LATHROP ENGINEERING

Name:

UNIT 4: MODELING

Introduction to Engineering & Design Unit Due Date: **November 8, 2019**

Our fourth unit is all about modeling real-world things using math and computers. Engineers need to use various models to plan out their work and decide if they are making the right design decisions before they settle on a final product or solution. To do this, they often turn to mathematical models when their work fits regular patterns well. In other instances when they are trying to make complicated 3D objects, computer simulations and software like Autodesk Inventor become the right tools for the job. This unit is all about these tools and how to use them. In the end, the expectation is that you learn the following:

- How to create simple mathematical models like graphs and equations to describe real-world events
- How to use Autodesk Inventor to create basic 3D solids
- How to use Autodesk Inventor to create a constrained assembly of multiple parts
- How to use Autodesk Inventor to create dimensioned diagram of both a part and an assembly

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 (**November 8, 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: **Mathematical Models** *(30 pts) Approx. 3 days*		
In the first part of this unit, you'll look at a variety of ways to mathematically model different things. You'll take some notes on ways that we can create mathematical models, and then you'll collect data on rotational motion. You'll complete a math assignment, and then learn how to put a line of best fit through data using Microsoft Excel and your puzzle cube pieces from last unit!		Mathematical Models Notes
		Motion Modeling Assignment
		Puzzle Cube Regression
		Check-off From Mr. Benshoof

Part 2: **Autodesk Parts** *(50 pts) Approx. 3 days*		
For the second part of this unit in modeling, we finally get to jump into Autodesk Inventor and start creating some simple parts. You'll take some notes on the simple functions in Autodesk, and then build a simple shape by following a tutorial. Then, you'll use some calipers to measure each dimension of your puzzle cube pieces and model each of them perfectly in Autodesk.		Autodesk Notes
		First Autodesk Shape Tutorial
		Puzzle Cubes in Autodesk
		Take the Unit 4 Quiz!
		Check-off from Mr. Benshoof

Part 3: **Autodesk Drawings/Assemblies** *(50 pts) Approx. 3 days*		
Finally, your job will be to combine your many individual puzzle cube pieces that you built as "parts" in Autodesk into a completed puzzle cube! To do this, we'll learn how to create assemblies using basic constraints to combine multiple pieces. We'll also then take some time to look at how to create diagrams from our models so that we can have nice perfect drawings of complex shapes like our puzzle cube!		Notes on Autodesk Assemblies
		Assemble Your Puzzle Cube!
		Notes on Autodesk Diagrams
		Diagram a Puzzle Cube Piece
		Diagram Your Complete Puzzle
		Check-off from Mr. Benshoof

(30 pts) Approx. 3 days

The first part of our unit is all about mathematical models. Later we'll be getting into the computer and Autodesk, but for now we need to look at ways tha twe can use mathematics – graphs and equations – to model real-world things. We'll colelct a variety of data over these first dew days and use that to practice some mathematical modeling.

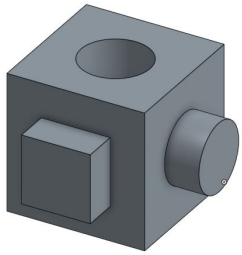
1. Start by watching the presentations *Mathematical Models* and *Graphing Motion*. Take a full page of notes on the topics covered in those presentations. Be sure to include an example motion graph either directly from the presentation or of your own creation.
2. Next, complete the Motion Modeling Assignment. This is the closest thing we'll have to "math homework" all unit, but it's important stuff. Take your time and complete the assignment. Make sure that you show all your work as you complete it, and then check your work with the answer key.
3. Finally, complete the puzzle cube regression by following these steps:
    a. Get your puzzle cube.
    b. For every piece, count how many cubes are in it, and then also weigh it.
    c. Record your data points in your engineering notebook, and enter your data points into Microsoft Excel.
    d. Use the Excel commands to calculate the line of best fit. You should get both a SLOPE and a Y-INTERCEPT.
    e. Record those values in your engineering notebook along with a sketch of the data and graph.
    f. Interpret your slope and y-intercept values in your notebook.

Part 1: Tasks	*5 points*	*4-3 points*	*2-1-0 points*
Mathematical Models Notes	+ You took a full page of notes on mathematical modeling + Your notes include some example motion graphs either from the presentation or of your own creation	- Your notes are less than a page - You did not include an example motion graph	- Your notes are missing - Your notes are very brief
	15-12 points	*11-6 points*	*5-0 points*
Motion Modeling Assignment	+ You completed the Motion Modeling Assignment + You showed your work + You checked your answers with the key	- You did not complete the Assignment - You did not show your work - You did not check your work	- Your assignment is missing - Your assignment is mostly incomplete
	10 points	*8-6 points*	*5-0 points*
Puzzle Cube Regression	+ You collected data on your puzzle cube pieces + You entered your data into Excel and used Excel to create the regression line + You interpreted the regression line and the graph in your notebook	- You did not collect all the data - You did not complete the Excel tasks - Your work is not shared in your engineering notebook	- You did not collect any data - Nothing is in your notebook

(50 pts) Approx. 3 days

For the second part of our unit, we'll be getting into Autodesk Inventor and learning how computer models can be made. Some of you will have done this in previous engineering courses like *Engineering & Robotics*, others will be very new to Atuodesk. In either case, we'll have a pretty easy time getting used to the key tools in Autodesk and in making some simple pieces. Our job here will be to make a first practice piece called the "Sketch Plane Cube" by following a tutorial. After that, you'll model every one of your puzzle cube pieces.

