

## Introduction to Unmanned Vehicle Systems Fall 2016

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### Section Information:

AE 5378-001 LEC	INTRO TO UNMANNED VEHICLE SYST
MAE 4378-001 LEC	INTRO TO UNMANNED VEHICLE SYST
ME 5378-001 LEC	INTRO TO UNMANNED VEHICLE SYST
EE 4378-001 LEC	INTRO UNMANNED VEHICLES
CSE 4378-001 LEC	INTRO TO UNMANNED VEHICLE SYST
CSE 5383-001 LEC	INTRO-UNMANNED VEHICLE SYSTEMS
IE 4378-001 LEC	INTRO TO UNMANNED VEHICLE SYST
IE 5378-001 LEC	INTRO TO UNMANNED VEHICLE SYST
EE 6321-001	INTRO TO UNMANNED VEHICLE SYS

**Time and Place of Class Meetings:** NH 105, Mon. – Wed. 4:00 PM to 5:20 PM

**Description of Course Content:** Introduction to UVS (Unmanned Vehicle Systems) such as UAS (Unmanned Aircraft Systems), UGS (Unmanned Ground System) and UMS (Unmanned Maritime System), their history, missions, capabilities, types, configurations, subsystems, and the disciplines needed for UVS development and operation. UVS missions could include student competitions sponsored by various technical organizations. This course is team-taught by engineering faculty. Prerequisite: Admission to a professional engineering or science program.

**Student Learning Outcomes:** This course is designed to provide students with a general overview of technologies and engineering methods used to develop and deploy Unmanned Vehicle Systems. This course explicitly takes a multi-disciplinary approach to presenting unmanned systems. The class will be team-taught with faculty from the Electrical, Computer Science, Mechanical, Aerospace, and Industrial Engineering Departments. This course is designed to present the student with materials that would typically fall outside his/her main area of study challenging the student to explore the inherently multi-

disciplinary nature of today's complex engineered systems. This course is the first course of a common two course sequence that forms the foundation of an Undergraduate and Graduate UVS Certificate program offered in the Electrical Engineering, Computer Science Engineering, Mechanical and Aerospace Engineering, and Industrial and Manufacturing Systems Engineering Departments.

**By the end of the course, you should be able to:**

- Describe the common types, missions and roles of Unmanned Vehicle Systems
- Identify and list the common subsystems and technologies deployed in UVS
- Use the Matlab/Simulink toolsets to model unmanned systems
- Discuss the various types of sensors used within UVS and describe suitable sensor fusion methods
- Describe the common methods used by UVS to perform Guidance, Navigation, & Control functions
- Describe the approaches and technologies used to create UVS man/machine interfaces

**Course Schedule.**

The following is a list of topics to be covered in this course:

**Introduction** (two class periods): Class objectives, introduction to the types, history, and missions & roles of unmanned vehicle systems.

**Systems Engineering** (one class period): An introduction to the systems development lifecycle.

**Matlab/Simulink** (two class periods): An introduction to the Matlab/Simulink toolsets with examples relevant to the development of unmanned vehicle systems.

**Mobile Platforms** (three class periods): These classes will introduce vehicle design, system dynamics, and vehicle structures.

**Power Systems** (one class period): An introduction into vehicle propulsion systems and the generation and storage of power on UVS.

**Feedback Control** (one class period): An introduction to feedback control theory and its application to UVS.

**Test 1 (in-class exam)**: Scheduled for the 6<sup>th</sup> week of class.

**Sensors** (two class periods): Classes will provide an introduction to the classes of sensors typically found on unmanned vehicle systems. Sensors used for mobility platform control and those utilized within payloads will be discussed.

**Sensor Fusion** (one class period): Techniques, like Kalman Filters, used to combine sensor inputs to create more robust estimates of environmental conditions and system states will be presented.

**Localization & Mapping** (two class periods): Methods used to determine the vehicle's position within a given reference frame and techniques used to map the UVS operational environment will be reviewed.

**Guidance, Navigation, & Control** (three class periods): Topics relating to vehicle guidance and path planning, navigation, vehicle control, and mission planning will be presented.

