LATHROP ENGINEERING

Name:

UNIT 9: REMOTE SURVEYING

Aerospace Engineering Unit Due Date: **March 6, 2020**

Welcome to the ninth unit of *Aerospace Engineering*! This unit is all about what can be done with unmanned systems. An "unmanned system" is a device that does not have a human on-board when it flies and does its work. Satellites and rovers are two good examples of unmanned systems used by NASA to conduct their scientific work. Here you'll investigate unmanned systems and start the planning for our own LASA Satellite! In the end, the expectation is that you learn the following:

- How unmanned systems are used in Aerospace science and engineering
- How different design elements impact the effectiveness of an unmanned craft
- What factors need to be considered when collecting information using remote sensing techniques
- How to work with a team to design and build a complex machine

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 (**March 6, 2020**). 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: **Unmanned Systems** *(30 pts) Approx. 3 days*		
The first part of our unit is all about learning the different capabilities of unmanned systems. We'll start with a few short presentations on what unmanned systems are able to do. Then we'll take some time to do some research about an unmanned system of your own choosing! You'll share your results with your classmates and think about what might be possible with unmanned systems on Earth and in space!		Notes on Unmanned Systems
		Unmanned Systems Investigation
		Data Sharing
		Check-off from Mr. Benshoof

Part 2: **Design & Programming** *(40 pts) Approx. 3 days*		
The second part of this unit will have us designing a small satellite system that can be used to get topographic data on the unknown Martian surface. You'll need to work with your team to plan, design, build, and program a small satellite to meet our surveying needs. The satellite you design and build will be used to collect data from the Martian surface so that you can make a map and eventually use it to navigate your rover.		Team Planning
		Design Satellite
		Build Satellite
		Program Satellite
		Check-off from Mr. Benshoof

Part 3: **Remote Surveying** *To be done next unit*		
With your satellite designed and built, it's now your job to collect data from the unknown surface of Mars. You and your team will run your satellite program to get data on elevations from the unknown Martian surface. That data will then be used to create a topographic map using Excel.		Collect Satellite Data
		Create Topographic Map
		Complete Surveying Reflection
		Check-off from Mr. Benshoof
Achievement: Complete the Topographic Map of the Martian Surface		

(30 pts) Approx. 3 days

Unmanned systems let scientists and aerospace engineers collect data and accomplish tasks without putting human lives at risk. Often, unmanned systems are used in places that humans cannot travel. Space is one good example of where unmanned systems can make many things possible without putting people in danger.

One branch of unmanned systems operation is in the use of satellites. Satellite systems make it possible to communicate and survey large areas from space. In this part of the unit, we'll learn about unmanned systems, satellite launching, and remote sensing techniques. These are just some of the ways that aerospace engineers can collect data.

1. **Notes:** Start by watching the *Unmanned Systems, Getting Satellites to Space,* and *LiDAR Remote Sensing* videos. Each of these share different pieces of information about how satellites and other unmanned systems are used by scientists today. Take a full page of good, detailed notes on the topics presented. Think a little bit about what other unmanned systems are in operation today.
2. **Unmanned System Investigation:** Start your *Unmanned System Investigation* by working with your classmates to brainstorm different unmanned systems. Then, go to work looking up the basic information about four (4) unmanned systems *per person*. Share your results with your team and discuss which ones are the coolest.
3. Once your group has discussed and shared your ideas, have each person select one (1) unmanned system to investigate further. Follow the *Unmanned System Investigation* assignment sheet and conduct your own individual research about your chosen system. Make sure you find information about all the questions posed.
4. **Data Sharing**: Add the results of your investigation to the class Google Doc/Spreadsheet so that others can see it too. Take some time to look through their results as well before answer the reflection questions.
5. Answer the three reflection questions on unmanned systems in your engineering notebook. Those questions are on the assignment sheet and also listed below:
    a. Does a common thread or theme exist relating to unmanned system development throughout time?
    b. List major influences on the unmanned systems industry and explain their significance.
    c. Explain the cause and effect relationship of the unmanned systems industry.

Part 1: Tasks	*10 points*	*9-6 point*	*5-0 points*
Notes on Unmanned Systems	+ You took a full page of notes describing Unmanned Systems and Satellite abilities + Your notes include details about what remote sensing makes possible	- Your notes are lacking - Your notes do not describe remote sensing systems	- Your notes are missing - Your notes are missing many important parts
Unmanned Systems Investigation	+ You worked with your classmates to investigate remote systems + You completed your individual unmanned systems investigation	- You only did part of the unmanned system investigation	- Your unmanned system investigation is missing major parts
Data Sharing	+ You added your results from your investigation to the class Google Spreadsheet/Google Doc + You answered the reflection questions in your engineering notebook	- You did not share all of your information - Your reflection question answers are missing	- Your information was not shared at all - You did not record anything in your notebook

(20 pts) Approx. 2 days

The second part of our unit will have you designing, building, and programming your very own satellite! You'll work with the engineers in your AE class to get a satelite working correctly so that it can be used to survey the distant Martian surface as we continue to plan out the Malemute Mars Mission.

