CENTRAL WASHINGTON UNIVERSITY,
IET 265.001
ENGINEERING DESIGN USING SOLIDWORKS

INSTRUCTIONS FOR MODELING A PAIR OF SPUR GEARS IN SOLIDWORKS 2009.

THIS EXERCISE UTILIZES GEAR RATIOS AND SKETCH METHODS FOR AN APPROXIMATION OF INVOLUTE GEAR TEETH DESIGN.

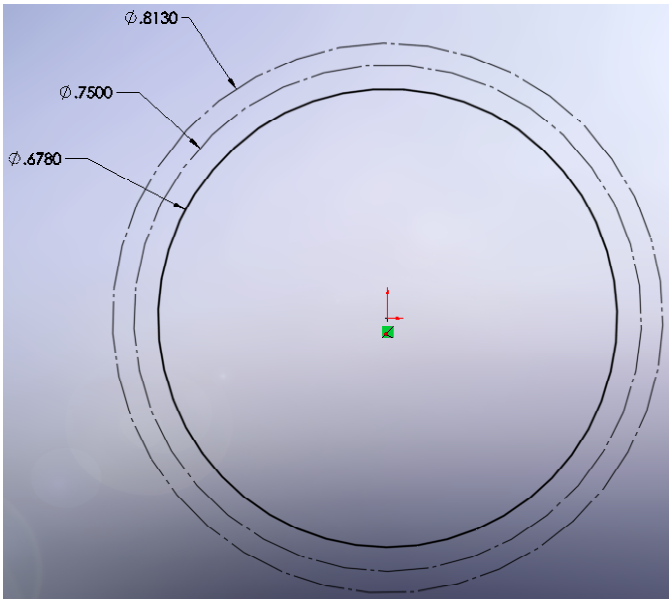
Requirements:
Precision to 3 significant digits
Material: a metal of your choice
Read and understand the information provided through the links on the Student Resources page of the Class Website

Formulas needed for this design:

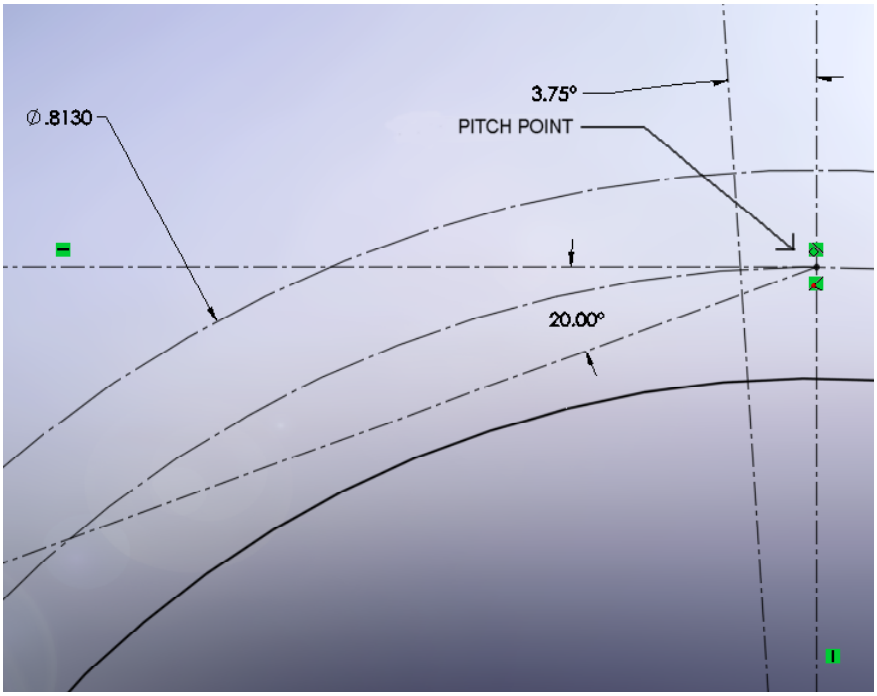
Gear Ratio	Rg	Rg=N2/N1	Given	
Dimetral Pitch	Pd	Pd=N/Dp	Given	Common design value for both gears
Teeth, Pinion Gear	N1	N1=Dp/Pd	Given	
Teeth, Gear Wheel	N2	N2=Dp/Pd	Determine	Use Gear Ratio
Outside Diameter	Do	Do=(Nx+2)/Pd	Determine	Maximum extent of gear
Pitch Diameter	Dp	Dp=Nx/Pd	Determine	Considered edge of the friction wheels
Root Diameter	Dr	Dr=(Nx-2)/Pd	Determine	Maximum extent of tooth cut
Pitch Point Circle Diameter	Dc	Dc=1/4*Dp	Determine	For the involute tooth edge
Base Diameter	Db	(Db=Dp cos Ø)	Sketch geom.	Pressure point where the teeth touch, tooth geom based on this diameter
Angular Circular Pitch	Ta	Ta=(360/Nx)*1/2	Determine	Angular distance between one tooth and the next tooth measured in degrees
Thickness				space measured on Pitch Diameter
Center Distance	Xc	Xc=(Dp1+Dp2)/2	Determine	Distance between centers of both meshed gears

