GIS-540: INTRODUCTION TO SUAS (DRONE) SYSTEMS

Effective Term
Spring 2024

BOT Approval Date
05/12/2022

Discipline
GIS - Geospatial Information Science
Course Number
540

Course Title
Introduction to sUAS (Drone) Systems

Short Title
sUAS - Drone Systems

Credit Status (CB 04)
D - Credit - Degree applicable

Units

Lecture Units
2.00

Lab Units
1.00

Total Units
3.00

Hours

Lecture Contact Hours
32-36
Out of Class Hours Lecture
64-72

Lab Contact Hours
48-54
Out of Class Hours Lab
0.00

Total Contact Hours
80 - 90

Total Out of Class Hours
64 - 72

Total Student Learning Hours
144 - 162

Is this an existing Extensive Lab?
Yes

Distance Education
Yes

Distance Education

Distance Education Type
Hybrid Only

What will be done in face-to-face meetings
Laboratory requires the use of drone simulator equipment and programs as well as real time flying of drones.

Are you using publisher content?
No

Regular Substantive Interaction
Instructor-to-student, student-to-student, and student-to-content contact shall be distributed in a manner that will ensure regular substantive interaction (RSI) is maintained not only weekly but also for the duration of the course. Instructor interactions should be equivalent in time, quality and consistency to the engagement students would receive in a face-to-face course—for example, through announcements, discussion participation, personalized feedback, video messages, or other instructional communications. Instructors are expected to be responsive to student inquiries within a 24-72 hour time frame excluding holidays. RSI will be maintained through a variety of methods: • Orientation - Students must be oriented to the online and face-to-face portions at the start of the course. • Announcements - Announcements using the course management system must be posted at least weekly to keep students current on course events, due dates, materials, etc. • Discussion Forums - Content-related discussion forums within the designated CMS will include appropriate instructor participation and will be initiated and maintained, with timely feedback provided. Instructors are required to monitor the discussions and related activities to provide guidance and direction. Open-ended discussion boards may be used to further learning and interaction. • MSJC Communication – Instructor will use MSJC-administered communication tools (such as email or the designated CMS communication tools) to regularly communicate with and provide ease of access to students. • Timely Feedback - Timely feedback on student work will be provided by the instructor, which may include comments and/or rubrics, within the Grades area of the designated CMS. • Scheduled Meetings – Hybrid and synchronous courses will meet at regularly scheduled times. ADA Compliance - All course interactions and content must be designed with accessibility in mind and meet ADA requirements.

Catalog Description
This course introduces students to the basic operations of small, unmanned aircraft systems (sUAS), drone vehicles, for use in geospatial information science (GIS) applications. The course equips students with the basic drone flight skills and knowledge about the regulations and procedures governing the safe and legal operation of small, unmanned aircraft systems. The course prepares students to become commercial sUAS pilots and to take the Federal Aviation Administration's Part 107 airman knowledge test.

Attach Supporting Documents
COE Labor Market Report NEW Geographic Information Sciences (GIS) - Drones (1).docx

Codes

TOP Code (CB 03)
2206.10* - *Geographic Information Systems

CIP Code
45.0702 - Geographic Information Science and Cartography.

Repeatability Code
No

Grading Option
Letter grade OR P/NP

Learning Objectives

Learning Objectives

Learning Objective
1. Assemble the components, equipment, and technology to set-up a working drone.
2. Assess and differentiate airspace classification, operating requirements, and flight restrictions affecting sUAS operation.
3. Evaluate aspects of drone flight geospatial patterns and distribution with respect to socio-cultural perspectives, as they pertain to race, gender identity, sexual orientation, and cultural differences.
4. Analyze aviation weather and emergency situations which may be encountered when flying sUAS platforms.
5. Assess and evaluate crew resource management characteristics.
6. Apply information necessary to successfully complete the FAA Part 107 pilots license examination.
7. Evaluate the physiological effects of drugs and alcohol on a pilot's ability to safely operate an sUAS.
8. Interpret ethical and privacy concerns of sUAS operations around human populations.
9. Critique factors of airport operations and communications when flying an sUAS.
10. Assemble, and validate basic drone flight skills and knowledge about the regulations and procedures governing the safe and legal operation of small, unmanned aircraft systems.

