LATHROP ENGINEERING

Name:

UNIT 6: QUADCOPTERS

Aerospace Engineering Unit Due Date: **December 12, 2019**

Welcome to the sixth unit of *Aerospace Engineering*! This unit explores the concepts behind quadcopters and other multirotor copters. You'll learn some of the basic physics and terminology behind how multirotor copters are able to fly, get to fly a nice consumer quadcopter, and then build your own simple quadcopter to transport a payload as efficiently as possible. In the end, the expectation is that you learn the following:

- How quadcopters are able to fly
- The basic physics behind multirotor copters and other unmanned aerial vehicles (UAVs)
- What components need to go into a working quadcopter
- How to pilot a simple quadcopter
- How to apply the engineering design process to improve a quadcopter to meet a challenge

As we move through this unit, you are responsible for making adequate progress through the assignments, and for being done by the Unit Due Date (**December 12, 2019**). You are also responsible for completing each part before moving on to the next. Our unit is broken up into three main parts:

Part 1: **UAVs Today** *(20 pts) Approx. 2 days*		
The first part of this unit will ask you to watch a variety of videos that cover topics in quadcopter flight, basic physics, and the use of UAVs in the world today. Then, you'll use our class quadcopter to learn some simple controls for flying a quadcopter as well as how the principles of flight from earlier in our semester apply. You'll complete a short flight course to wrap up the first part of the unit!		Notes on Quadcopter Flight
		Notes on UAV Applications
		Learn to Fly a Quadcopter
		Check-off from Mr. Benshoof

Part 2: **Quadcopter Build** *(60 pts) Approx. 3 days*		
Next, you'll use the basic components of a quadcopter – motors, rotors, flight controllers, receivers, and transmitters to design and build a simple quadcopter. You'll complete the design and building of your quadcopter and then demonstrate your ability to fly it well by completing the same short flight test with your custom built quadcopter!		Notes on Quadcopter Design
		Plan & Build Small Quadcopter
		Complete Flight Test
		Check-off from Mr. Benshoof

(20 pts) Approx. 2 days

We've spent the semester talking about *fixed wing* aircraft and aircraft designs. Fixed wing vehicles have stationary wings like gliders and airplanes do. A group of flying vehicles have rotors instead of those fixed wings. The physics and design principles behind helicopters are tremendously complex and a very cool application of physics and calculus. On a smaller scale, quadcopters and other multi-rotor copters (like hexcopters or octocopters) are being used by hobbyists, scientists, and professionals for a wide range of flight-based tasks.

In this part of the unit, you'll take some notes on the physics, vocabulary, and flight principles behind the functioning of quadcopters. You'll also take a look at the different modern-day applications of quadcopters and other unmanned aerial vehicles (UAVs) before taking flight with our class's own professionally built quadcopter.

1. **Quadcopter Flight:** Start by watching the *How Quadcopters Fly* and *Quadcopter Forces* presentations. Take a full page of notes on these ideas. Make sure that your notes include some pictures of how the quadcopter rotors need to be arranged and the various vocabulary presented.
2. **UAV Applications:** Next, watch the *Quadcopter Research* and *Cool Quadcopter Applications* presentations. Take one more page of notes on the ideas and applications presented here. Brainstorm a few new applications for quadcopters that have not been discussed so far!
3. **Learn To Fly**: This is the fun part! With your group, talk to Mr. Benshoof to get the class quadcopter. Review the controls of the quadcopter with Mr. Benshoof and then begin taking turns to practice flying. Keep in mind that the battery only runs for about 15 minutes (maybe) on a single charge. You'll need to be patient and take turns so that everyone can practice flying and get used to the controls.

   When you feel good about the controls, practice and complete the flight test course without crashing! Have your classmates confirm your successful flight!

Part 1: Tasks	*5 points*	*4-3 point*	*2-1-0 points*
Notes on Quadcopter Flight	+ You took a full page of notes on *How Quadcopters Fly* and *Quadcopter Forces* + Your notes include a picture of the structure of a standard quadcopter	- Your notes do not cover all topics - Your notes are lacking important parts	- Your notes are missing - Your notes are missing many important parts
Notes on UAV Applications	+ You took a full page of notes on *Quadcopter Research* and *Cool Quadcopter Applications*	- Your notes do not cover all topics - Your notes are lacking important parts	- Your notes are missing - Your notes are missing many important parts
	10 points	*9-6 point*	*5-0 points*
Learn to Fly a Quadcopter	+ You successfully completed the flight test course + You did not destroy the quadcopter	- You were mostly able to complete the test course - You crashed the quadcopter	- You were not able to complete any of the course

(60 pts) Approx. 3 days

The second part of our unit will give you the materials and tools to build your own working quadcopter! We'll start with some basic notses on the design, building, and functioning of the quadcopter components we have available. Then you'll draw up a written plan for the construction of your quadcopter from available materials before building and learning to fly your creation!

1. **Quadcopter Design:** Watch the video *Quadcopter Design* and take a full page of notes. There are lots of details about the parts we have to work with, and you should be taking careful notes on what each one does and what bits of information you need to keep in mind when constructing!
2. **Quadcopter Plan:** Next, plan out your quadcopter design by drawing a careful diagram in your engineering notebook. Be sure to include detailed labels about what parts and pieces will go where. Also include a materials listing that states what the main body of the quadcopter will be made of. Good options include:

LEGOs	Balsa Wood	*Carbon Fiber*	Cardboard
Foam	*Foam Board*	Card Stock	*Plastic*

3. **Quadopter Build:** Have Mr. Benshoof confirm your quadcopter plans and then get to building! Construct your quadcopter following your written plans. If you need to make any changes to your design while you build, make sure you record those changes in your engineering notebook!
4. **Flight Test:** Complete the same flight test as we did with the professional quadcopter in Part 1. Take careful note of the differences in how they fly! You'll find that these self-built quadcopters are much more difficult to pilot, but that they follow the same kinds of pathways that the last one did. You'll probably need to take some serious time to practice with your quadcopter in order to be able to complete the entire course successfully!

Part 2: Tasks	*10 points*	*8-5 point*	*4-0 points*
Notes on Quadcopter Design	+ Take a full page of notes on the construction of our simple quadcopters	- Less than a full page of notes on the Autodesk Frame Generator	- Very brief or no notes.
	25-20 points	*19-10 points*	*9-0 points*
Plan & Build Small Quadcopter	+ You designed your quadcopter before building + Your design includes a diagram that lists materials and dimensions + Your plan reflects the information in the quadcopter notes video	- Your plans are missing important parts - Your plans do not reflect the information from the quadcopter notes video	- Your plans do not have a picture - You do not follow your plans
Complete Flight Test	+ You successfully completed the flight test course + You did not destroy the quadcopter	- You were mostly able to complete the test course	- You were not able to complete any of the course