (esp. thermal and electrical)

Data collection from “Day in the Life” testing

Class time to work on Flight Readiness Review (FRR)

[Movie Night 2!](#)

Tuesday, Oct. 26 (*Slides due at noon – (i.e. BEFORE class)*)

Flight Readiness Reviews (FRR) (12-15 minutes per team, oral with slides)

Prediction software, launch logistics, tracking, recovery logistics

Class time to finalize payloads (**especially rigging**); weigh-in/turn-in if finished

Thursday, Oct. 28

Final deadline for payload weigh-in/turn-in at noon

Friday, Oct. 29

Team homework (GPS hunt and flight predictions) both due by e-mail by noon

Optional (interesting, but not for class points) – packing for the flight, 2 to 4 p.m.

Saturday, Oct. 30 (alternate dates – Oct. 31st, Nov. 6th, 7th)

Launch day (actual launch site and flight timing TBA) – approximate schedule will be depart from Akerman ~6:30 a.m., launch ~9:30 a.m., flight ~3 hours, recovery and return to the Twin Cities may take until late afternoon – student vans will return to campus no later than 5 p.m. (possibly as early as 3 p.m, if the recovery is easy) – wear long pants, closed-toed shoes, and a warm jacket – bottled water and light snacks will be provided but bring a sack lunch or some money for a fast-food drive-through

Tuesday, Nov. 2

Discussion of Gravity, Orbits, and Mission Design

Class time for data extraction from payloads, data analysis tips, preliminary data analysis

Essay A2: first draft due (electronically) by midnight to peer reviewer (copy to instructor)

Friday, Nov. 5

Team Project Documentation – Rev B: Design/Build sections, due electronically, 4 p.m.

Due date modified to be Sunday, Nov. 7, instead.

Essay A2: peer reviewer comments due (electronically) by midnight to author (copy to instructor)

Tuesday, Nov. 9

Discussion of Launch Vehicles: Past, Present, and Future

Class time to continue work on data analysis and generate data analysis visuals/graphs

Essay A2: final draft due (electronically) by midnight to instructor

Tuesday, Nov. 16 (*Data visuals/graphs due at noon – (i.e. BEFORE class)*)

Discussion of Telemetry and Communication Systems

Class time to work on Final Team Presentation (FTP)

Feedback offered on data analysis visuals/graphs

Tuesday, Nov. 23 (*Slides due at noon – (i.e. BEFORE class)*)

Final Team Presentations (FTP) (20 – 25 minutes per team, oral with slides)

Tuesday, Nov. 30

Discussion of Re-entry and Landing Systems

Design a ballooning mission to another solar system body

~~Movie Night 3!~~ Other movie options given instead – optional essay, for extra credit.

Potential field trip (date to be determined, possibly over the weekend of Dec. 4-5 or Dec. 11-12) to the Science Museum to see “Hubble” (IMAX movie), if sufficient interest.

Friday, Dec. 3

Team Project Documentation – Rev C: Complete document, due electronically, 4 p.m.

Due date changed to Tuesday, Dec. 7, 1:30 p.m. (i.e. end of office hour)

Tuesday, Dec. 7

In-class writing assignment “Essay B” on recent movie

Design a ballooning mission to another solar system body (continued)

Class time to work on mission-summary poster and payload/laptop exhibit

(optional) Sunday, Dec. 12, evening

Assembly of stairwell exhibit.

Tuesday, Dec. 14 (*Optional (extra credit) movie essay due by e-mail by noon*)

3:35 to 4:30 p.m.: Public reception in lobby hangar (optional – help with balloon inflation before class, starting about 3 p.m.) to talk about mission, with posters and stairwell payload/laptop exhibit

Course evaluations and post-instruction survey

Wrap-up discussion topic: Where do we go from here?

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