Learning Outcome Information

Course Learning Outcomes

Learning Outcome
Appraise conditions for safe operations of a sUAS.
Exercise reflective thought concerning the operation of drones in restricted airspace.
Analyze the capabilities, limitations, and features of drone technology and equipment.
Apply knowledge and skills to operate and program a drone.
Recall and explain applicable regulations relating to sUAS rating privileges, limitations, and flight operation.
Develop drone piloting skills for varied applications with a perspective from the students' age, ethnic, racial, gender and/or socio-economic background.
Independently adapt knowledge and experience related to drone piloting to support theories to explain, and/or process information used in GIS applications.
Assemble and critique pilot and crew management criteria for safe drone operations
Organize and operationalize information and knowledge necessary to successfully complete the FAA Part 107 sUAS piloting examination.
Assess sUAS load capacity aspects of weight and balance.
Appraise and evaluate hazards to sUAS flight and emergency procedures.

Program Learning Outcomes

Learning Outcome
Integrate spatial thinking with applied technology to analyze physical and cultural patterns, and discuss trends and relationships.
Explore spatial relationships at different scales from local, regional to global.
Explain the interrelationship between humans and the physical environment
Apply the scientific method to objective and subjective analysis of cultural and physical environments.
Appreciate different cultural and ethnic perspectives within the context of opportunities and challenges.

Institutional Learning Outcomes

Aesthetic Awareness: The student will identify and evaluate how aesthetic expression leads to an appreciation of social and cultural context as well as the values of art and nature.
Critical Thinking: The student will analyze problems, gather and synthesize relevant information, evaluate ideas, information, and evaluate alternative points of view to create, innovate and implement effective solutions.
Information and Technology Literacy: The student will access, interpret, evaluate, and apply relevant information sources and digital media effectively, and in an ethical and legal manner.

Personal
and Professional Responsibility
Civic

Content

Course Lecture Content

1. Introduction
   a. Historical look at the development and use of drones in professional applications
   b. Types of drones
   c. Ready to fly RTF vs Do it yourself DIY
   d. Multi-rotor, hexicopter, fixed-wing, hybrids, octocopter, heavy-lifters
2. The Anatomy of a sUAS (drone) - Equipment Setup
   a. Safety
   b. Motors
   c. Propellers
   d. Electronic speed controls
   e. Batteries
   f. Remote controls
   g. Assembly
   h. Repairing, replacing, service and maintenance
   i. Normal procedures
   j. Emergency Procedures
   k. Regulations
3. sUAS (drone) Piloting for Digital Imaging
   a. Survey potential capture devices
   b. Checklist
   c. Flight operation and camera operation
   d. First Person View systems
   e. Flight Parameters
   f. Flight times & wireless transmission
   g. Limitations
   h. Way finding
4. Federal Aviation Regulations
   a. History of FAA
   b. Rulemaking process
   c. Types of operation
      i. Public operations - diversity and privacy concerns
      ii. Civil operations (commercial)
      iii. Recreational operations
      iv. Documenting distribution of Human Populations
      v. Ethnic and Racial Considerations of video photography
      vi. Socio-economic, gender, and privacy considerations
   d. Part 107 certification requirements
   e. Registration of sUAS
5. Flight Airspace Considerations
   a. Flight rules
      i. Visual
      ii. Instrument
   b. National airspace
      i. Class A
      ii. Class B
      iii. Class C
      iv. Class D

v. Class E
vi. Class G
c. Airspace entry requirements
6. Flight Restrictions
a. Special use airspace
b. Prohibited airspace
c. Restricted airspace
d. Warning airspace
e. Alert airspace
f. Military operations area airspace
g. Temporary flight restrictions
h. Advisory circular
i. Human Ethical and Privacy Concerns
i. Flight considerations of distribution of human populations diversity
ii. Varied responses of ethnic and racial populations to drone flight and digital data gathering
iii. Dealing with varied socio-economic consideration of drone flight and digital data gathering
iv. Gender diversity consideration of drone flight and digital data gathering
7. FAA Part 107 Examination Procedures
8. FAA Part 107 Local Testing Centers
9. Application Process for Licensing

