UAS 209 Photogrammetry, Remote Sensing, & Analysis

Course Master Syllabus

Course Information

Catalog Description: This course will provide students with a foundational understanding encompassing all elements of numerous Unmanned Aircraft Systems (UAS). Students will be provided with the knowledge and necessary skill set to support UAS applications. Students learn the foundations of remote sensing and data analysis; acquiring knowledge of the characteristics of various sensors and remote sensing applications applicable to civil unmanned aircraft systems (UAS) operations. Emphasis is placed on data acquisition and processing.

Prerequisite(s):

Corequisite(s): UAS 202 – Introduction to Digital Photography

Credits: 3

Hours: 3

Required Text(s):

- Lillesand, T., Kiefer, R.W., & Chipman, J. (2015). Remote sensing and image interpretation (7th ed.). Wiley. ISBN: 13: 978-1118343289

Supplemental Materials:

- Colomina, I. & Molina, P. (2014) Unmanned aerial systems for photogrammetry and remote sensing: A review. *ISPRS Journal of Photogrammetry and Remote Sensing, 92*(2914), 79-97. https://doi.org/10.1016/j.isprsjprs.2014.02.013

Instructor Information

Instructor's Name:

Contact Information:

Office Hours:

Program Goals

1. Equip students with comprehensive knowledge of unmanned systems, including their standards, regulations, and operational frameworks, preparing them for FAA Part 107 certification and other regulatory requirements.
2. Develop proficiency in using geographic information systems (GIS) and remote sensing technologies, enabling students to analyze and interpret spatial data for applications in environmental monitoring, urban planning, and emergency response.
3. Foster a strong understanding of safety protocols, risk management strategies, and security measures in unmanned aviation to ensure compliance with industry standards and promote operational excellence.
4. Provide hands-on training in maintaining, repairing, and optimizing unmanned aircraft systems (UAS) to extend operational life and enhance performance in various industry settings.
5. Introduce students to advanced robotics, programming, and cutting-edge technologies, including infrared thermography and digital photography, to expand their expertise in innovative applications of unmanned systems.
6. Equip students with the skills and knowledge to contribute to the development and operation of innovative unmanned aerial transportation systems, addressing future urban and regional mobility challenges.

Class Core Competencies

The following core competencies are embedded in this curriculum:

- Communicate effectively in both speech and writing.
- Apply appropriate mathematical and statistical concepts and operations to interpret data to solve problems.
- Use scientific method of inquiry, through the acquisition of scientific knowledge.
- Use computer systems or other appropriate forms of technology to achieve educational and personal goals.
- Address an information need by locating, evaluating, and effectively using information.

Class Learning Assessment

Student Learning Outcomes	Suggested Means of Assessment
Demonstrate a practical understanding of remote sensing systems, their respective capabilities, and their relationship to unmanned aircraft systems (UAS).	Homework, tests
Describe the consideration, tools and products related to the processing of unmanned aircraft systems (UAS) collected data.	Homework, tests
Provide a technical overview of unmanned aircraft systems (UAS) -based remote sensing technologies and the applicability of collected data to help solve real world problems.	Homework, tests
Demonstrate the ability to apply knowledge of key UAS sensors and system applications to execute during UAS operations. This includes installation, trouble shooting, and data collection.	Practical experience
Demonstrate a foundational understanding of key UAS components and the science behind their function.	Homework, tests
Demonstrate knowledge of UAS sensors and systems on applicable UAS platforms.	Tests

Grading System

Letter Grade	Percentage Range
A	90 to 100 percent
B Plus (B+)	87 to 89.9 percent
B	80 to 86.9 percent
C Plus (C+)	77 to 79.9 percent
C	70 to 76.9 percent
D	60 to 69.9 percent

Letter Grade	Percentage Range
F	Below 60 percent

College Information

Disability Services
Disability Services Webpage

Statement and Policy on Cheating, Plagiarism, and Academic Conduct
Academic Conduct Policy (Policy 304) [PDF]

Students are required to perform all the work specified by the instructor and are responsible for the content and integrity of all academic work submitted. A violation of academic integrity will occur if a student: (1) knowingly represents work of others as one's own, (2) uses or obtains unauthorized assistance in any academic work, (3) gives fraudulent assistance to another student, or (4) furnishes false information or other misuse of college documents.

Unauthorized use of Artificial Intelligence (AI) is prohibited unless the instructor explicitly permits it in the syllabus or assignments. If tools such as ChatGPT are permitted by an instructor to be used for an assignment, they should be used with caution and with proper citation. In all such cases, you may only use the specific tools identified as acceptable and you must adhere to the College's standards for attribution, validation, and transparency.

In cases of suspected violation of academic integrity, the incident is to be reported to the Office of Academics. A student found guilty of violating the rule of academic integrity by the Vice President of Academics will be considered to have failed in personal obligation to the College; such failure will be subject to disciplinary action by the College. Unless otherwise notified, the instructor will allow students who are pending disciplinary action to attend class.

Tutoring and Testing at the Instructional Support Center (ISC)

- Instructional Support Center (ISC) Webpage

WCCC Library Services

- WCCC Library Website

Citation Styles and Formatting

Work submitted for any Warren County Community College course must conform to the required formatting and citation style that are specified by the instructor. The Library and Instructional Support Center can assist students with formatting and citations for assignments and papers.

WCCC Attendance Expectations

The College expects students to attend and participate in all classes. This involves sharing discussions and lectures in class, as well as interacting with other students. Grades are based on the quality of work students complete in meeting the requirements for a particular course, as stated in the course syllabus and catalog description. Attendance, among other factors, may be an additional criterion for assigning grades. Students should realize that they are responsible for all class meetings and that work missed because of absences may affect their grades. Attendance in online classes is determined by the completion of assignments/ tests. Students who have not completed any assignments or tests will be considered non-attending and receive an NF grade in online classes.

Class Attendance Expectations

Topical Outline

1. Brief history of remote sensing
2. Electromagnetic spectrum overview
3. Mapping cameras: understanding of lenses, physics of light and cameras, other photography concepts, such as ISO, shutters, exposure time etc.
4. Overview of photogrammetry
5. Overview of aerial mapping and orthorectification
6. Overview of computer vision photogrammetry
7. Traditional platforms used for aerial acquisition & link to UAS
8. Image interpretation
9. Image scale
10. Image resolution, including spatial, spectral, radiometric, temporal
11. Ground control points, including Root Mean Square Error (RMSE)
12. Accuracy and precision of imagery
13. Variety of common payloads and how these tie into the spectrum, including:
    a. Electro-Optical (EO)
    b. Near-Infrared (NIR)
    c. Multi/Hyperspectral (MSI/HSI)

d. Light Detection and Ranging (LiDAR)
e. Lenses, physics of light, and cameras in context of remote sensing
f. Other photography concepts, such as International Organization of Standards (ISO) for film speed, shutters, exposure time etc.

14. Types of algorithms and applications commonly used to exploit data
    a. Change detection
    b. Normalized Digital Vegetation Index (NDVI)
    c. Classification of material
    d. Object recognition
15. Examples of applications
    a. Plant sciences
    b. Earth sciences
    c. Hydrospheric sciences
    d. Land use
    e. Aerial mapping: purpose, map scale etc.
16. Flight control sensor and payload systems
17. Propulsion systems
18. Ground and autopilot systems
19. Launch and recovery systems
20. UAS applications

Grading Methods

Assignment	Points/Percentage

Class Itinerary

Week / Unit	Topic	Readings/Assignments

Week / Unit	Topic	Readings/Assignments