Syllabus: MAE 431 Microgravity Research II

Class times: T: 5-5:50 PM; F: 8-8:50 PM, plus group meetings

CRN 13130, Spring 2017, 3 credits

Course Description:

MAE 431 is a 3-credit hour senior mechanical and aerospace engineering technical elective course focusing on the design and construction of a microgravity research experiment, and the conduct of the experimental research plan, and analysis of the resulting results. The primary objective of the course is to provide students with a unique design and research opportunity as a learning experience. Students, working as a team, will design, develop, and test a new experiment to be conducted aboard the NASA Microgravity Research Aircraft, historically, through the NASA Reduced Gravity Education Flight Program (RGEFP). This semester, we will this model loosely, working through the NASA USIP SFRO program. Results will be reported in a required final report, along with the details of the experimental apparatus. The experiments will be designed and constructed by the undergraduate student team with overall guidance from the course instructor, Dr. John Kuhlman.

The workload for the spring semester course, Microgravity Research 2, consists of the actual design, fabrication, and testing of the experimental apparatus, based on the preliminary design work done during the previous semester in MAE 430 Microgravity Research I. Tests and research will be conducted by the team members collectively under the supervision of the class instructor/project advisor. Additionally, the team will then also construct the final experimental apparatus that will be tested aboard the parabolic trajectory aircraft, and conduct further engineering tests to prove the effectiveness of the experiment, its possibility of success, and its overall safety. The functionality and safety of the experiment for flight aboard the microgravity research aircraft will be documented in detail in the series of NASA Reviews (PDR, CDR, etc.), and the final experiment will be flown aboard the microgravity research aircraft. Data will be analyzed and a final report will be prepared and submitted to document the results. Additionally, various outreach activities, such as school visits, tours, presentations about the experiment, and the development of a team web site, will be conducted during the semester to spread interest about Microgravity Research at West Virginia University.

This course exposes students to the “hands-on” design experience of designing and constructing an experimental payload, generally for flight aboard the NASA Microgravity Research Aircraft. Students will gain experience in the areas of design, technical report writing, instrumentation, data acquisition, interfacing, and programming, data reduction, and data analysis.

Educational Objectives: The course incorporates two primary pedagogical objectives:

- Students will gain experience in synthesizing knowledge from their undergraduate education to design and develop an experiment that will satisfy specific design constraints, including size, cost, strength, weight, accuracy, efficiency, or other pertinent measures as determined by the project and the instructor.
- Students will gain experience in professional communication, including both written and oral communication.

Learning Outcomes:

At the end of this course the students, in a team environment, will have:

- Completed the design and fabrication of their microgravity experiment, subject to payload technical, size, weight, safety, and cost constraints,
• Written an engineering document (usually, the TEDP) to prove the safety of their experiment,
• Tested their completed experiment,
• Analyzed their experimental results, and written a report to present results, and
• Engaged in outreach activities, e.g., by making presentations about their research to local area school children.

**Course Instructor:**
Dr. John M. Kuhlman, MAE Dept., Room 841C ESB
Phone: 293-3180, or 599-1009 at home, in emergencies.
Email: [John.Kuhlman@mail.wvu.edu](mailto:John.Kuhlman@mail.wvu.edu)

**Course Procedures:**
Office Hours will be finalized in class. My tentative office hours are MTWTh, 1 – 1:50 PM.

The only prerequisite to this course is MAE 430, or permission of the instructor.

Letter grades will be determined by cut-offs of approximately 90-80-70-60 for A-B-C-D-F. I reserve the right to curve down from this, and will not curve up; that is, a 90% will be an A, not a B, etc. There will be no hour exams or final exam in this design project course; 80% of your course grade will be determined by the timely, successful completion of the deliverables described in the next paragraph.

There will be two or three major deliverables in this project course: first, a successfully operating experimental apparatus must be developed and delivered in a timely fashion, and second, the team must successfully pass their experiment Design and Operations Review to be held prior to the flight. Third, it is also hoped that successful data will be obtained, and that this data will be analyzed in a formal technical report. Letter grades on these three deliverables will be an A grade once the deliverable has been submitted to and accepted by NASA; an F grade will be assigned if the deliverable is not completed/submitted or accepted in a timely fashion. There will be some other individual or group assignments as well, including participation in the outreach activities.