Course Lab Content

1. Navigation and Pre/post Flight Preparation
a. Pre-flight planning
b. Latitude and longitude
c. Time zones
d. Determining altitude
e. Aeronautical sectional charts
i. Radio aids
ii. Airports
iii. Airspace
iv. VFR checkpoints
v. Military training routes
vi. Chart legends
f. Pre-flight briefing and inspection
g. Post-flight debriefing and inspection
h. Right of way
i. Maintenance
2. Aviation Weather
a. Atmosphere and air pressure
b. Heat and temperature
c. Wind
d. Precipitation
e. Micrometeorology in urban settings
f. Aviation weather services
3. Weight and Balance
a. Terminology
b. Weight and balance control
c. Calculating weight and balance
4. Emergency Procedures
a. In-flight emergencies
b. Loss of link
c. Fly-aways
d. Loss of power
e. In-flight shutdowns

5. Crew Resource Management
   a. Risk management
   b. Risk assessment
   c. Rick factors
   d. Mitigating risk
   e. Hazardous attitudes
   f. Decision making process
   g. Situational awareness
6. Airport Operations and Radio Communications
   a. Airport operations
      i. Airport information sources
      ii. Notices to Airmen
      iii. Traffic patterns
      iv. Airport signs
   b. Towered and non-towered airports
   c. Unicom and Multicom
   d. Communicating with ATC
   e. Collision avoidance
7. Physiological Effects of Drug and Alcohol
   a. Medical conditions
   b. Medications
   c. Alcohol
   d. Regulatory citations
8. Operationalization of Ethical and Privacy Concerns
   a. Flights adjacent to distribution of human populations
   b. Exploration of various ethnic and racial reactions to drone flight
   c. Socio-economic consideration of drone flight
   d. Diversity in age and gender consideration of drone flight
9. Preparing to Fly
   a. Development of a flight plan
   b. Drone maintenance preparation
   c. Crew and airspace validation
10. Drone flight skills practice - approximately 3 hours of flight time per student
11. FAA Part 107 Examination and Licensing
12. Fight Logbook and Drone Maintenance Data
    a. Scheduled and unscheduled maintenance
    b. Pre-flight inspection
    c. Record keeping

Methods of Instruction

Method

Lecture

Integration

Lectures explore the professional understandings of the components, equipment, and technology used to set-up and fly a drone. Lectures include aspects of the legal and ethical responsibilities in operations of sUAS as required by the Federal Aviation Administration. Lectures include information necessary to pass the FAA Part 107 sUAS commercial pilot's license examination.

Method

Observation and Demonstration

Integration

Observations and demonstrations require students to observe, participate and evaluate drone flight considerations and applications. These demonstrations guide students through the preparation, documentation, flight processes and applications used in flying sUAS for professional purposes.

Method

Activity

Integration

Activities are designed for students to participate in laboratory groups to operate and program a sUAS, drone. Students work as a team of two or more individuals with one person operating the camera and one operating the drone flight. When possible additional students act as visual observers informing the pilot and photographer of flight details and possible concerns.

Method

Field Experience

Integration

In field experiences students participate to learn to properly operate a sUAS, drone. These experiences help develop an understanding of the components, equipment, and technology needed to set-up a working drone.

Method

Individualized Instruction

Integration

Individualized instruction is used for students to work individually with the instructor to develop and demonstrate the ability to operate and program a drone, equipped with a variety of sensors including GPS, video and/or still photography, in a manner capable of passing the Federal Aviation Administration requirements for a commercial drone operator's license.

Method

Discussion

Integration

Students participate in a discussion of various aspects of drone data collection and analysis as to how it relates to human diversity. Discussion includes aspects of how members of
different social, cultural, racial, ethnic, gender, age characteristics of human population might/can be affected by drone digital data collection and analysis.