Procedure:

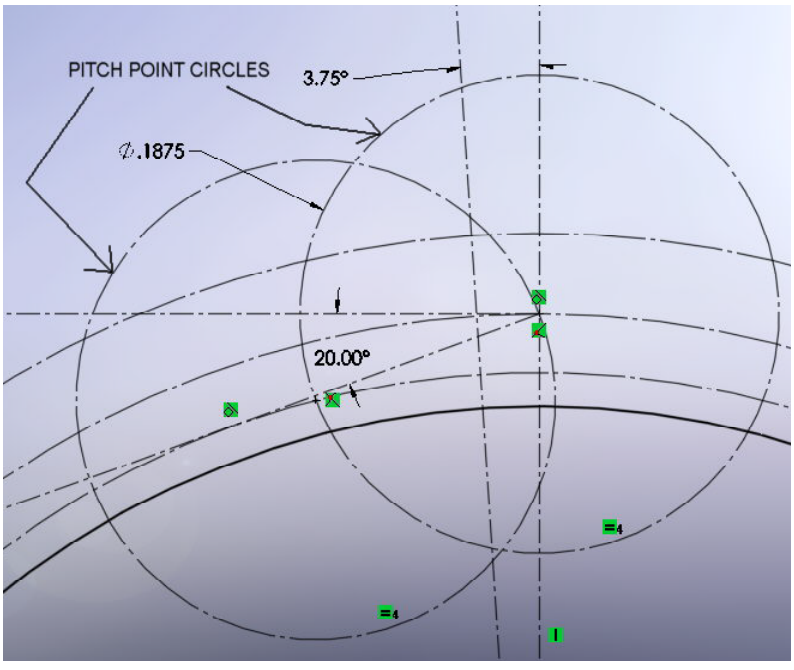
1. Using the given Gear Ratio, Dimetral Pitch and the number of teeth on the pinion gear determine the values shown in the table above (except for the Base Diameter (we will solve this using sketch geometry)). For the example following below we will use a Gear Ratio of 2.5, Dimetral Pitch of 32 and the Pinion Gear having 24 teeth.
2. Open SolidWorks, open your inches part template (change the precision to 4 digits after the decimal).



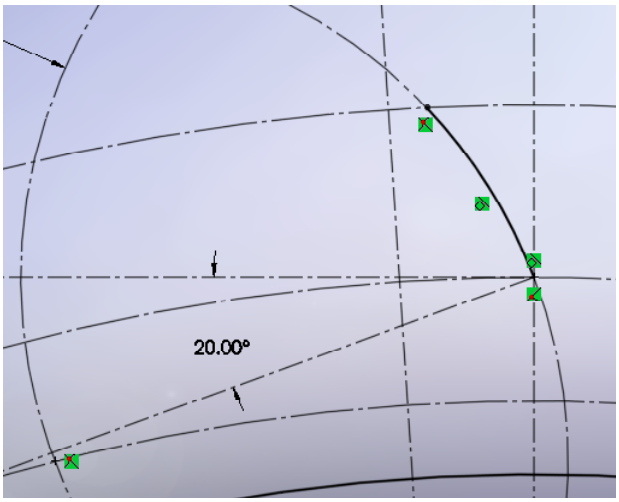
3. We will design the Pinion Gear first. Using the values determined above, sketch the three circular diameters on the Front Plane: Outside Diameter, Root Diameter and Pitch Diameter. The Root Diameter will be a sketch line with the two other circles being Construction Lines. The sketch should look similar to the nearby image.
4. Next, determine the Angular Circular Thickness. Take this value and divide it in half. Draw a construction line from the Origin vertical beyond the top of the Outer Diameter and a second line to the left of the first one with the angle determined using the equations listed above.
5. Draw a horizontal Construction Line to the left from the intersection of both the Pitch Diameter and the vertical line drawn above. This point is called the Pitch Point. Then draw a Construction Line, also from the Pitch Point, 20° below the line just drawn. This is the Pressure Line and represents the line of pressure from the powered gear tooth to the non-powered tooth of the opposing gear. In this gear, the powered tooth is rotating clockwise. In our gear design a 20° pressure angle will be used however, designs using other angles, such as 14.5° are less common but can also be found. The sketch now should look similar to the image nearby.



