# **Learning SOLIDWORKS 2021** Modeling, Assembly and Analysis





Better Textbooks. Lower Prices. www.SDCpublications.com

# Visit the following websites to learn more about this book:





Googlebooks



# **Table of Contents**

Preface	i
Acknowledgments	ii
Table of Contents	iii

## Chapter 1 Introduction – Getting Started

Introduction	1-2
Development of Computer Geometric Modeling	1-2
Feature-Based Parametric Modeling	1-6
Getting Started with SOLIDWORKS	1-7
Starting SOLIDWORKS	1-7
SOLIDWORKS Screen Layout	1-10
Menu Bar	1-10
Menu Bar Pull-down Menus	1-11
Heads-up View Toolbar	1-11
Features Toolbar	1-11
Sketch Toolbar	1-11
Property Managers	1-12
Graphics Area	1-13
Reference Triad	1-13
Origin	1-13
Confirmation Corner	1-13
Graphics Cursor or Crosshairs	1-13
Message and Status Bar	1-13
Using the SOLIDWORKS Command Manager	1-14
Mouse Buttons	1-15
[Esc] - Canceling Commands	1-15
SOLIDWORKS Help System	1-16
Leaving SOLIDWORKS	1-16
Creating a CAD files folder	1-17

### Chapter 2 Parametric Modeling Fundamentals

Introduction	2-2
The Tiger Head Design	2-3
Starting SOLIDWORKS	2-3
SOLIDWORKS Part Modeling Window Layout	2-4
Step 1: Determine/Set up the Base Solid Feature	2-6
Sketching Plane – It is an XY CRT, but an XYZ World	2-6

Creating Rough Sketches	2-8
Step 2: Creating a Rough Sketch	2-9
Graphics Cursors	2-9
Geometric Relation Symbols	2-10
Step 3: Apply/Modify Constraints and Dimensions	2-11
Viewing Functions – Zoom and Pan	2-16
Delete an Existing Geometry of the Sketch	2-17
Use the 3-Point Arc Command	2-17
Step 4: Complete the Base Solid Feature	2-19
Isometric View	2-20
Rotation of the 3D Model – Rotate View	2-20
Rotation and Panning –Arrow Keys	2-22
Dynamic Viewing - Quick Keys	2-23
Viewing Tools – Heads-up View Toolbar	2-25
View Orientation	2-26
Display Style	2-27
Orthographic vs. Perspective	2-27
Customizing the Heads-up View Toolbar	2-27
Step 5-1: Add an Extruded Feature	2-28
Step 5-2: Add a Cut Feature	2-32
Step 6: Add Additional Features	2-34
Add a Decal	2-36
Save the Model	2-39
Review Questions	2-40
Exercises	2-41

# Chapter 3 CSG Concepts and Model History Tree

Introduction	3-2
Binary Tree	3-3
Model History Tree	3-4
The A6-Knee Part	3-5
Starting SOLIDWORKS	3-5
Modeling Strategy	3-6
The SOLIDWORKS Feature Manager	3-7
Base Feature	3-7
Units Setup	3-8
Create the Base Feature	3-9
Adding the Second Solid Feature	3-13
Renaming the Part Features	3-15
Adjust the Dimensions of the Base Feature	3-15
History-Based Part Modifications	3-18
Add a Placed Feature	3-19
Create an Offset Extruded Feature	3-22
Add another Hole Feature	3-25

iv

3-31

#### Chapter 4 Parametric Constraints Fundamentals

Exercises

DIMENSIONS and RELATIONS	4-2
Create a Simple Triangular Plate Design	4-2
Fully Defined Geometry	4-3
Starting SOLIDWORKS	4-3
Create a User-Defined Part Template	4-4
Start a New Model using the New Template	4-8
Display/Hide Applied Geometric Relations	4-9
Apply Geometric Relations/Dimensional Constraints	4-10
Geometric Editing with Drag and Drop	4-14
Create Fully Constrained Sketches	4-16
Over-Defining and Driven Dimensions	4-17
Delete the Fix Constraint	4-19
Use the Fully Define Sketch Tool	4-20
Add Additional Geometry	4-22
Relations Settings	4-26
Model the B3-Leg Part	4-27
Create the 2D Sketch for the Base Feature	4-28
Parametric Relations	4-29
Use the Equations Command	4-31
Complete the Base Feature	4-32
Sketches vs. Profiles	4-34
Redefine the Profile with Contour Selection	4-37
Create an Extrusion with the Taper Angle Option	4-38
A Profile Containing Multiple Closed Regions	4-41
The Convert Entities Option	4-43
Add a Feature using Existing Geometry	4-43
Save the Model File	4-45
Use the Measure Tools	4-45
Create a Metric Part Template	4-48
The Boot Part	4-50
Review Questions	4-53
Exercises	4-54