Methods of Evaluation

Method

Exams/Tests

Integration

Exams/Tests include a variety of question formats that evaluate student comprehension of lectures, assigned readings and exercises. These examinations include knowledge necessary to successfully pass the FAA part 107 commercial pilot's license examination. Examinations and tests include traditional multiple choice, short answer and fill-in the blank style questions. Answers are evaluated on accuracy and student understanding of concepts and information presented in lecture and laboratory instruction.

Method

Class Participation

Integration

In class participation students demonstrate a mastery of course objectives through their ability to discuss complex drone flight spatial analysis problems. Students are required to propose flight plans, suggest appropriate geospatial information, flight concerns, crew requirement and data collection methods. Students demonstrate drone piloting and data collection skills. Student participation in these activities are graded with criteria representing various levels of assimilation of course content.

Method

Final Performance

Integration

Final performance is demonstrated by the development and execution of a sUAS flight plan. The final performance grading criteria includes assessment of the presentation of the drone flight plan, the equipment used, a maintenance schedule for the equipment, pertinent weather and crew information and logbook recordings. The final performance includes an evaluation of the student's ability to demonstrate a real-time sUAS, drone, flight.

Method

Portfolios

Integration

Portfolios include the documentation of professional sUAS flight operations in a "flight logbook". This documentation includes a description of all data applicable to each flight. Students are required to begin the development of their commercial flight "portfolios" represented by data entered into their personalized drone flight logbook. Flight log data and information are graded using a rubric specifically designed for portfolio development.

Method

Simulation

Integration

Simulation exercises require students to design and present, to the class, a simulation specifically designed to fly a sUAS to collect data on one or more specifically identified diverse groups. Students present the simulation to the class and lead a discussion as to how the collection and interpretation of the data might be perceived by a diversity of individuals in geographically dispersed populations. Simulations are evaluated with a grading criteria designed to measure success in development of the simulation as well as the effectiveness of leading the discussion.

Assignments

Assignment Type

Reading

In-class and/or outside of class

Outside of class

Formative or Summative

Formative

Assignment

Gather information about career opportunities for professional drone pilots. Read to identify and describe the use of drones in a minimum of three (3) drone flight careers.

Assignment Type
Writing

In-class and/or outside of class
Outside of class

Formative or Summative
Summative

Assignment
Demonstrate a mastery of course objectives through your ability to discuss a drone flight spatial analysis problems. Discuss flight concerns related to the various classifications of National Airspace.

Assignment Type
Other

In-class and/or outside of class
In-class
Outside of class

Formative or Summative
Formative

Assignment
Prepare a drone flight plan to be executed on the college campus site. Include the route the drone will fly, approximate duration of the flight and any potential concerns that need to be considered. Demonstrate your ability to successfully implement the flight plan and document the flight and drone maintenance details in your flight logbook.

Assignment Type
Reading

In-class and/or outside of class
In-class
Outside of class

Formative or Summative
Formative

Assignment
Research the impact of drone flying and remote data collection on diverse groups of human populations. Lead a discussion as to how the collection and interpretation of the data might be perceived by members of different populations.

Course Materials

Textbooks
Unmanned Aerial Systems: Theoretical Foundation and Applications, Editors: Anis Koubaa, Ahmad Taher Azar, 1st Edition , 2021; ISBN-13: 978-0128202760 ISBN-10: 0128202769

Remote Pilot Test Prep 2021: Study & Prepare aviation training (ASA Test Prep Series) 2021

Other Resources
Federal Aviation Administration. Remote Pilot-Small Unmanned Aircraft Systems Study Guide. Washington DC: Flight Standards Services, 2021.

Small Unmanned Aircraft Systems Guide: Exploring Designs, Operations, Regulations, and Economics, Brent Terwilliger, David C. Ison, John Robbins, Dennis Vincenzi, 2017

Open Educational Resources

Drone Technology - https://www.oercommons.org/courses/drone-technology-course

Class Size Information

Class Size

32

Class Size Category

G - Large lab 32

Diversity and Inclusion

Explain how diversity and inclusion(e.g., gender, culture/race, sexuality, etc.) is infused into the course.

