UNIVERSITY OF CALIFORNIA A-G CMP Course Management Portal (/dashboard)

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AIR ACADEMY: HONORS ADVANCED UNMANNED AERIAL SYSTEMS (UAS) ROP

Career Education Center (formerly Ventura County ROP)

Basic Course Information

Title:

AIR ACADEMY: HONORS ADVANCED UNMANNED AERIAL SYSTEMS (UAS) ROP

Transcript abbreviations:

Length of course:

Full Year

Subject area:

College-Preparatory Elective ("g") / Laboratory Science – Integrated Science

Integrated (Academics / CTE)?

Yes

Grade levels:

11th, 12th

UC honors designation?

Yes

Course learning environment:

Classroom Based

Course Description

Course overview:

In this course students will apply aerodynamic theory, programming, and manufacturing principles from the beginning Unmanned Aerial Systems course. Students will build and program their own Unmanned Aerial Vehicle (UAV) and learn how to analyze data to improve efficiency in areas such as: law enforcement, agriculture, search and rescue, photography and cinematography.

There is an ever-increasing demand for qualified designers, builders, and pilots of UAS's in industry and government. These aircraft are often in the news media, with considerable concerns over privacy and air safety frequently cited. This course will teach students to responsibly and appropriately use and navigate UAS's, while complying with the rules and regulations set by the Federal Aviation Administration (FAA). Students will apply principles of flight, aerodynamic design, and the Scientific Method continuously in this course. Students will also acquire skills and knowledge that will prepare them for careers in the dynamic uses of UAS's, and as responsible UAS pilots and designers.

The purpose of this course is to research UAS regulations in order to pilot a UAV without violating federal regulations. Students will demonstrate, test, and comprehend principles of flight by designing and constructing a remotely controlled paper airplane that can stay aloft for 3-4 minutes or more. Programming a navigated flight path and implement algorithms in the software routines that illustrate the chosen flight path is a goal for all students. They will pilot a quad copter safely over a given course through the control software. Students will show mastery of piloting, programming, mathematical principles, aerodynamic design, through the Scientific Method and continuous application to their UAS knowledge with a cumulative project throughout the course.

Cumulative Project - Throughout all units, students will keep a log of their hours and activities studied. The format of the log will be that of an actual flight log used by pilots. Students are encouraged to not only track activities in the form of logging hours, but they should also journal and take photos of their class experiences. These will be displayed in a final presentation to the class at the end of the course. Experience is essential for the safe operation of any aircraft, and students will track their hours and activities as a practice for what they will be required to do should they decide to pursue a career in aviation. For student pilots, a log book is essential for success. Without the proper logbook, it can be difficult to receive one's Private Pilot License (PPL). All flight examiners require proper documentation of previous experience prior to issuing a PPL license. Students will be given the choice of using a paper log, an online log created in a document, or a digital flight log tool such as an app. The cumulative project will be due when students take their final exam.

Prerequisites:

Unmanned Aerial Systems ROP (Required)
Integrated Math 2 (Required)

Co-requisites:

Physics (Recommended)

Course content:

Unit 1 Nomenclature
Content

Students will analyze the different aspects of the UAS industry. They will research the largest UAV in use and determine the cost and how long it took to build as well as discover if the aircraft works on batteries or fuel. Basic components of an airplane will be analyzed as students learn the basic vocabulary surrounding the components of an airplane. This unit will conclude with a summative project where students create a model and label the parts.

Sample Assignments

- Students will research and determine the largest rotary UAV in use and determine cost of the UAV. They will determine how long it took to construct the UAV and computer the maximum altitude of the aircraft. Finally students will determine if the aircraft works on batteries or fuel. Students will be encouraged to share their findings with the class.

- Students will learn each part of the airplane through the lesson by the teacher. They will be given an airplane handout to label. To all student interaction and collaboration, students will attempt to label their own plane for 5 minutes with no assistance. They will be assigned to small groups where they will collaborate with their group members on how the plane is labeled. After 5 more minutes the students will be assigned to a new group to collaborate further. After 5 minutes the teacher will reveal the correct labeling of the airplane so students can see how well they did.

- Summative project - Students will choose certain parts of the UAV and create clay replicas of the part and place a label on the model UAV part they have created. Having a physical replica of the part will allow students to connect kinesthetically to the terminology improving the long-term retention of vocabulary.

