University of Idaho

Industrial Technology (IndT) 473

Fundamentals of Unmanned Aerial Systems

3 Credit Hours 16 Weeks
Spring Semester 2022 Year
Prerequisite(s): General technical background

Instructor Information

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E-mail is the preferred medium of communication for any changes to the class schedule. All e-mail notifications will be sent to the student's University of Idaho account only. Course information can be found on Canvas in the Courses section.

Course Description (Catalog)

The course introduces students to unmanned aerial systems (UAS) and provides an overview of UAS types, applications, and operation considerations. The general principles of aerodynamics, propulsion, navigation and stability control applied to UAS are studied. The course provides an in-depth coverage of the main components integrated into both civilian and military UAS, such as payloads, ground control systems, communication data links, and launch/recovery systems.

Course Scope

Fundamentals of unmanned aerial systems, providing coverage of applications, regulations, navigation principles, payloads, and ground communication.

Course Objectives

After the completion of the course, students should demonstrate the ability to:

1. Understand the fundamental aspects of UAS operation, navigation, and propulsion.
2. Distinguish between different UAS platforms, and define the main operational characteristics of the individual UAS types.
3. Indicate the principal components in the modern UAS, and understand their integration in accomplishing application/mission goals.

4. Identify and select payloads and sensors for usage in different UAS applications, based upon required performance and applicable data rates.
5. Outline the current federal airspace regulations in registering and operating UAS, and related civil issues.
6. Describe current methods and principles in UAS mission planning and control, and launching/recovery systems.

Learning Outcomes and Competencies

The course provides the students with the ability to:

1. Apply theories and principles from mathematics, physical science, and computer applications and information technology to solve practical technology problems (1a).
2. Draw conclusions from and explain information synthesized from several sources (3b).
3. Demonstrate ability to adapt emerging technologies (4c).
4. Recognize and evaluate the impact of engineering decisions in a global and societal context (4d).

Note: The numbers in parentheses refer to Learning Outcomes and Competencies for the Industrial Technology program at the University of Idaho, as defined by the Advisory Board. The full list of learning outcomes and competencies at the following link.

Project Information

A project is required for successful completion of the course. The project involves operation of a small UAS for agricultural monitoring and assessment of crop health in a field. The first part of the project includes pre-flight mission planning, flying path definition, flying the mission, and collecting images of a defined area. In the second part of the project, the students will use a software package to process the acquired images, and extract information of the crop health and related vegetation indices. For the first part of the project the class will meet on a day that everyone is available (possibly Friday, Saturday, or Sunday, we will discuss it with everyone in the class). The date for the meeting will also depend on the weather conditions (e.g., chances of rain, and wind intensity). Additional information regarding the project will be posted on Canvas.

Course Materials

Textbook: Paul Fahlstrom, Thomas Gleason
"***Introduction to UAV Systems***"
4nd edition, 308 pages, Wiley, 2012
ISBN: 978-1119978664

Optional Reference Materials

Supplementary course material will be posted on the course home page on Canvas.

Evaluation Procedures

The course is delivered in a hybrid format, and it includes both live classroom meetings and web-based lectures. The dates of the class meetings are indicated in the Course Outline below. Participation in all class meetings is expected. In the case of illness or another event that would prevent attendance, the students must inform the course instructor.

Examination: There is one mid-semester examination, and one final examination. The dates of each examination are indicated in the Course Outline below. Failure to take the exams on the due dates, without prior approval, will result in zero marks. Prior approval could be granted only under acceptable circumstances. Information regarding the course project is outlined in the Project Information section above.

Assignments: There are four homework assignments. The due dates for the homework assignments are indicated in the Course Outline below.

Grading/Evaluation Procedure:

Homework Assignments (4×10)	40 marks
Midterm Exam	20 marks
Project	20 marks
Final Exam	20 marks
Total	100 marks

Final Grades:	Above 90	A
	80 – 89	B
	70 – 79	C
	60 – 69	D
	Below 60	F

Example of Assessment of Learning Outcomes: Students' ability to adapt emerging technologies will be assessed through the course project. The students are expected to operate an unmanned aerial system and use a multispectral image sensor for completing the task of collecting aerial images of an agricultural field. With that, the students will demonstrate an ability to deal with emerging technology. The assessment pertains to Competency #3 listed in the above section on Learning Outcomes and Competencies.

Course Outline

Date	Topics	Course Objectives	Learning Outcomes	Readings	Assignments/ Meetings
Jan. 18	**Introduction to UAS**	1, 2	2, 4	Chapter 1	**Class Meeting**
Jan. 25	**UAS Categories and Classification, Application Domains**	1, 2	4	Chapters 1, 2	

Feb. 1	**Federal Regulations**	5	4	Lecture Notes	HW 1 Due
Feb. 8	**Basic Aerodynamics**	1, 3	1	Chapters 3, 4, 6	**Class Meeting**
Feb. 15	**Stability and Control, Sources of Power**	1, 3	2, 4	Chapters 5, 6	
Feb. 22	**Mission Planning and Control**	6	2	Chapters 8, 9	HW 2 Due
Mar. 1	**Aviation Weather**	1, 3	4	Lecture Notes	**Class Meeting**
Mar. 8	**Midterm Exam**				
Mar. 22	**Payloads, Imaging Sensors**	1, 3, 4	1	Chapters 10, 11, 12	**Class Meeting**
Mar. 29	**Communications and Data Links**	1, 3, 4	1, 2, 3	Chapters 13, 15	
Apr. 5	**Airspace Classification, Aeronautical Charts**	1, 5	2	Lecture Notes	**Class Meeting** HW 3 Due
Apr. 12	**Risk Management, Airports and Communication**	1, 5	2	Lecture Notes	
Apr. 19	**Launch and Recovery Systems**	1, 3, 6	3	Chapters 17, 18	
Apr. 26	**Course Project - Part 1: Aerial Imaging with Small UAS**	1, 3, 4, 6	1, 2, 3		**Class Meeting** HW 4 Due
May 3	**Course Project: Part 2: Image Processing**	3, 4, 6	1, 2, 3, 4		Project Report Due
May 10	**Final Exam**				

Policies

WRITING EXPECTATIONS

All written submissions should be submitted in a font and page set-up that is readable and neat. It is recommended that students try to adhere to a consistent format, which is described below.