The course operates with a foundational intention of diversity and inclusion. Included in the objectives, is the necessity of teaching diverse content from multicultural and intersectional perspectives across all aspects of the course content. Emphasis is placed on the articulation of how drone technology data collection and analysis contributions to the discipline of geospatial science. The course offers students' opportunities to foster empathy, expose variant interpretations, and exhibit diverse societal concerns represented by the geographic distribution of humans around the globe. The course content is designed to align objectives with and to create opportunities for students from a variety of backgrounds to hone new skills while acknowledging and honoring their diverse, existing knowledge base. The course emphasizes the need to investigate not only geophysical aspects of human geospatial distribution, but as well, the socio-cultural perspective as it pertains to race, gender identity, sexual orientation, and cultural differences. Students are expected to consider cultural, economic, political, and gender-based positioning in developing assignments affecting the geospatial distribution of human activities. Assignments are formatted to allow students to reflect on their cultural frame of reference and to investigate their personal perspectives as to the geospatial aspects of the communities to which they associate.

Describe how assignments, instruction, evaluation, course content, and interactions are contextualized for diverse learners promoting an equitable course.

The course emphasizes the need to use drone technologies to investigate not only geophysical aspects of geospatial distribution but as well the socio-cultural perspective, as it pertains to race, gender identity, sexual orientation, and cultural differences. Students contextualize how population data collection and analysis relate to their representation of the diversity of human populations. Students explore how their own diverse learning styles contribute to the collection and analysis of drone data. Students are encouraged to consider factors representing their personal cultural, economic, political, and gender-based positioning in developing assignments affecting the geospatial distribution of human activities. Students are urged to consider not only how “time and place” have affected their own geographic distribution but how “historical context” is used to capture the deeper connections between socio-historical forces and the geospatial distribution of humans.

Interactions

Explain how the course will incorporate student-to-student interaction.

Students are encouraged to work together to solve geospatial problems of drone flights considerations and digital data applications both in lecture and laboratory situations. Students work as a team of two or more individuals with one person operating the camera and one operating the drone flight. When possible additional students act as visual observers informing the pilot and photographer of flight details and possible concerns. Student are required to participate in weekly student to student discussion sessions on topics related to the course materials. Class activities, lectures and assignments are environments in which the classroom community can bring in their own cultural experiences in addition to practicing the application of new concepts from diverse socio-cultural perspectives.

Explain how the course will incorporate instructor-to-student interaction.

The instructor facilitates instructor to student interactions by encouraging and requiring students to reflect on course topics and articulate an understanding of the material to the instructor and other students. Laboratory instruction is designed to include lab group as well as intensive instructor student one-on-one instruction in the use of the professional drones for flight and data collection applications and software. To better support a diverse range of learners, instructors are encouraged to incorporate formative and summative active learning strategies in the laboratory assignments which promote students to ask questions and get clarification of examples from the instructor.

Explain how the course will incorporate student-to-content interaction.

Student to content interaction is incorporated in both lecture and laboratory presentations and assignments as well as weekly laboratory and semester projects. Students are required to apply lecture content to application laboratory assignments. Students are

introduced to content in the lecture portion of the class and interact with the content in many ways including researching relevant information, summarizing lecture presentations, taking short quizzes, participating in discussions, project development and semester examinations. Laboratory assignments require students to prepare flight plans, do pre and post flight operations and to demonstrate their ability to fly a professional drone. Students must interact with the course content to produce drone acquired digital output using information discussed and developed in lecture. This output represents a variety of data presentations all of which include mapping and data analysis of specific geospatially related questions; what resources are being explored; who (the diversity of populations) are impacted by the resources; where the resources are congregated and the historical data influencing the geospatial distributions.

Explain how the course will incorporate student-to-self interaction (metacognitive).

The goal is to support students in connecting their personal experiences with the terms and concepts presented in the course and to validate the student's life experience by seeing themselves in the use of the material and assignment requirements. Drone flight is being used for many applications which interact with a wide variety of human populations. Class activities, reading, lecture, discussions and student flight plans and technical sUAS drone application projects encourage and allow students to explore various personal interpretations and understandings of their individual relationships to the commercial use of geospatial organization related to their own diversity, socio-economic status, gender, ethic-racial background and other aspects of their own identity and history.

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