**Communications** (two class periods): Topics relating to the creation and maintenance of communications channels within the UVS. Specific topics include: networks, protocols, security, and architectures.

**Autonomy** (two class periods): An introduction into systems autonomy. Various autonomous vehicle control architectures will be presented and discussed.

**Human/Operator Interface** (two class periods): Methods and technologies used to communicate the operator's intent to the unmanned vehicle will be presented. Topics will include: data displays, mission input, and the man-mission interface.

**Integrative Infrastructure** (two class periods): Methods, techniques, and tool used to effectively integrate complex electromechanical systems will be presented. Topics will include: computing architectures, common software, and modular hardware.

**Final Class** (one class period): This class will attempt to summarize and integrate the major themes in the course. The follow-on Unmanned Vehicle Systems Development course will be discussed.

**Test 2 (in-class exam)**: Taken at the official exam time associated with the class time during finals week.

*The instructors for this course reserve the right to adjust this schedule in any way that serves the educational needs of the students enrolled in this course.*

**Required Textbooks and Other Course Materials:** There is no required text for this course. Notes and supplemental materials will be provided by the course instructors.

**Descriptions of major assignments and examinations:** There will be two tests. The two exams will be taken in class. There will be one take home exam. The second in class exam will be taken during Finals Week at the official exam time assigned to the class.

**Attendance:** Attendance of the class is required.

**Other Requirements:** Undergraduate Students must be accepted into the professional program within their home engineering department. Graduate students must be in good academic standing at the time of enrollment for the class. Degreed Undergraduates seeking to obtain a UVS Certificate without pursuing a Masters degree, must be accepted into one of the departmental Graduate UVS Certificate programs.

**Grading:** The following items will be graded and used to determine the final class grade.

Five or Six Homework Assignments	30%
Test 1 – In class test	30%
Test 2 – In class test	30%
Class Participation/Pop Quizzes	10%

The following scale will be used to assign class grades:

A	90% - 100%
B	80% - 89%
C	70% - 79%
D	60% - 69%
F	less than 60%

Students are expected to keep track of their performance throughout the semester and seek guidance from available sources (including the instructor) if their performance drops below satisfactory levels.

**Attendance:** Attendance of the class is required. At The University of Texas at Arlington, taking attendance is not required but attendance is a critical indicator in student success. Each faculty member is free to develop his or her own methods of evaluating students' academic performance, which includes establishing course-specific policies on attendance. As the instructors of this section, we reserve the right to take attendance sporadically, or use some other mechanism like an unannounced Quiz or signup sheet, to determine if you are attending class on any given date. However, while UT Arlington does not require instructors to take attendance in their courses, the U.S. Department of Education requires that the University have a mechanism in place to mark when Federal Student Aid recipients "begin attendance in a course." UT Arlington instructors will report when students begin attendance in a course as part of the final grading process. Specifically, when assigning a student a grade of F, faculty report the last date a student attended their class based on evidence such as a test, participation in a class project or presentation, or an engagement online via Blackboard. This date is reported to the Department of Education for federal financial aid recipients.

**Grade Grievances:** Any appeal of a grade in this course must follow the procedures and deadlines for grade-related grievances as published in the current University Catalog. [Some instructors opt to cut and paste the relevant policy here. Every school or college must create his/her/its own grade grievance policy. For undergraduate courses, see <http://catalog.uta.edu/academicregulations/grades/#undergraduatetext>; for graduate courses, see <http://catalog.uta.edu/academicregulations/grades/#graduatetext>. For student complaints, see <http://www.uta.edu/deanofstudents/student-complaints/index.php>.

**Drop Policy:** Students may drop or swap (adding and dropping a class concurrently) classes through self-service in MyMav from the beginning of the registration period through the late registration period. After the late registration period, students must see their academic advisor to drop a class or withdraw. Undeclared students must see an advisor in the University Advising Center. Drops can continue through a point two-thirds of the way through the term or session. It is the student's responsibility to officially withdraw if they do not plan to attend after registering. **Students will not be automatically dropped for non-attendance.** Repayment of certain types of financial aid administered through the University may be required as the result of dropping classes or withdrawing. For more information, contact the Office of Financial Aid and Scholarships (<http://wweb.uta.edu/aao/fao/>).

