NOTE: Modifications to this syllabus may be required during the semester. Any changes to the syllabus will be announced in class.

Catalog Course Description: Static stability and control, equations of motion, stability derivatives, stability of longitudinal and lateral motion of aircraft. Credits: 3

Pre-requisites: EAS 4101 (Aerodynamics) and EML 4312 (Control of Mechanical Engineering Systems). Working knowledge of at least one programming language is required.

Course Objectives: This course will focus on the stability of different phases of aircraft flight. Following a glancing review of aerodynamics and propulsion; the equations of motion (both particle and rigid body) will be developed. Linear perturbation theory will be covered, leading to static stability in longitudinal, lateral and directional modes. The course will finish with dynamic stability and a peek into control methods.

By the end of the course, you should be able to:
(i) conceptually distinguish between various modes of aircraft flight, e.g. level flight, takeoff/landing, gliding etc.,
(ii) use Newton’s laws to write equations of motion of rigid body aircraft motion,
(iii) apply perturbation theory to linearize equations of motion, and
(iv) understand the meaning of stability coefficients and their relevance in aircraft design.

Contribution of course to meeting the professional component (ABET): The table below describes the contribution of this course to development of specific components of professional growth as described in the ABET program criteria. The components have been divided into three streams: aeronautical (ae), astronautical (as) and mechanical (me). There is high coverage for professional components (ae5), (ae6) and (me1) and medium coverage for (ae1). In addition to the program criteria described above, this course will also contribute to the development of proficiency in the subject of numerical methods and the use of computational tools to solve engineering problems.

<table>
<thead>
<tr>
<th>Aeronautical</th>
<th>Astronautical</th>
<th>Mechanical</th>
</tr>
</thead>
<tbody>
<tr>
<td>(ae1) Aerodynamics: ✓</td>
<td>(as1) Orbital mechanics: ×</td>
<td>(me1) Apply principles of engineering, basic science &amp; mathematics (inc. multivar. calculus &amp; differential eqns) to model, analyze, design &amp; realize physical systems, components or processes: ✓</td>
</tr>
<tr>
<td>(ae2) Aerospace materials: ×</td>
<td>(as2) Space environment: ×</td>
<td>✓</td>
</tr>
<tr>
<td>(ae3) Structures: ×</td>
<td>(as3) Attitude determination and control: ×</td>
<td>✓</td>
</tr>
<tr>
<td>(ae4) Propulsion: ×</td>
<td>(as4) Telecommunications: ×</td>
<td>✓</td>
</tr>
<tr>
<td>(ae5) Flight mechanics: ✓</td>
<td>(as5) Space structures: ×</td>
<td>✓</td>
</tr>
<tr>
<td>(ae6) Stability and control: ✓</td>
<td>(as6) Rocket propulsion: ×</td>
<td>✓</td>
</tr>
</tbody>
</table>

Mathematics: 30 %, Engineering Sciences: 70 %

Relationship of course to program outcomes (ABET): This course will meet several program outcomes as described in the ABET criteria, described in the table below. There will be high coverage for outcomes (a), (e) and (k) in this course. These outcomes will be assessed throughout the semester via
homework assignments (to be completed by individual effort) and selected problems on exams.

**Instructor:**
Mrinal Kumar (mrinalkumar@ufl.edu). Office Location: 306 MAE-A, Telephone: (352) 392-0886. Office hours: MW 4 PM - 5 PM. Also welcome to come in any other time if I am available.

**Teaching Assistant:** We have two teaching assistants, Mr. Yifei Sun and Mr. Jason Cantrell:

- Yifei Sun: Email: yfsun@ufl.edu (preferred), Tel: (352) 870-7743. Office Hours: Wed 3:00 PM - 4:30 PM, MAE-A 315.
- Jason Cantrell: Email: jasontcantrell@gmail.com (preferred), Tel (904) 553-8015. Office Hours: Mon Period 7 (1:55 PM - 2:45 PM), Wed Period 3 (9:35 AM - 10:25 AM), Thu Period 7 (1:55 PM - 2:45 PM), NEB 109.

**Class meeting times:** MWF, Period 6 (12:50 PM - 1:40 PM).

**Meeting location:** 303 MAE-A.

**Textbook/Software:**


   **Note:** This textbook is recommended, but not an absolute must. An electronic version is available from the UF library website. Even though following this book is highly recommended, attending class regularly and taking notes should be sufficient for doing well in this course. Classroom instruction will be boardwork intensive.


   **Note:** This is an excellent text but slightly advanced. Buying it is optional. Notes from relevant portions of this book will be provided in class (as required).

3. In addition to the above books, student must have access to at-least one programming language (e.g. MATLAB).

**Other recommended reading:**


**Note:** You do **not need** to buy the above books. They have been suggested as alternative reading material if you wish to explore the subject deeper.

**Course outline:**

The table below provides a tentative weekly schedule for this course. Please note that the table is meant only as a guideline and there may be significant variations depending on several factors, e.g. how easily the introductory material is grasped by the class, allowing me to proceed to more advanced topics.