Unit 2 Types of UAV's and Applications
Content

Students will learn the types of UAV's that exist, as well as their weak points and their strengths. They will be able to critically decipher the need for various aircrafts based on their circumstance.

Sample Assignments

- Students will simulate being a new UAV pilot that has been asked to accomplish a mission on behalf of the wildlife preservation. A river that runs for 10 miles has an indigenous beaver population. The wildlife preservation would like to know how many dams are on the river presently to give an indication of the beaver population's health. Students will decide what UAV type to recommend for accomplishing this mission. They will list rationale and reasons for selection of type, and anticipated limitations. Finally they will determine what type of payloads would best meet the requirements.

- Summative Project- Students will research and find two articles about UAVs. One article will address the types of UAVs and one will address the general application in current events such as movies, news incident, regulations, employment, etc. Students will post each article into their pilot's log with a paragraph the student writes addressing their lessons learned or reaction to each article.

Unit 3 Safety and Operations
Content

Students will study airspace as it relates to UAVs and flight safety. The safety of flight for everyone and everything in the air relies on the understanding of the zones of flight currently defined by law.

Sample Assignments

- Students will write a crash-investigation paper. The FAA reported in 2015 over 1,400 near collisions between UAV's and commercial aircraft. Students will research a case study of one of these near collisions and determine the primary and secondary reasons that the collision almost occurred. They will describe what mitigation strategies they will set for themselves to not have that scenario happen when they are flying UAVs.

- Students will draw Class B airspace with dimensions. After creating this drawing, students will get into small groups to compare drawings. After a brief time of collaboration, students will explain all of the requirements to fly within Class B airspace within their group, and then each group will present and explain two assigned requirements to the class while the rest of the class takes notes below their drawings.

- Students will analyze the differences between hobbyists and professionals in the world of UAVs. They will learn about authorized locations for flying UAVs and compare and contrast hobbyists and professionals. After they know this basic information, they will engage in an organized class discussion where they discover if their goals are to fly UAVs as a hobby or as a professional. The teacher will guide the discussion. At the end of the discussion students will write down their goal and the reason for choosing it to demonstrate their understanding of the different types of pilots.

- Summative Project- Students will perform a preflight checklist within groups as the teacher observes. Students will demonstrate their understanding of the safety requirements and operating instructions to allow them to safely fly the specific UAV they will be using. Students will be able to demonstrate the mastery of the safety rules of UAV operations in order to be able participate in the hands-on flights. This will further reinforce the nomenclature that students will be learning in the course.

Unit 4 Basics of Flight
Content

Students will learn about the principles of flight and how they relate to UAV's. They will analyze thrust, drag, weight, and lift and apply them to UAVs.

Sample Assignments

- Principles of Flight Assignment – students will work a series of math problems related to thrust, drag, weight, and left. The teacher will review the correct answers with the findings of the students and discuss them as a class.

- Students will conduct research and create a presentation over their favorite aircraft. They will describe the year it was built and which company constructed it focusing on the performance, limitations, and qualities of the aircraft. Students will present their findings to the class.

- Summative Project – Using their research from their previous presentation, students will extend their initial presentation as they create a brochure demonstrating the principles of flight. On their example aircraft students will label the modes of flight: Throttle/ascend/descend, Yaw, Roll, Pitch, Course Lock (grid pattern), Home Lock (pie slices), Arm/disarm, GPS, LED, IOC (Intelligent Orientation Control), RTL (Return to Launch) vs Failsafe, Orientation Control, IMU (Inertial Measurement Unit), Voltage, and Basic Multirotor.

Unit 5 Basics of Aerodynamics
Content

Students will learn the basic principles of aerodynamics and flight by building a paper airplane and flying their planes. Students will apply the scientific method through trial and error of flight with their airplanes. They will learn vernacular associated with Aerodynamics and test hypothesis and verify conclusions. Students will develop critical thinking skills by seeing how variables affect flight patterns.

Sample Assignments

- Learning how aerodynamics is the study of how gases interact with moving bodies, students will apply the knowledge that aerodynamics is primarily concerned with the forces of drag and lift, which are caused by air passing over and around solid bodies. Using a diagram, students will label each vector and determine where the air is the slowest, fastest, highest and lowest surrounding the airfoil. The teacher will evaluate the diagrams as the students work so that on-the-spot corrections and instructions can be made as the concept is discussed.