1. **Autodesk Notes –** watch the *Sketch Plane Tutorial* presentation and take some notes on how to use Autodesk. In addition to walking through the creation of the Sketch Plane Cube, this video also does a good job of pointing out all the important tools that we'll use when making things in Autodesk. Take a full page of notes on Autodesk as you go.
2. **Sketch Plane Cube** – Following the tutorial instructions in the *Sketch Plane Tutorial* video, create the Sketch Plane Cube in Autodesk. You can follow the directions pretty much exactly as they're outlined in the video, or if you feel pretty confident, you can try and create the Sketch Plane Cube shown at the right with the following parameters:



   a. ***The main body is a perfect cube with a side length of 2"***
   b. ***One face (shown as the front) has a 1" x 1" square centered on the face and extruded away from the face by 0.5"***
   c. ***Another face (shown here as the right) has a 1" diameter circle centered on the face and extruded away from the face by 0.5"***
   d. ***The last adjustment (shown here as the top) has a 1" diameter circle extruded down into the cube by 0.5"***
3. **Puzzle Cube Models** – With the Sketch Plane Cube all taken care of, you'll now get out your puzzle cube! If you don't have one, talk to Mr. Benshoof to borrow one. You'll then take every single piece (there are probably 4, 5, or 6) and model them in Autodesk. As you do, you want the following to happen:
   a. **Model EVERY puzzle cube piece in Autodesk as a new "Part"**
   b. **Save every puzzle cube piece to your jumpdrive as an .ipt file**
   c. **Try and make every piece a different color (this will make the assembly later much easier)**

Part 2: Tasks	*10 points*	*8-5 points*	*4-0 points*
Autodesk Notes	+ You took a full page of notes on how to use Autodesk + Your notes include specific details about how to use Autodesk	- You did take a full page of notes - Your notes do not address specific tools	- Your notes are missing
First Autodesk Shape Tutorial	+ You followed the tutorial to create the complete "Sketch Plane Cube" part	- You did not finish your "Sketch Plane Cube" - Your Sketch Plane Cube is the wrong shape/size	- You did not create a "Sketch Plane Cube" - Your Sketch Plane Cube is way off-base
	20 points	*16-10 points*	*9-0 points*
Puzzle Cubes in Autodesk	+ You modeled each of your puzzle cube pieces + Every puzzle cube piece is saved as a separate .ipt file + All of your puzzle cube pieces are different colors	- You modeled most of your puzzle cube pieces - Your pieces are not separately colored	- You only modeled one or two pieces - You did not save your pieces as .ipt files - You did not save your pieces to your jump drive
	10 points	*8-5 points*	*4-0 points*
Take the Unit 4 Quiz!	+ You took the quiz by the due date + Your grade is based on number correct	N/A	- You did not take the quiz by the due date

(50 pts) Approx. 3 days

The final part of our unit is to look at two newer parts of Autodesk: *assemblies* and *diagrams*. Autodesk can take multiple parts (like your puzzle cube pieces) and assemble them into onto one large object. It can also take different Autodesk files and create nice precise diagrams of them, including dimensions. In this part of the unit, you'll be asked to learn how those two tools work and use them to finish investigating your puzzle cube.

1. **Assembly Notes –** You should start by watching the *Assemblies in Autodesk* and the *Puzzle Cube Assemblies* presentations. Take a full page of notes on how Autodesk assemblies work, making particular note of the "Flush" and "Mate" constraint tools.
2. **Puzzle Cube Assembly** – Now, following the notes and suggestions from the video, assemble your puzzle cube pieces into a complete puzzle cube. When you're done, the proper faces should be mated so that the final object looks like a nice completed cube!
3. **Diagram Notes –** Now, watch the presentations *Drawings of Assemblies* and *Drawings in Autodesk*. These will give a nice overview of how to create diagrams/drawings in Autodesk. It's actually a super-fast procedure. Take a full page of notes, and make sure those notes include details about how to place a "Base View" and how to add "Annotations" or dimensions to your drawing!
4. **Puzzle Cube Drawings –** Complete two Autodesk drawings. The first should be of your most complex puzzle cube piece, and the second should be of your completed puzzle cube assembly. Be sure and include at least 3 multiview perspectives and 1 isometric perspective in each drawing. Also be sure to add dimensions!

Part 3: Tasks	*10 points*	*8-6 points*	*5-0 points*
Notes on Autodesk Assemblies	+ You took a full page of notes on how to create assemblies in Autodesk + Your notes include details about how to use the "Flush" and "Mate" constraints	- Your notes are not a full page - Your notes do not include details on the constraints	- Your notes are missing
Assemble Your Puzzle Cube!	+ You assembled all your puzzle cube pieces into a complete assembly + Your assembly makes a proper cube	- Your assembly is incomplete - Not all the pieces fit together properly	- You did not assemble your puzzle
Notes on Autodesk Diagrams	+ You took a full page of notes on how to make diagrams in Autodesk + Your notes include details about how to place the "Base View" as well as "Annotate"	- Your notes are not a full page - Your notes do not include details about specific tools	- Your notes are missing
Diagram a Puzzle Cube Piece	+ You made an Autodesk Diagram of your most interesting puzzle cube piece + Your diagram includes 3 multiview perspectives and 1 isometric	- Your diagram is of a very simple piece - Your diagram does not include all views - Your diagram is not fully dimensioned	- Your diagram is missing - Your diagram lacks many components
Diagram Your Complete Puzzle	+ You made a complete diagram of your assembled puzzle cube + Your diagram has 3 multiview perspectives and 1 isometric	- Your diagram is missing a view - Your diagram is hard to understand	- Your diagram is missing - Your diagram lacks many components