

SYLLABUS FOR AE 5362/MAE 4301: Guidance, Navigation and Control of Aerospace Vehicles

Course (Catalog) Description: AE 5362: Guidance, Navigation and Control of Aerospace Vehicles (3-0) 3 hours credit. Design of guidance and navigation systems for various aerospace vehicles. Discussion of the various guidance and control systems used in missile systems and launch vehicles. Equilibrium glide trajectories for atmospheric flight, energy guidance methods. Selection and trade-off between various navigation components such as the IMU, GPS and other navigation components. Multi-sensor fusion.

Prerequisites: MAE 3319 or MAE 3405 or MAE 4310 or EE 5322 (Linear Systems) or equivalent

Instructor: Dr. Kamesh Subbarao, Associate Professor, Mechanical and Aerospace Engineering Dept., 315 G Woolf Hall, (817) 272 7467, Office hours: By Appointment, Email: subbarao@uta.edu

Teaching Assistant: None

Office Hours: TuTh 11:00 AM - 12:30 PM

Textbook and/or other required material: There is no prescribed textbook but the following are good references for the material to be covered in this course.

- Modern Navigation, Guidance and Control Processing Volume-II, Ching-Fang Lin, Prentice Hall Series in Advanced Navigation, Guidance and Control and Their Applications.
- Tactical and Strategic Missile Guidance, Paul Zarchan, AIAA Progress in Astronautics and Aeronautics
- Advances in Missile Guidance Theory, Joseph Z. Ben-Asher and Issac Yaesh, AIAA Progress in Astronautics and Aeronautics
- Software: MATLAB Student Edition/Control Toolbox by Mathworks Inc.

Class Schedule: NH 109, TuTh 9:30 AM - 10:50 AM

Contribution of course to meeting the professional component: Engineering science - 3 hours credit.

Course Objectives

- Develop mathematical models that characterize aerospace vehicle dynamics.
- Develop linear control laws.
- Develop linear guidance and navigation laws.
- Analyze performance of the integrated guidance and navigation controller.

Course Content:

- Aerospace Vehicle Dynamics Review

- Review of governing equations of motion for aerospace vehicles
- Linear systems analysis of aerospace systems
- Applications - aircraft, spacecraft, missiles, launch vehicles
- Basic linear control laws for aerospace applications
- Guidance Processing
 - Guidance mission and performance
 - Optimal guidance
 - Guidance algorithm - guidance laws, single-dual-multimode guidance
 - Advanced guidance system design
 - Practical navigation and guidance filter design
- Inertial Navigation
 - Navigation computation and error modeling
 - Inertial navigation systems
 - External navigation aids - GPS, Doppler radar, Star trackers
 - Integrated inertial navigation system - Integrated sensing/flight control, Integrated missile guidance systems
- Advanced Topics
 - Multisensor fusion
 - Game theory applied to missile guidance
 - Sensitivity analysis of navigation and guidance laws
 - Robust navigation and guidance laws
 - Optimal guidance with multiple targets

Course Requirements:

Attendance- Class attendance is required.

Final Examination- The final examination will be **comprehensive** and test you on all aspects of the material covered in the class.

Homework- A number of homework assignments will be given during this course. Homework is due in class on the assigned date before the actual class begins. Late homework will not be accepted, unless in cases of unforeseen circumstances such as medical conditions. Each such instance will be dealt with on a case by case basis. MATLAB/SIMULINK will be used extensively for homework. Students are allowed to discuss concepts. Any other form of collaboration such as sharing code, results is not allowed.

Project- There will be one project that illustrates concepts discussed in the class. For the project, you may either reproduce the results of a Journal Article (not authored by you) or choose to work on a problem in consultation with the instructor. The topic for the project has to be chosen and approved by the instructor on or before February 18, 2014.

Grade Allocation: Grading follows the standard format. $A = 90\%$ and above, $B = 80\% - 89\%$, $C = 70\% - 79\%$, $D = 60\% - 69\%$.

Weightages for final grade calculation: Final 25%; Homeworks 50%; Project 25%.

University Policies:

Email to Faculty- To contact a faculty member use the email address provided in the syllabus. Use as the “subject line”: [AE5362]. Put your name inside the email message, start with the main point/question of the message. Emails from outside the UTA domain are subject to be treated as SPAM by the server and deleted. Unsigned emails will not be replied to and will be deleted.

Student Evaluation of Teaching- You will be asked to complete feedback forms at the end of the semester.

Absences Based on Religious Beliefs- A student who misses an examination, work assignment, or other project due to the observance of a religious holy day will be given the opportunity to complete the work missed. To be eligible for such a make-up the student must notify his/her instructor in writing within the first 15 days of class. Failure to follow the rules provided above within the time frames listed will result in the absence being considered unexcused.

American with Disabilities Act- The University of Texas at Arlington is on record as being committed to both the spirit and letter of federal equal opportunity legislation; reference Public Law 93112 – The Rehabilitation Act of 1973 as amended. With the passage of new federal legislation entitled Americans With Disability Act - (ADA), pursuant to section 504 of The Rehabilitation Act, there is renewed focus on providing this population with the same opportunities enjoyed by all citizens. As faculty members, we are required by law to provide “*reasonable accommodation*” to students with disabilities, so as not to discriminate on the basis of that disability. Student responsibility primarily resets with *informing faculty at the beginning of the semester and in providing authorized documentation through designated administrative channels*. For more information contact the Office of Students with Disabilities at 817-272-3364.

Academic Dishonesty- It is the philosophy of The University of Texas at Arlington that academic dishonesty is a completely unacceptable mode of conduct and will not be tolerated in any form. All persons involved in academic dishonesty will be disciplined in accordance with University regulations and procedures. Discipline may include suspension or expulsion from the University. “Scholastic dishonesty includes but is not limited to cheating, plagiarism, collusion, the submission for credit of any work or materials that are attributable in whole or in part to another person, taking an examination for another person, any act designed to give unfair advantage to a student or the attempt to commit such acts.” (Regents Rules and Regulations, Part One, Chapter VI, Section 3, Subsection 3.2, Subdivision 3.22)

Student Support Services Available- The University of Texas at Arlington provides a variety of resources and programs designed to help students develop academic skills, deal with personal situations, and better understand concepts and information related to their courses. These resources include tutoring, major-based learning centers, developmental education, advising and mentoring, personal counselling, and federally funded programs. For individualized

referrals to resources for any reason, students may contact the Maverick Resource Hotline at 817-272-6107 or visit www.uta.edu/resources for more information.

Inclement Weather Policy- In the event the weather or other conditions are such that normal campus operations could be impeded the following policy will apply for this class. If the University is closed this class will not meet. Any assignments due or examinations scheduled will be due or rescheduled to the very next class period that the class meets. Local media should announce any such closings. You can also get information by dialing (972) 601-2049

Notice- The instructors reserve the right to make changes to the course syllabus as necessary. It is the student's responsibility to keep up with the changes to the syllabus as posted on the class website.