

 <b>FLORIDA ATLANTIC UNIVERSITY</b>	<b>NEW COURSE PROPOSAL</b> <b>Undergraduate Programs</b>		UUPC Approval <u>4-26-21</u> UFS Approval _____ SCNS Submittal _____ Confirmed _____ Banner Posted _____ Catalog _____
	<b>Department</b> Ocean & Mechanical Engineering  <b>College</b> COECS <i>(To obtain a course number, contact <a href="mailto:erudolph@fau.edu">erudolph@fau.edu</a>)</i>		
<b>Prefix</b> EAS  <b>Number</b> 4010	<i>(L = Lab Course; C = Combined Lecture/Lab; add if appropriate)</i>  <b>Lab Code</b>	<b>Type of Course</b> <input type="text" value="Lecture"/>	<b>Course Title</b> Flight Dynamics
<b>Credits</b> <i>(Review Provost Memorandum)</i>  3	<b>Grading</b> <i>(Select One Option)</i>  <b>Regular</b> <input checked="" type="radio"/> <b>Pass/Fail</b> <input type="radio"/> <b>Sat/UnSat</b> <input type="radio"/>	<b>Course Description</b> <i>(Syllabus must be attached; Syllabus Checklist recommended; see <a href="#">Guidelines</a>)</i>  This course provides an introduction to the flight dynamics, modeling and fundamental stability and control aspects of aircraft. The course covers aircraft roll, pitch and yaw static stability and control basics and develops the full nonlinear equations of motion. The concept of numerical simulation of these equations is also introduced. Finally, with the dynamic models in-hand, open-loop response to actuation of the control systems is analyzed and the concept of closed-loop aircraft control system design is presented.	
<b>Effective Date</b> <i>(TERM &amp; YEAR)</i>  Fall 2021	<b>Prerequisites, with minimum grade*</b>  EAS 4101 Aerodynamics		<b>Corequisites</b>   
		<b>Registration Controls</b> <i>(Major, College, Level)</i>   	
<i>*Default minimum passing grade is D-. Prereqs., Coreqs. &amp; Reg. Controls are enforced for all sections of course</i>			
<b>WAC/Gordon Rule Course</b>  <input type="radio"/> Yes <input checked="" type="radio"/> No  WAC/Gordon Rule criteria must be indicated in syllabus and approval attached to proposal. See <a href="#">WAC Guidelines</a> .		<b>Intellectual Foundations Program (General Education) Requirement</b> <i>(Select One Option)</i>  None  General Education criteria must be indicated in the syllabus and approval attached to the proposal. See <a href="#">GE Guidelines</a> .	
<b>Minimum qualifications to teach course</b> Ph.D Degree in Mechanical or Aerospace Engineering and equivalent			
<b>Faculty Contact/Email/Phone</b> Dr. S. Verma/ <a href="mailto:vermas@fau.edu">vermas@fau.edu</a> 954-924-7202		<b>List/Attach comments from departments affected by new course</b>   	
<b>Approved by</b> Department Chair <u>Mambr...</u> College Curriculum Chair <u>Daniel Meeroff</u> College Dean <u>Fred Bloetscher</u> UUPC Chair <u>Jerry Haky</u> Undergraduate Studies Dean <u>Edward Pratt</u> UFS President _____ Provost _____			<b>Date</b> <u>4-12-21</u> <u>4-15-21</u> <u>4-15-21</u> <u>4-26-21</u> <u>4-26-21</u> _____ _____

Email this form and syllabus to [mjenning@fau.edu](mailto:mjenning@fau.edu) seven business days before the UUPC meeting.