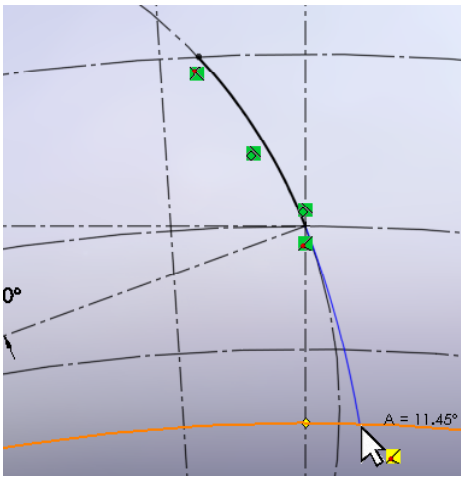
6. Now draw the Base Diameter. This circle has its center at the Origin and is tangent to the Pressure line.
7. Draw the first Pitch Point Circle with the center at the Pitch Point. Draw the second Pitch Point Circle with the center at the intersection of the first Pitch Point Circle and the Base Diameter. A portion of this circle will represent the arc on one side of the upper edge of the gear tooth.



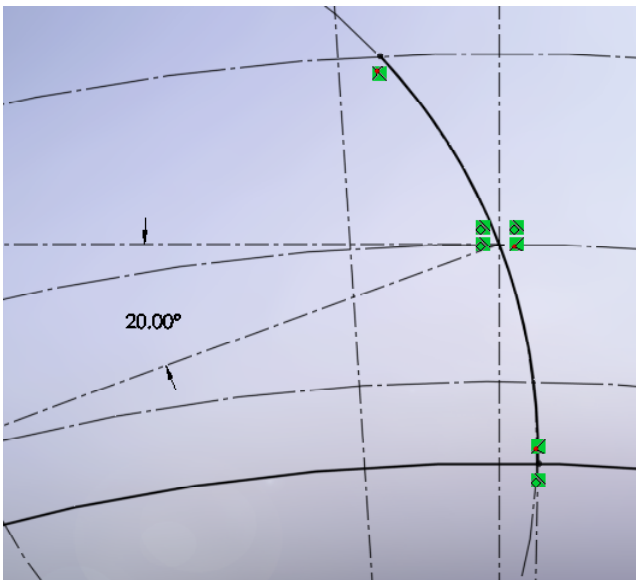
8. Now draw a 3 Point Arc from the intersection of the Outside Diameter to the Pitch Diameter with the third point on the second Pitch Point Circle. Refer to the image nearby.



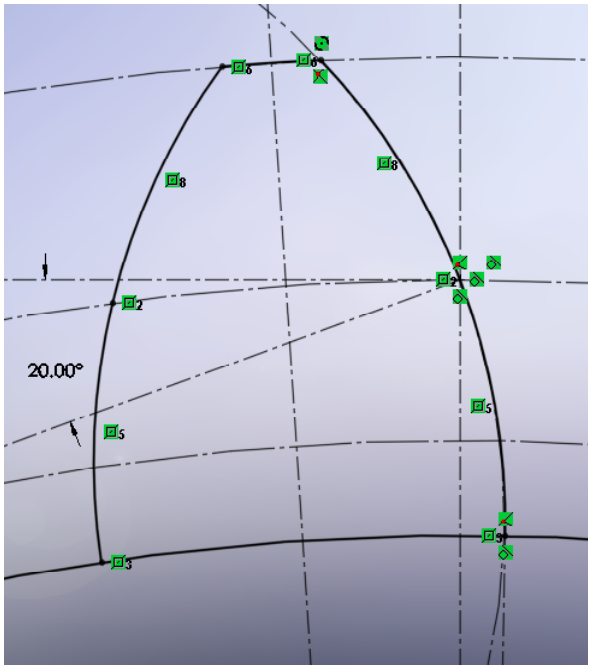
9. Sketch a Tangent Arc from the bottom end point of the 3 Point Arc sketched above to the Root Diameter. Refer to the image nearby.