- Students will create three types of paper airplanes with the goal of seeing how they fly. Students will analyze what effects of aerodynamics are as they apply the scientific method to their various airplanes. They will analyze how the design affects the flight as they apply what they have learned about aerodynamics to the successes

and failures of their flights.

- Summative Assessment – Students will demonstrate airplane design by building three types of paper airplanes and observing flight patterns. They will choose their best design and make adjustments to it based on their application of knowledge about aerodynamics. They will compete with each other as they determine which design in the class was the most aerodynamically sound. They will analyze why the winning airplane soared above the rest. The teacher will help each student determine the failures in their design.

Mid Term Exam - Students will be assessed on nomenclature, types of UAVs, safety and operations, basics of flight, and the basics of aerodynamics.

Unit 6 Power Up 3.0
Content

Students will further analyze how the design of an aircraft impacts the aerodynamic through a classroom experiment. They will apply the principles of design and witness the impacts of those principals on the design. Types of propulsion systems will be applied to aircrafts as students learn about Bluetooth applications versus hand controllers and radio waves. A summative project will wrap up the unit as students create motorized airplanes and document the variations in flight.

Sample assignments

- Students will review design impact on aerodynamics and apply the impact of their designs. They will put engines on their planes and watch them fly. The engines will be controlled by an app on their phones. They will act as miniature drones. Students will explore the various way propulsion systems are created and how they make UAV's move. Students will choose what type of propulsion systems would work for their paper airplanes and which would not. They will justify this through researching and summarizing at least three academic sources. They will write a paper with a minimum five paragraphs with a works cited pages at the end documenting their sources.

- Students will compare Bluetooth applications versus hand controller and radio waves. Students will put tiny engines on their paper airplanes to learn aerodynamic principles such as lift, drag, and mass center by constructing a remotely controlled paper airplane. They will observe their flights, analyze the factors contributing to the flight characteristics and optimize their design to make an airplane that can fly higher, longer and further using the scientific method for analysis. Through Bluetooth students will control the compass, thrust, throttle, and rudder of the paper airplane. This will reinforce elements of flight and aerodynamic principles through application.

- Summative Project - Students will analyze the literature surrounding UAV designs by finding two articles about UAVs. One should address the content of Unit 6 and one will address general application of UAVs in current events. (Movies, news incident, regulations, employment, etc.) Students will post each article into their pilot log book with a paragraph summarizing each. The current event article must be different from the article chosen at the beginning of the first semester and should show changes or progress made in the area of UAVs since the first article was viewed.

Unit 7 Flight Time Challenge
Content

Students will revisit the scientific method as they collect data, interpret data, and analyze motorized airplanes. Students compare the designs of three motorized paper airplanes.

Sample assignments

- Students will learn how to collect data and account for variables. They will also analytically show that they understand data analysis. They will fly their motorized airplanes and compare planes by collecting data on flight time and distance of each plane in the class. Through observation, data interpretation, and reviewing statistics on their spreadsheets, the teacher will help students determine which type of plane and motor combination was most successful.

- Summative Project: Students will submit their collected data with a written analysis on three different designs of motorized paper airplanes. They will demonstrate their understanding of the process of data collection and interpretation by writing at least one paragraph describing each of the three planes.

Unit 8 Quad versus Fixed Wing
Content

Students will be introduced to quadcopters and learn what factors to consider when choosing an aircraft. They will make a choice and defend that choice by creating a presenting a persuasive argument about their choice. Students will be given different scenarios and then choose quad or fixed wing based on the circumstances of the scenario.

Sample assignments

- Students will identify various types of quadcopters and determine what factors to consider when choosing and aircraft. They will research and find one reliable online resource that discusses the aerodynamics, landing, and recovery of a quadcopters. Students will bookmark their article for the class discussion.

- Students will write a three-paragraph paper comparing and contrasting quadcopters and fixed wing aircraft. Included in the paper will be a Venn diagram showing the similarities and differences.

- Summative Project - Students will present a persuasive argument on quad v. fixed wing UAV's in the form of a class debate. They will be given a side that they must prepare to defend. After the debate they will then be given scenarios in which they have to choose the appropriate aircraft and defend their choice.

Unit 9 Survey Project
Content

Utilizing the skills learned in the course, students will apply cross curricular understanding of Unmanned Aerial Systems. Students will utilize mathematics, science, computer science, and language arts to solve a comprehensive real world circumstance. This process will be done in a collaborative setting. The result will be that students will understand how their core curriculum relates to this real world circumstance and global impact of UAV's. Students will create a project representing a relevant task for using a UAV to gather image data. They will identify limiting factors which may constrain which flight path alternatives meet task requirements and which alternatives do not, choosing which alternatives could be more optimal.