<table>
<thead>
<tr>
<th>Material</th>
<th>Week #</th>
<th>Assignment Due?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brief review of aerodynamics &amp; propulsion (Chapters 1-2, Appendix B)</td>
<td>1 (Aug 22-26)</td>
<td>×</td>
</tr>
<tr>
<td>Aircraft Performance (Chapter 3)</td>
<td>2</td>
<td>✓</td>
</tr>
<tr>
<td>Coordinate systems, aircraft (particle) equations of motion, Euler’s eqns, perturbation theory (Chapters 4, 6)</td>
<td>4 (Sep 12-16)</td>
<td>×</td>
</tr>
<tr>
<td>Static stability: longitudinal and lateral (Chapter 5)</td>
<td>8 (Oct 10-14)</td>
<td>×</td>
</tr>
<tr>
<td>More on linearization (Chapter 6)</td>
<td>11</td>
<td>×</td>
</tr>
<tr>
<td>Dynamic stability (Chapter 7)</td>
<td>12 (Nov 7-10)</td>
<td>✓ (Midterm quiz)</td>
</tr>
<tr>
<td>Initial thoughts on control (Chapter 8)</td>
<td>16 (Dec 5-7)</td>
<td>×</td>
</tr>
</tbody>
</table>

**Attendance/Other expectations:**

Students are expected to attend all lectures although there are no penalties for missing classes. Any activity that acts as a distraction for other students (e.g. talking on phone/texting/Rubik’s cube/juggling etc.) is not permitted while class is in progress.

**Grading policy:**

Your homework assignments will be crucial to success - both in understanding the material and earning a good grade. All assignments are to be completed individually. You are encouraged to discuss assigned problems with fellow students, but you must turn in your own work. Shared computer programs will not be considered for evaluation. Details of grade distribution:

- **Weekly Assignments** (approximately 8): 35%
- **Mid-term quiz** (2): 30%
- **Final exam**: 35%

**Late assignment policy:** You are allowed to turn in 1 assignment late without penalty (your 1st late submission). The 2nd late submission will incur a penalty of 25% and 50% the 3rd onwards.

**Grading scale:**

<table>
<thead>
<tr>
<th>Score</th>
<th>Grade</th>
<th>Score</th>
<th>Grade</th>
<th>Score</th>
<th>Grade</th>
<th>Score</th>
<th>Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>93-100</td>
<td>A</td>
<td>86-89</td>
<td>B+</td>
<td>76-78</td>
<td>C+</td>
<td>66-68</td>
<td>D+</td>
</tr>
<tr>
<td>90-92</td>
<td>A-</td>
<td>82-85</td>
<td>B</td>
<td>72-75</td>
<td>C</td>
<td>62-65</td>
<td>D</td>
</tr>
<tr>
<td>79-81</td>
<td>B-</td>
<td>69-71</td>
<td>C-</td>
<td>59-64</td>
<td>D-</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The above table represents a guideline for letter-grade allocation. In borderline cases, I reserve the right to assign a grade different from the grade derived from the table above. Such an assignment will be based on the progressive performance of the student in the course. For example, a student ending up with a final score of 85 may be awarded an A- (instead of B+) if her performance has progressively improved.
over the course of the semester. A lower grade may similarly result.

Note: A C- will not be a qualifying grade for critical tracking courses. In order to graduate, students must have an overall GPA and an upper-division GPA of 2.0 or better (C or better). Note: a C- average is equivalent to a GPA of 1.67, and therefore, it does not satisfy this graduation requirement. For more information on grades and grading policies, please visit: http://www.registrar.ufl.edu/catalog/policies/regulationgrades.html

Make-up exam policy: You must obtain permission from me well in advance if you require to re-schedule your mid-term or end-term exam due to unavoidable circumstances. It may be difficult to accommodate last moment requests.

Honesty Policy: All students admitted to the University of Florida have signed a statement of academic honesty committing themselves to be honest in all academic work and understanding that failure to comply with this commitment will result in disciplinary action. This statement is a reminder to uphold your obligation as a UF student and to be honest in all work submitted and exams taken in this course and all others.

Accommodation for Students with Disabilities: Students Requesting classroom accommodation must first register with the Dean of Students Office. That office will provide the student with documentation that he/she must provide to the course instructor when requesting accommodation.

UF Counseling Services: Resources are available on-campus for students having personal problems or lacking clear career and academic goals. The resources include: Resources are available on-campus for students having personal problems or lacking clear career and academic goals. The resources include:

- UF Counseling & Wellness Center, 3190 Radio Rd, 392-1575, psychological and psychiatric services.
- Career Resource Center, Reitz Union, 392-1601, career and job search services.

Software Use: All faculty, staff and student of the University are required and expected to obey the laws and legal agreements governing software use. Failure to do so can lead to monetary damages and/or criminal penalties for the individual violator. Because such violations are also against University policies and rules, disciplinary action will be taken as appropriate. We, the members of the University of Florida community, pledge to uphold ourselves and our peers to the highest standards of honesty and integrity.