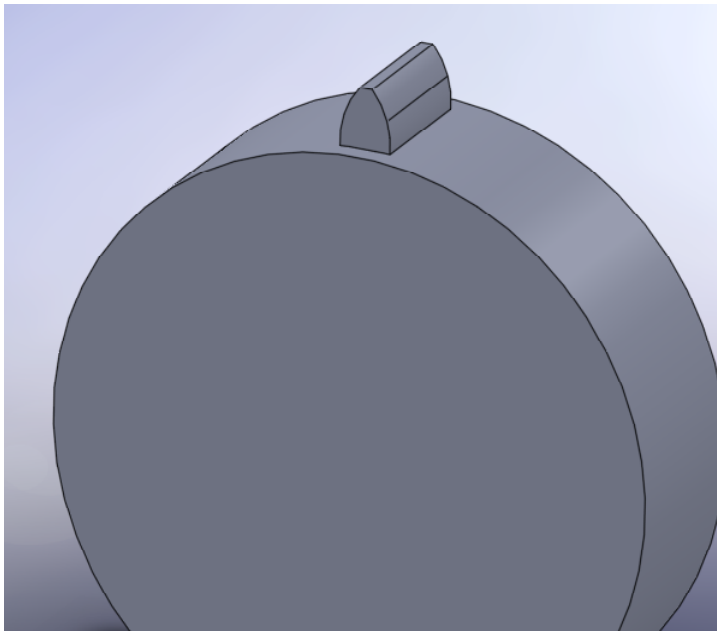
10. To make the last arc sketched perpendicular to the Root Diameter, sketch a Construction Line from the endpoint of the arc sketched above to the Origin. Make this line tangent to the arc sketched above. For some of the designs this arc will almost be Coradial with the second Pitch Point Circle but not always.



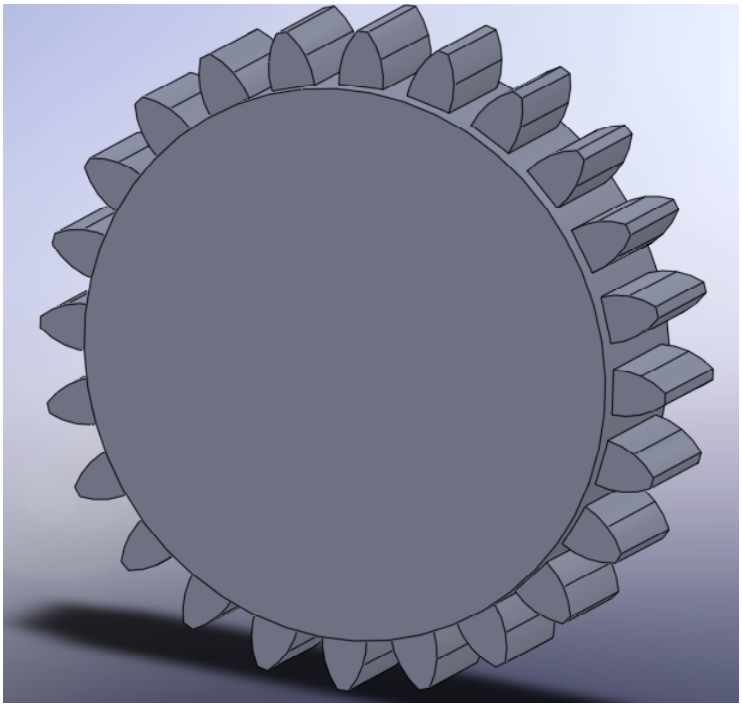
11. Now mirror the two arcs sketched above using the line representing half of the angular Circular Thickness. Sketch a 3 Point Arc connecting the two endpoints of the mirrored arcs on top with the third point on the Outside Diameter. You should now have 2 areas of enclosed geometry ready for some 3D features.



12. Go to the "Extrude Boss/Base" and extrude using the Mid Plane direction option, a distance of your choice, selecting the center region of the gear in the "Selected Contours" section of the Properties Manager. Name this feature "Base Extrude". Borrow the sketch from the first feature and using the "Extrude Boss/Base" feature again extrude the region for the gear tooth a distance less than the first extrude. Name this feature "Gear Tooth".



13. From the pull down menu "View" select "Temporary Axes" and using the "Circular Pattern" feature, pattern the "Gear Tooth" around the gear.



14. Add features such as a center hole or axle for your Motion Study or insets and/or spokes in the gear base that increase strength and reduce the material needed. You may want to add fillets between the tooth and gear base as you would expect to find, however it may slow your computer down. Add the fillets before the circular feature. You may add features that enhance the motion during the Motion Study for extra credit. These may include knobs and arms on the front gear face or objects behind the gears base. Be prepared to "suppress" all of these extra features if your Motion Study is having difficulty.
15. Design the Gear Wheel in a similar manner as the Pinion Gear as described above along with a mounting back plate. Take these components and create an assembly for your Motion Study.