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Course Syllabus**

<b>1. Course title/number, number of credit hours</b>	
<b>EAS 4010 Flight Dynamics</b>	3 credit hours
<b>2. Instructional Method</b>	
<p>This class consists of lectures which will be conducted in-class and/or live using WebEx or Zoom, and recorded so students can watch the lectures at a later time and date. . Students will be accommodated as much as possible with their needs during the pandemic.</p> <p><b><u>You will need to have a computer (or laptop), a reliable WIFI access, and a webcam and micro-phone connected to your computer for this course.</u></b></p> <p>In the event you might not have a computer, there is a Laptop Loaner Program at FAU for first-generation, low-income students.  <a href="https://www.fau.edu/newsdesk/articles/fau-announces-laptop-loaner-program.php">https://www.fau.edu/newsdesk/articles/fau-announces-laptop-loaner-program.php</a></p> <p>In the event you might not have reliable internet access remotely, you may use the internet connection on campus. You may use the classroom during the live course times for watching lectures, and taking quizzes and exams. Note that there are only reduced seating capacities in the classroom, and only those who do not have reliable internet access should use the classroom. Social distancing must be strictly followed in the classroom at all times. You will need to make reservation for your seating every week on Canvas. The instructions for the reservation are provided at the following link:  <a href="https://fau.edu/oit/instructional/support/files/seatReservationTool_student.pdf">https://fau.edu/oit/instructional/support/files/seatReservationTool_student.pdf</a></p> <p><u>After two full weeks of face to face instruction with consecutive 'no show' of any students in person section in the classroom, the modality of this course section may be changed to remote instruction only at the discretion of the university.</u></p>	
<b>3. COVID 19 Statement</b>	
<p>All students in face-to-face classes are required to wear masks during class, and students must sanitize their own workstations upon entering the classroom. Taking these measures supports the safety and protection of the FAU community. Students who do not adhere to these rules will be asked to leave the classroom and/or be removed from the course. Students experiencing flu-like symptoms (fever, cough, shortness of breath), or students who have come in contact with an infected person should immediately contact FAU Student Health Services (561-297-3512).</p>	
<b>4. Course pre-requisites, co-requisites, and where the course fits in the program of study</b>	
<p><b>List Prerequisites, Co-requisites:</b>  Prerequisite: Aerodynamics (EAS 4101)</p> <p>If students have not completed the required prerequisites for the course and do not inform their course instructor and advisor, they will be dropped from the course. If this occurs after the first week of the semester, they will be fee liable to the University.</p>	
<b>5. Course logistics</b>	
<p><i>Term:</i> Fall 2021/Spring 2022</p> <p><i>Class location and time:</i>  :</p>	
<b>6. Instructor contact information</b>	
<i>Instructor's name</i> <i>Office address</i> <i>Office Hours</i> <i>Contact telephone number</i> <i>Email address</i>	

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<b>7. TA contact information</b>			
<i>TA's name</i> <i>Office address</i> <i>Office Hours</i> <i>Contact telephone number</i> <i>Email address</i>			
<b>8. Course description</b>			
This course provides an introduction to the flight dynamics, modeling and fundamental stability and control aspects of aircraft. The course covers aircraft roll, pitch and yaw static stability and control basics and develops the full nonlinear equations of motion. The concept of numerical simulation of these equations is also introduced. Finally, with the dynamic models in-hand, open-loop response to actuation of the control systems is analyzed and the concept of closed-loop aircraft control system design is presented.			
<b>9. Course objectives/student learning outcomes/program outcomes</b>			
<i>Course objectives</i>	1. Modeling and analysis of aircraft flight dynamics 2. Introduction to aeroelastic phenomena		
<i>Student learning outcomes &amp; relationship to ABET 1-7 objectives</i>	Students will be able to: <ol style="list-style-type: none"> <li>1. Calculate and analyze aircraft trim and static stability characteristics</li> <li>2. Analyze dynamic aircraft flight conditions using the non-linear state equations</li> <li>3. Assess aircraft stability from the linearized equations of motion</li> <li>4. Compute and demonstrate understanding of aircraft lateral and longitudinal modes and effects</li> <li>5. Demonstrate basic understanding of aircraft open-loop control response</li> <li>6. Demonstrate basic understanding of aircraft closed-loop control design concepts and approaches.</li> </ol>		
<b>10. Course evaluation method</b>			
Homework	40%		
Project	20%		
Midterm	20%		
Final	30%		
<b>11. Course grading scale</b>			
<b>A</b>	> 95%	<b>C+</b>	70 – 74.9
<b>A-</b>	90 – 94.9	<b>C</b>	65 – 69.9
<b>B+</b>	85 – 89.9	<b>C-</b>	60 – 64.9
<b>B</b>	80 – 84.9	<b>D</b>	50 – 59.9
<b>B-</b>	75 – 79.9	<b>F</b>	< 50
<b>Note: The minimum grade required to pass the course is C.</b>			
<b>12. Policy on makeup tests, late work, and incompletes</b>			
Late work will not be accepted unless there is solid evidence of a medical or otherwise serious emergency that prevented the student from completing the assignments on time. Incomplete grades are against the policy of the department. Unless there is solid evidence of medical or otherwise serious emergency situation, incomplete grades will not be given.			