#### Chapter 5 Pictorials and Sketching

Engineering Drawings, Pictorials and Sketching	5-2
Isometric Sketching	5-7

Isometric Sketching Exercises	5-9
Oblique Sketching	5-19
Oblique Sketching Exercises	5-20
Perspective Sketching	5-26
SOLIDWORKS Orthographic vs. Perspective Display	5-27
One-point Perspective	5-28
Two-point Perspective	5-29
Perspective Sketching Exercises	5-30
Review Questions	5-36
Exercises	5-37

# Chapter 6 Symmetrical Features and Part Drawings

Drawings from Parts and Associative Functionality	6-2
The A12- Rear Axle Support Design	6-3
Starting SOLIDWORKS	6-3
Modeling Strategy	6-4
Create the Base Feature	6-5
Create a Symmetrical Cut Feature	6-8
Create a Revolved Feature	6-10
Create another Extruded Feature	6-15
Create a Cut Feature	6-18
Create a Mirrored Feature	6-20
Drawing Mode – 2D Paper Space	6-21
The Drawing Sheet Properties	6-22
Add a Base View	6-24
Add Centerlines	6-26
Display Feature Dimensions	6-29
Add Additional Dimensions – Reference Dimensions	6-31
Complete the Drawing Sheet	6-32
Associative Functionality – Modify Feature Dimensions	6-34
Review Questions	6-37
Exercises	6-38

# Chapter 7 Datum Features in Designs

Reference Features	7-2
The <i>B2-Chassis</i> Part	7-2
Modeling Strategy	7-3
Starting SOLIDWORKS	7-4
Create the Base Feature	7-5
Create the Second Extruded Feature	7-8
Create a Tapered Extruded Feature	7-10

vii

Create an Offset Reference Plane	7-11
Create a Revolved Feature	7-12
Create an Angled Reference Plane	7-15
Create another Offset Reference Plane	7-16
Create an Extruded Feature with Reference Plane 3	7-18
Change the Appearance of the Solid Model	7-22
The Crank-Right Part	7-24
The A10-Crank Left Part	7-28
The Motor Part	7-30
The A1-Axle End Cap Part	7-33
The Hex Shaft Collar Part	7-34
The A8-Rod Pin Part	7-38
Review Questions	7-39
Exercises	7-40

# Chapter 8 Gears and SOLIDWORKS Design Library

Introduction to Gears	8-2
Spur Gear Nomenclatures	8-4
Basic Involute Tooth Profile	8-6
Gear Ratio	8-7
SOLIDWORKS Gear Toolbox	8-9
Starting SOLIDWORKS	8-10
Open the SOLIDWORKS Design Library	8-10
SOLIDWORKS Spur Gear Toolbox	8-12
Create a 42 Teeth Spur Gear	8-13
Modify the Generated 42T Gear	8-14
Create a Mirrored Feature	8-18
Import the Profile of the Pinion Gear	8-19
Complete the G2-Spur Gear Part	8-25
Create the G3-Spur Gear Part	8-27
Create the GO-Pinion Part	8-31
Start a New Part File	8-33
Export/Import the Generated Gear Profile	8-36
Create a Circular Pattern	8-39
Review Questions	8-46
Exercises	8-47

### Chapter 9 Advanced 3D Construction Tools

Introduction	9-2	
A Thin-Walled Design: Battery Case	9-2	
Modeling Strategy	9-3	

Starting SOLIDWORKS	9-4
Create the Base Feature	9-5
Create a Cut Feature	9-7
Create a Shell Feature	9-11
Create a Cut Feature	9-12
Create another Extruded Feature	9-14
Create another Cut Feature	9-16
Mirror the Last Feature	9-18
Create another Cut Feature	9-19
Complete the Model	9-20
A Thin-Wire Design: Linkage Rod	9-22
The Sweep Operation	9-22
Start a New Model	9-22
Complete the Swept Feature	9-27
Create a Mirrored Feature	9-28
The Gear Box Right Part	9-29
The Gear Box Left Part	9-34
Review Questions	9-38
Exercises	9-39

# Chapter 10 Planar Linkage Analysis using GeoGebra

Introduction to Four-Bar Linkages	10-2
Introduction to GeoGebra	10-5
Hide the Display of Objects	10-14
Add a Slider Control	10-16
Use the Animate Option	10-19
Tracking the Path of a Point on the Coupler	10-20
Exercises	10-25