**Disability Accommodations:** UT Arlington is on record as being committed to both the spirit and letter of all federal equal opportunity legislation, including *The Americans with Disabilities Act (ADA)*, *The Americans with Disabilities Amendments Act (ADAAA)*, and *Section 504 of the Rehabilitation Act*. All instructors at UT Arlington are required by law to provide "reasonable accommodations" to students with disabilities, so as not to discriminate on the basis of disability. Students are responsible for providing the instructor with official notification in the form of **a letter certified** by the Office for Students with Disabilities (OSD). Only those students who have officially documented a need for an accommodation will have their request honored. Students experiencing a range of conditions (Physical, Learning, Chronic Health, Mental Health, and Sensory) that may cause diminished academic performance or other barriers to learning may seek services and/or accommodations by contacting:

**The Office for Students with Disabilities, (OSD)** [www.uta.edu/disability](http://www.uta.edu/disability) or calling 817-272-3364. Information regarding diagnostic criteria and policies for obtaining disability-based academic accommodations can be found at [www.uta.edu/disability](http://www.uta.edu/disability).

Counseling and Psychological Services, (CAPS) [www.uta.edu/caps/](http://www.uta.edu/caps/) or calling 817-272-3671 is also available to all students to help increase their understanding of personal issues, address mental and behavioral health problems and make positive changes in their lives.

**Non-Discrimination Policy:** *The University of Texas at Arlington does not discriminate on the basis of race, color, national origin, religion, age, gender, sexual orientation, disabilities, genetic information, and/or veteran status in its educational programs or activities it operates. For more information, visit [uta.edu/eos](http://uta.edu/eos).*

**Title IX Policy:** The University of Texas at Arlington ("University") is committed to maintaining a learning and working environment that is free from discrimination based on sex in accordance with Title IX of the Higher Education Amendments of 1972 (Title IX), which prohibits discrimination on the basis of sex in educational programs or activities; Title VII of the Civil Rights Act of 1964 (Title VII), which prohibits sex discrimination in employment; and the Campus Sexual Violence Elimination Act (SaVE Act). Sexual misconduct is a form of sex discrimination and will not be tolerated. *For information regarding Title IX, visit [www.uta.edu/titleIX](http://www.uta.edu/titleIX) or contact Ms. Jean Hood, Vice President and Title IX Coordinator at (817) 272-7091 or [jmhood@uta.edu](mailto:jmhood@uta.edu).*

**Academic Integrity:** Students enrolled all UT Arlington courses are expected to adhere to the UT Arlington Honor Code:

*I pledge, on my honor, to uphold UT Arlington's tradition of academic integrity, a tradition that values hard work and honest effort in the pursuit of academic excellence.*

*I promise that I will submit only work that I personally create or contribute to group collaborations, and I will appropriately reference any work from other sources. I will follow the highest standards of integrity and uphold the spirit of the Honor Code.*

UT Arlington faculty members may employ the Honor Code in their courses by having students acknowledge the honor code as part of an examination or requiring students to incorporate the honor code into any work submitted. Per UT System *Regents' Rule* 50101, §2.2, suspected violations of university's standards for academic integrity (including the Honor Code) will be referred to the Office of Student Conduct. Violators will be disciplined in accordance with University policy, which may result in

the student's suspension or expulsion from the University. Additional information is available at <https://www.uta.edu/conduct/>.

**Electronic Communication:** UT Arlington has adopted MavMail as its official means to communicate with students about important deadlines and events, as well as to transact university-related business regarding financial aid, tuition, grades, graduation, etc. All students are assigned a MavMail account and are responsible for checking the inbox regularly. There is no additional charge to students for using this account, which remains active even after graduation. Information about activating and using MavMail is available at <http://www.uta.edu/oit/cs/email/mavmail.php>.