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**13. Special course requirements**

**Special instructions due to hybrid teaching restrictions:**

1. Canvas registration is required.
2. The instructor will regularly post materials/announcements on Canvas. It is student's responsibility to regularly check Canvas and their FAU email for the most recent information.
3. No hard-copy handouts will be provided. Copies will be posted in files on Canvas
4. Attendance is required. All classes will be hybrid, with the live-remote session delivered via WebEx in Canvas. You are expected to participate in all sessions and keep up with the material.
5. Students need a reliable internet condition capable of streaming WebEx lectures, taking exams on Canvas, etc. Recommended: Broadband Internet connection with a speed of 4 Mbps or higher. To function properly, Canvas requires a high-speed Internet connection (cable modem, DSL, satellite broadband, T1, etc.). The minimum Internet connection speed to access Canvas is a consistent 1.5 Mbps (megabits per second) or higher
6. Students should have an operational computer system equipped with Windows 10 or macOS Sierra (or higher), Microsoft Office, web browser, a webcam, speakers, and microphone, which should be compatible with the most recent version of LockDown Browser, Respondus Monitor, Cisco WebEx, etc.
7. All exams will be held using either LockDown Browser and Respondus Monitor, or live via Zoom/WebEx, as determined by the instructor. More information will be provided as we get closer to exams. You must be able to scan answers and upload them to Canvas during tests. Please test this BEFORE the exam.
8. These are the links where you can find the steps to use your cell phone as a webcam.

For Android:

<https://helpdesk.fau.edu/TDClient/2061/Portal/KB/ArticleDet?ID=104057>

For iPhone or iPad

<https://helpdesk.fau.edu/TDClient/2061/Portal/KB/ArticleDet?ID=104056>

More details will be announced throughout the semester. It is the students' responsibility to review and follow communications posted by the instructor.

**14. Classroom etiquette policy**

University policy requires that in order to enhance and maintain a productive atmosphere for education, personal communication devices, such as cellular phones, are to be turned off in class sessions.

**15. Attendance Policy Statement**

Students are expected to attend all of their scheduled University classes and to satisfy all academic objectives as outlined by the instructor. The effect of absences upon grades is determined by the instructor, and the University reserves the right to deal at any time with individual cases of non-attendance.

Students are responsible for arranging to make up work missed because of legitimate class absence, such as illness, family emergencies, military obligation, court-imposed legal obligations or participation in University approved activities. Examples of University-approved reasons for absences include participating on an athletic or scholastic team, musical and theatrical performances and debate activities. It is the student's responsibility to give the instructor notice prior to any anticipated absences and within a reasonable amount of time after an unanticipated absence, ordinarily by the next scheduled class meeting. Instructors must allow each student who is absent for a University-approved reason the opportunity to make up work missed without any reduction in the student's final course grade as a direct result of such absence.