Sample assignment

- Students will complete a final research project using Google Earth surveying and data collection. They will create a project representing a relevant task for using a UAV to gather image data. They will identify patterns of flight, which fly the UAV over the entire area of a rectangular field. Students will identify limiting factors which may constrain which flight path alternatives meet task requirements and which alternatives do not meet task requirements, choosing which alternatives could be more optimal. Students will analyze which alternatives need further mathematical analysis, written description of solution, and/or computational analysis. Students will record their choice of best flight path due to their analysis of constraints in their flight logs. Students use paper and pencil to draw a representation of a rectangular field, subdivide it into contiguous rectangles representing the area of the field that appears in a photo taken from above from the Google Earth, and draw an arrow through all the sub-rectangles representing the flight path.

Cumulative Project Explanation

Cumulative Project - Throughout all units, students will keep a log of their hours and activities studied. The format of the log will be that of an actual flight log used by pilots. Experience is essential for the safe operation of any aircraft, and students will track their hours and activities as a practice for what they will be required to do should they decide to pursue a career in aviation. For student pilots, a log book is essential for success. Without the proper logbook, it can be difficult to receive one's Private Pilot License (PPL). All flight examiners require proper documentation of previous experience prior to issuing a PPL license. Students will be given the choice of using a paper log, an online log created in a document, or a digital flight log tool such as an app. The cumulative project will be due when students take their final exam.

Final Exam Project - Students will complete their log books and present them to the class in the form of a Power Point or Google Slides Presentation. Students were encouraged to not only track activities in the form of logging hours, but they should also have kept a journal and taken photos of their class experiences. These will be incorporated into their final presentation.

The final presentation should have a minimum of 18 slides. This includes an introduction slide, a concluding slide, and 16 slides in between so that there are at least two slides per unit studied.

The first slide of each unit will show how much time was logged in the classroom. It should have at least three bullet points telling what the student learned in that unit.

The second slide describing each unit should have at least two images. The images can be actual photos taken during class, working on a project, or an image of what was covered. For example an image might be a picture of the paper airplanes that were created, or an example of a labeled aircraft. The images should be labeled.

If images are borrowed, the final slide should have a works cited page telling from where the images were obtained.

The final exam project will be presented to the class in a presentation that will be 5-7 minutes.

Rubric

Category	Scoring Criteria for UAV Final Project	Total Points	Score

	The type of presentation is appropriate for the topic and audience.	5
Organization (15 points)	Information is presented in a logical sequence by unit.	5
	Presentation has at least three bullets appropriately describing each unit.	5
	Intro slide establishes a framework for the rest of the presentation.	5
	Technical terms are well-defined in language appropriate for the target audience.	5
	Presentation contains accurate information.	10
Content (45 points)	Material included is relevant to the overall message/purpose.	10
	Appropriate amount of material is prepared, and points made reflect well their relative importance.	10
	There is an obvious conclusion summarizing the presentation.	5
	Speaker maintains good eye contact with the audience and is appropriately animated (e.g., gestures, moving around, etc.).	5
	Speaker uses a clear, audible voice.	5
	Delivery is poised, controlled, and smooth.	5
	Good language skills and pronunciation are used.	5
Presentation (40 points)	Visual images are well prepared, informative, effective, and not distracting.	5
	Length of presentation is within the assigned time limits (4-7 minutes).	5
	Log book was turned in at time of presentation.	10
Score	**Total Points**	**100**

Honors Final Exam Details:

The Final Exam Details are not available electronically.

Course Materials

Textbooks

Title	Author	Publisher	Edition	Website	Primary
The Pilot's Manual Ground School	Barry Schiff	Aviation Supplies and Academics	3rd/2006	[empty]	Yes
Introduction to UAV Systems	Paul Fahlstrom, Thomas Gleason	Wiley	4th/2012	[empty]	Yes
Drones: Their Many Civilian Uses and the U.S. Laws Surrounding	Barry SchiffX	Aviation Supply and Academics	3rd/2012	[empty]	No

Websites

Title	Author(s)/Editor(s)/Compiler(s)	Affiliated Institution or Organization	URL
Drone University	[empty]	Drone University	http://www.amazon.com/Drone-University-John-M-Glover/dp/0692316035