1. Review the presentations *Remote Sensing 1, Remote Sensing 2,* and *Active vs Passive Sensing*. Take a full page of notes on the capabilities of satellites and remote sensing setups. Be sure to include at least a few pictures of how remote sensing works!
2. **Brainstorm:** Work with your team to brainstorm at least 15 different input values that sensors on remote surveying satellites might have. Add your list of brainstormed ideas to your page of notes.
3. **Discuss:** Work with your team to read through the satellite design parameters listed below. Write a complete design brief in your engineering notebooks that includes all the relevant parts of a design brief!

   YOUR SATELLITE MUST:

   Work reliably
   Be able to read distances from the satellite to the ground every few inches
   Be able to drive itself along a 1" x 1" beam
   Be programmed as described in the Satellite Building Guide
   Be able to collect a range of distance values that can be converted into a map

4. **Build:** Following the Satellite Building Guide, build your complete satellite using VEX components and all the proper sensors needed to make a complete, functioning satellite.
5. **Program:** Using ROBOTC and the Satellite Programming Guide, write a program that an make your satellite properly read distances and save them to a file.

Part 2: Tasks	*5 points*	*4-3 point*	*2-0 points*
Notes on Satellites	+ You took a full page of notes on the ideas presented in the three presentations. + Your notes include some pictures + Your notes include your list of brainstormed satellite inputs	- Less than a full page of notes on the topics - Your notes do not include a picture - Your brainstorming is missing	- Very brief or no notes.
Satellite Design Brief	+ You wrote a complete design brief of the satellite challenge in your engineering notebook	- Your design brief is missing an element	- Your design brief is missing multiple elements
Build Satellite	+ Build your satellite using the Satellite Building Guide + Your satellite should be ready to function!	- Your satellite is missing important parts - Your satellite cannot work by itself	- Your satellite is non-functional
Program Satellite	+ Get your satellite programmed using ROBOTC and the satellite programming guide	- Your satellite is not properly programmed or needs a lot of assistance	- You did not program your satellite

(30 pts) Approx. 4 days

Congratulations, LASA and the Lathrop Aeronautical Engineers: your hard work has finally paid off big! After 9 months in space, your satellite finally reached Mars and was able to survey the potential mission site. Your job is to help get data collected, and then use your results to create a map of the area. You'll then follow the Cartographer's Report to complete your map and get it printed so that you can start planning out your rover's big mission.

To wrap up this part of the unit, you and your team need to collect data on the Martian surface using your satellite. Once you and your team have confirmed that your satellite works with a test mapping, Mr. Benshoof will send it Mars and relay your results. You'll then use your complete data set in Microsoft Excel to create and label your very own Martian map! Work together, and it'll all come together nicely.

1. **Data Collection:** Start by working with Mr. Benshoof to conduct a test-sampling using your satellite. Your test-sampling must work correctly before Mr. Benshoof can collect the Martian data.
2. **Technician's Report:** When your data set is complete, the Technician's report and your data will become available. Read through the Technician's Report with your team and make all necessary adjustments to the data set to make it usable. Then, use Excel to create a topographic map of the area.
3. **Cartographer's Report:** Follow the directions on the Cartographer's Report to name various features on the Martian Surface. When that work is complete, give your map file and all names to Mr. Benshoof for final map printing!
4. **Remote Surveying Reflection:** Take a page in your notebook and write a full-page reflecting on the ideas of remote sensing and the process of getting a satellite working. What are some of the potential benefits and applications of remote sensing that you think are cool? What are some of the challenges faced by engineers when trying to make remote sensing satellites? What about the process did you find fun and interesting? What parts were particularly difficult? What could make this kind of problem solving process easier in the future for you and your team?

Part 3: Tasks	*10 points*	*8-5 points*	*4-0 points*
Data Collection Test-Sampling	+ You got a successful test-sample using your programmed satellite	- Your test sample was only partly successful	- You did not complete your test-sampling demonstration
	5 points	*4-3 point*	*2-1-0 points*
Technician's Report	+ You followed the guidelines in the Technician's report to work with your data + You made your data a topographic map in Excel	- You only completed some of the Technician's procedures	- You did not work with your data - You did not complete any of the technician tasks
Cartographer's Report	+ You followed the guidelines in the Cartographer's report + You named all the features that needed naming + You got your map turned in to Mr. Benshoof for printing	- You only completed some of the Cartographer's procedures	- You did not complete your map - You did not get your map print-ready
	10 points	*8-5 points*	*4-0 points*
Remote Sensing Reflection	+ You completed your Remote Sensing Reflection	- Your reflection is missing important parts	- Your report is missing