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<b>16. Disability Policy Statement</b>
In compliance with the Americans with Disabilities Act Amendments Act (ADAAA), students who require reasonable accommodations due to a disability to properly execute coursework must register with Student Accessibility Services (SAS) and follow all SAS procedures. SAS has offices across three of FAU's campuses – Boca Raton, Davie and Jupiter – however disability services are available for students on all campuses. For more information, please visit the SAS website at <a href="http://www.fau.edu/sas/">www.fau.edu/sas/</a>
<b>17. Counseling and Psychological Services Center</b>
Life as a university student can be challenging physically, mentally and emotionally. Students who find stress negatively affecting their ability to achieve academic or personal goals may wish to consider utilizing FAU's Counseling and Psychological Services (CAPS) Center. CAPS provides FAU students a range of services – individual counseling, support meetings, and psychiatric services, to name a few – offered to help improve and maintain emotional well-being. For more information, go to <a href="http://www.fau.edu/counseling/">http://www.fau.edu/counseling/</a>
<b>18. Code of Academic Integrity Policy Statement</b>
Students at Florida Atlantic University are expected to maintain the highest ethical standards. Academic dishonesty is considered a serious breach of these ethical standards, because it interferes with the university mission to provide a high quality education in which no student enjoys unfair advantage over any other. Academic dishonesty is also destructive of the university community, which is grounded in a system of mutual trust and place high value on personal integrity and individual responsibility. Harsh penalties are associated with academic dishonesty. See University Regulation 4.001 at <a href="http://www.fau.edu/regulations/chapter4/4.001_Code_of_Academic_Integrity.pdf">www.fau.edu/regulations/chapter4/4.001_Code_of_Academic_Integrity.pdf</a>
Cell phones are not allowed during exams. If cell phones are detected during any exam periods, this will result in a <b>grade of "zero" on that exam and a note in the student's academic file.</b>
<b>19. Required texts/reading/Lab kits</b>
<b>20. Supplementary/recommended readings</b>
<b>21. Course topical outline, including dates for exams/quizzes, papers, completion of reading</b>
<b><u>Topics:</u></b> 1. Introduction a. Review b. Aerodynamic Nomenclature 2. Aircraft Static Stability and Control a. Definitions b. Longitudinal Static Stability c. Longitudinal Control d. Directional Stability and Control e. Roll Stability and Roll Control 3. Introduction to Static Aeroelastic Phenomena a. Divergence analysis using a Spring restrained Airfoil Model b. Location of Elastic Axis versus Aerodynamic Center c. Torsional Divergence d. Sweep Effects e. Aileron Reversal 4. Aircraft Equations of Motion a. Review b. Coordinate Systems and transformations c. Derivatives in Rotating Frames

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- d. Translational Equations
- e. Rotational Equations
- f. Effect of spinning rotors
- 5. Linearization
  - a. Small Disturbance Theory
  - b. Aerodynamic Force and Moment Derivatives Lateral-Directional
  - c. Equations of Motion
  - d. Equations of Motion in a Non-uniform Atmosphere
- 6. Aircraft Longitudinal Dynamics
  - a. Review of modal analysis
  - b. Longitudinal Motion
  - c. Approximations
  - d. Influence of Stability Derivatives
  - e. Transfer Functions
  - f. Flying Qualities
- 7. Aircraft Lateral Dynamics
  - a. Lateral-Directional Equations
  - b. Dutch Roll, Roll and Spiral Modes
  - c. Modal Analysis
  - d. Approximate Models
  - e. Transfer Functions
  - f. Flying Qualities
- 8. Introduction to Dynamic Aeroelastic Phenomena
  - a. Lift Deficiency Function
  - b. Flutter Analysis using a 2DOF Pitch-Plunge Model
  - c. Wing Flutter
  - d. IX. Aircraft Flight Control System Design 6
  - e. Longitudinal SAS and SCAS Designs
  - f. Lateral SAS and SCAS Designs