- Typewritten in double-spaced format with a readable style and font and submitted inside the electronic classroom (unless classroom access is not possible and other arrangements have been approved by the professor).
- Arial 11 or 12-point font or Times New Roman styles.
- Page margins Top, Bottom, Left Side and Right Side = 1 inch, with reasonable accommodation being made for special situations and online submission variances.

CITATION AND REFERENCE STYLE

Assignments completed in a narrative essay or composition format must follow APA or MLA style guidelines.

LATE ASSIGNMENTS

For each day of late submission of the homework assignments, 10 % of the assignment marks will be deducted, unless the student contacts the instructor ahead of time about an extenuating situation.

DISABILITY ACCOMODATIONS

This institution complies with the Americans with Disabilities Act, Section 504 of the Rehabilitation Act, and the World Wide Web Consortium's (W3C) Universal Access Guidelines. Reasonable accommodations are available for students who have a documented disability. Please notify your instructor(s) during the first week of class regarding accommodation(s) needed for the course. All accommodations must be approved through the ISU Counseling Testing and Career Services Office in Idaho Falls. For assistance, please call 282-7750 or stop by their office in the Student Union Building Room 223.

CELL PHONE/TEXTING POLICY

Cell phone/texting in the classroom is not permitted. If you have a family or work reason to call or text on your cell phone please excuse yourself from the classroom and use your mobile device in the hall. At times it might be necessary to use a mobile device as a web browser in the classroom in conjunction with an in-class discussion or exercise. The instructor will allow this use on a case-by-case basis.

NETIQUETTE

Online universities promote the advance of knowledge through positive and constructive debate – both inside and outside the classroom. Discussions on the internet, however, can occasionally degenerate into needless insults and "flaming." Such activity and the loss of good manners are not acceptable in a university setting, where basic academic rules of good behavior and proper "netiquette" must persist. Remember that you are in a place for the fun and excitement of learning, which does not include descent to personal attacks, or student attempts to stifle the discussion of others.

- Technology limitations: while you should feel free to explore the full-range of creative composition in your formal papers, keep e-mail layouts simple. The Educator classroom may not fully support MIME or HTML encoded messages, which means that bold face, italics, underlining, and a variety of color-coding or other visual effects will not translate in your e-mail messages.
- Humor note: despite the best of intentions, jokes and (especially) satire can easily get lost or taken seriously. If you feel the need for humor, you may wish to add "emoticons," such as ;-), :), or J, to help alert your readers.

ACADEMIC INTEGRITY

The University of Idaho expects that students will engage in academic activity with high standards of honesty and integrity. These values are central to the educational process and are also cornerstone values for citizenship and professional conduct after you leave the University.

The University of Idaho has specific academic honesty expectations described in the Student Code of Conduct. These are minimum standards that are generally applied across the University.

For more information see;

http://www.uidaho.edu/DOS/academicintegrity

NONDISCRIMINATION POLICY

The University of Idaho has a policy of nondiscrimination on the basis of race, color, religion, national origin, sex, age, disability or status as a Vietnam era veteran. This policy applies to all programs, services, and facilities, and includes, but is not limited to, applications, admissions, access to programs and services, and employment. Such discrimination is prohibited by titles VI and VII of the Civil Rights Act of 1964, title IX of the Education Amendments of 1972, sections 503 and 504 of the Rehabilitation Act of 1973, the Vietnam Era Veterans' Readjustment Assistance Act of 1974, the Age Discrimination Act of 1975, the Age Discrimination in Employment Act Amendments of 1978, the Americans With Disabilities Act of 1990, the Civil Rights Act of 1991, the Rehabilitation Act Reauthorization of 1992 and other state and federal laws and regulations. Sexual harassment violates state and federal law and policies of the Board of Regents, and is expressly prohibited, as stated in Faculty Staff Handbook (FSH) 3220. The University of Idaho also prohibits discrimination on the basis of sexual orientation, as stated in FSH 3215. The entire FSH can be accessed online at http://www.webs.uidaho.edu/fsh. Questions or concerns about the content and application of these laws, regulations or University policy may be directed to the Human Rights Compliance Officer (208-885-4213); Complaints about discrimination or harassment should be brought to the attention of the Human Rights Compliance Office (208-885-4212). Retaliation for bringing forward a complaint is prohibited by FSH 3810.

LIBRARY RESOURCES

As a UI student, you not only have access to valuable print and electronic resources from the university's library, but you also have the access to personalized assistance from the librarians. If you have assignments or research questions and aren't sure how to make the most of library resources from off campus, feel free to contact the College of Education liaison librarian with questions. Help may be obtained via phone; 208-885-2503. As always, you may also call the main reference desk anytime Monday to Thursday 9am to 9pm, Friday 9am to 5pm, and Sunday 1pm to 9pm, 208-885-6584, or visit http://www.lib.uidaho.edu for email or IM assistance.

DISCLAIMER STATEMENT

Course content may vary from the outline to meet the needs of this particular group.