## Chapter 11 Design Makes the Difference

Identify the Six-bar Linkage of the Mechanical Tiger11-4Starting GeoGebra11-6Add a Slider Control11-14Create the Second Four-bar Mechanism11-16Use the Animate Option11-20Tracking the Paths of the Feet11-22Adjusting the Crank Length11-22The Jansen Mechanism11-22The Klann Mechanism11-22Exercises11-22	Engineering Analysis – How does this work?	11-2
Starting GeoGebra11-6Add a Slider Control11-14Create the Second Four-bar Mechanism11-16Use the Animate Option11-20Tracking the Paths of the Feet11-21Adjusting the Crank Length11-22The Jansen Mechanism11-24The Klann Mechanism11-24Exercises11-24	Identify the Six-bar Linkage of the Mechanical Tiger	11-4
Add a Slider Control11-14Create the Second Four-bar Mechanism11-16Use the Animate Option11-20Tracking the Paths of the Feet11-22Adjusting the Crank Length11-22The Jansen Mechanism11-24The Klann Mechanism11-25Exercises11-27	Starting GeoGebra	11-6
Create the Second Four-bar Mechanism11-10Use the Animate Option11-20Tracking the Paths of the Feet11-21Adjusting the Crank Length11-22The Jansen Mechanism11-24The Klann Mechanism11-24Exercises11-24	Add a Slider Control	11-14
Use the Animate Option11-20Tracking the Paths of the Feet11-21Adjusting the Crank Length11-22The Jansen Mechanism11-24The Klann Mechanism11-24Exercises11-24	Create the Second Four-bar Mechanism	11-16
Tracking the Paths of the Feet11-2Adjusting the Crank Length11-2The Jansen Mechanism11-2The Klann Mechanism11-2Exercises11-2	Use the Animate Option	11-20
Adjusting the Crank Length11-22The Jansen Mechanism11-24The Klann Mechanism11-22Exercises11-22	Tracking the Paths of the Feet	11-21
The Jansen Mechanism11-24The Klann Mechanism11-25Exercises11-27	Adjusting the Crank Length	11-23
The Klann Mechanism11-2:Exercises11-2:	The Jansen Mechanism	11-24
Exercises 11-2'	The Klann Mechanism	11-25
	Exercises	11-27

# Chapter 12 Assembly Modeling and Basic Motion Analysis

Introduction	12-2
Assembly Modeling Methodology	12-3
The Mechanical Tiger Assembly	12-4
Additional Parts	12-4
Creating the Leg Subassembly	12-6
Starting SOLIDWORKS	12-6
Document Properties	12-7
Place the First Component	12-8
Place the Second Component	12-9
Degrees of Freedom and Assembly Relations	12-10
Assembly Mates	12-11
Apply the First Assembly Mate	12-12
Apply a Second Assembly Mate	12-14
Constrained Move	12-15
Place the Third Component	12-16
Apply a Coincident Mate	12-17
Apply another Aligned Mate	12-19
Edit Parts in the Assembly Mode	12-21
Assemble the <i>Boot</i> Part	12-25
Use the Design Library and Assemble Two Screws	12-27
Start the Main Assembly	12-29
Assemble the Gear Box Right Part	12-32
Assemble the Motor and the Pinion Gear	12-35
Assemble the G1 Gear	12-38
SOLIDWORKS Basic Motion Study	12-41
Assemble the G2 Gear	12-43
Assemble the G3 Gear	12-46
Assemble the Hex Shafts	12-48
Assemble the Crank Parts	12-51
Assemble the <i>Rear Shaft</i> and <i>Legs</i>	12-55
Assemble the Linkage-Rods	12-57
Complete the Assembly Model	12-62
Record an Animation Movie	12-63
Conclusion	12-64
Summary of Modeling Considerations	12-64
Review Questions	12-65
Exercises	12-66

## Chapter 13 Introduction to 3D Printing

What is 3D Printing	13-2
Development of 3D Printing Technologies	13-3

Primary types of 3D Printing processes	13-6
Stereolithography	13-6
Fused Deposition Modeling & Fused Filament Fabrication	13-7
Laser Sintering / Laser Melting	13-8
Primary 3D Printing Materials for FDM and FFF	13-9
From 3D model to 3D printed Part	13-11
Starting SOLIDWORKS	13-12
Export the Design as an STL file	13-13
Using the 3D Printing software to create a 3D Print	13-18
Questions	13-26

# Index