Attendance at each scheduled class period will not be taken, but is strongly encouraged. Students who do not contribute to the group will be asked to drop the course, or will be assigned a failing grade. It is hoped that this will not be necessary, and that this course will instead be both challenging and **FUN** for all involved!

**Grading:**

<table>
<thead>
<tr>
<th>Component</th>
<th>Percentage</th>
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</thead>
<tbody>
<tr>
<td>Participate in Preliminary Testing</td>
<td>10%</td>
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<tr>
<td>Deliverables:</td>
<td>80%</td>
</tr>
<tr>
<td>(Design and Construct Final Apparatus in timely fashion, Pass Design &amp; Operations Review (s), and Submit Final Data Report on time)</td>
<td></td>
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<tr>
<td>Outreach Activities</td>
<td>10%</td>
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<tr>
<td></td>
<td>100%</td>
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*Test Equipment Data Package

**Laboratory Safety Policy:**

All MAE classes that use a laboratory or mechanical shop space are required to have federally mandated laboratory safety and hazardous materials training. The laboratory safety and hazardous materials training must be renewed on annual basis. The instructors, TAs, and students with training that will expire before the end of the semester must renew their training by January 27, 2017. The safety
training is provided by WVU Environment, Health and Safety department. The training can be accessed through ecampus by following information for the online version located at http://ehs.wvu.edu/training/lab-safetyhazardous-materials. The instructors, TA’s, and all students are required to review and understand the safety PowerPoint presentation and complete three main module tests by January 27, 2017. All questions of the three main tests must be answered correctly. There are an unlimited number of chances to get 100%. MAE policy states that the failure to take the online safety quiz or failure to obtain 100% on the quiz, will result in receiving a failing grade for the course. Any questions or issues (technical and content) with regards to the safety training material or quiz should be directed to the MAE Safety Team members listed below.

Kelsey Crawford: kelsey.crawford@mail.wvu.edu
Kathy Sabolsky: kathy.sabolsky@mail.wvu.edu

Inclusivity Statement:

The West Virginia University community is committed to creating and fostering a positive learning and working environment based on open communication, mutual respect, and inclusion. If you are a person with a disability and anticipate needing any type of accommodation in order to participate in this class, please advise me and make appropriate arrangements with the Office of Disability Services (293-6700). For more information on West Virginia University’s Diversity, Equity, and Inclusion initiatives, please see: http://diversity.wvu.edu.

Academic Integrity Statement:

The integrity of the classes offered by any academic institution solidifies the foundation of its mission and cannot be sacrificed to expediency, ignorance, or blatant fraud. Therefore, I will enforce rigorous standards of academic integrity in all aspects and assignments of this course. For the detailed policy of West Virginia University regarding the definitions of acts considered to fall under academic dishonesty and possible ensuing sanctions, please see the Student Conduct Code, located at the following web address:


Should you have any questions about possibly improper research citations or references, or any other activity that may be interpreted as an attempt at academic dishonesty, please see me before the assignment is due to discuss the matter. NASA disqualifies teams caught plagiarizing from participation in the RGEPF.

Example Schedule for MAE 431 Microgravity Research 2

<table>
<thead>
<tr>
<th>Subject</th>
<th>Time</th>
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<tbody>
<tr>
<td>Review Preliminary Design from MAE 430; Plan Project Timeline</td>
<td>Week 1</td>
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<tr>
<td>Finalize Experiment: Construct/Test/Optimize Experiment</td>
<td>Weeks 2-10</td>
</tr>
<tr>
<td>Testing of Completed Experiment</td>
<td>Week 10</td>
</tr>
<tr>
<td>Analyze Ground Test Data from Experiment(s)</td>
<td>Weeks 11-15</td>
</tr>
<tr>
<td>Submit Final Report to Course Instructor</td>
<td>COB on 4/28/17</td>
</tr>
<tr>
<td>Outreach Activities</td>
<td>Continuous</td>
</tr>
</tbody>
</table>