**Campus Carry:** Effective August 1, 2016, the Campus Carry law (Senate Bill 11) allows those licensed individuals to carry a concealed handgun in buildings on public university campuses, except in locations the University establishes as prohibited. Under the new law, openly carrying handguns is not allowed on college campuses. For more information, visit <http://www.uta.edu/news/info/campus-carry/>

**Student Feedback Survey:** At the end of each term, students enrolled in face-to-face and online classes categorized as "lecture," "seminar," or "laboratory" are directed to complete an online Student Feedback Survey (SFS). Instructions on how to access the SFS for this course will be sent directly to each student through MavMail approximately 10 days before the end of the term. Each student's feedback via the SFS database is aggregated with that of other students enrolled in the course. Students' anonymity will be protected to the extent that the law allows. UT Arlington's effort to solicit, gather, tabulate, and publish student feedback is required by state law and aggregate results are posted online. Data from SFS is also used for faculty and program evaluations. For more information, visit <http://www.uta.edu/sfs>.

**Final Review Week:** for semester-long courses, a period of five class days prior to the first day of final examinations in the long sessions shall be designated as Final Review Week. The purpose of this week is to allow students sufficient time to prepare for final examinations. During this week, there shall be no scheduled activities such as required field trips or performances; and no instructor shall assign any themes, research problems or exercises of similar scope that have a completion date during or following this week *unless specified in the class syllabus*. During Final Review Week, an instructor shall not give any examinations constituting 10% or more of the final grade, except makeup tests and laboratory examinations. In addition, no instructor shall give any portion of the final examination during Final Review Week. During this week, classes are held as scheduled. In addition, instructors are not required to limit content to topics that have been previously covered; they may introduce new concepts as appropriate.

**Emergency Exit Procedures:** Should we experience an emergency event that requires us to vacate the building, students should exit the room on the left and move toward the nearest clear exit, which is located at the ends of the hallway on either your left front of the lecture hall or from the back of the lecture hall. If exiting from the front of NH 105 there are exits out of Nedderman Hall to both the Right after exiting into the atrium or to the left when exiting into the atrium. If you exit from the back of the lecture hall you will exit directly out of Nedderman Hall. When exiting the building during an emergency, one should never take an elevator but should use the stairwells. Faculty members and instructional staff will assist students in selecting the safest route for evacuation and will make arrangements to assist individuals with disabilities.

Students are encouraged to subscribe to the MavAlert system that will send information in case of an emergency to their cell phones or email accounts. Anyone can subscribe at <https://mavalert.uta.edu/> or <https://mavalert.uta.edu/register.php>

**Student Support Services:** UT 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. Resources include [tutoring](#), [major-based learning centers](#), developmental education, [advising and mentoring](#), personal counseling, and [federally funded programs](#). For individualized referrals, students may visit the reception desk at University College (Ransom Hall), call the Maverick Resource Hotline at 817-272-6107, send a message to [resources@uta.edu](mailto:resources@uta.edu), or view the information at <http://www.uta.edu/universitycollege/resources/index.php>.

**The IDEAS Center** (2<sup>nd</sup> Floor of Central Library) offers **free** tutoring to all students with a focus on transfer students, sophomores, veterans and others undergoing a transition to UT Arlington. To schedule an appointment with a peer tutor or mentor email [IDEAS@uta.edu](mailto:IDEAS@uta.edu) or call (817) 272-6593.

**The English Writing Center (411LIBR)**: The Writing Center Offers free tutoring in 20-, 40-, or 60-minute face-to-face and online sessions to all UTA students on any phase of their UTA coursework. Our hours are 9 am to 8 pm Mon.-Thurs., 9 am-3 pm Fri. and Noon-6 pm Sat. and Sun. Register and make appointments online at <http://uta.mywconline.com>. Classroom Visits, workshops, and specialized services for graduate students are also available. Please see [www.uta.edu/owl](http://www.uta.edu/owl) for detailed information on all our programs and services.

The Library's 2<sup>nd</sup> floor Academic Plaza offers students a central hub of support services, including IDEAS Center, University Advising Services, Transfer UTA and various college/school advising hours. Services are available during the library's hours of operation. <http://library.uta.edu/academic-plaza>

<p><b>Emergency Phone Numbers:</b> In case of an on-campus emergency, call the UT Arlington Police Department at <b>817-272-3003</b> (non-campus phone), <b>2-3003</b> (campus phone). You may also dial 911. Non-emergency number 817-272-3381</p>
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