Introduction to CAD, CAM, and Practical CNC Machining for Milling

Instructor guide

Course duration: ~13 hours

Level: Associate

Product: Autodesk® Fusion 360®

This instructor guide is a comprehensive tool for facilitating this in the classroom. Prepare to teach this course by thoroughly reviewing this document, as well as all related course materials and resources.

We've summarized the core Fusion 360 skills in Introduction to CAD, CAM, and Practical CNC Milling for Manufacturing course so you can familiarize yourself with them before delivering this learning content in the classroom. It's always recommended that you work through the course yourself in preparation for each lesson.

Learning objectives:

- Summarize the workflow of digital manufacturing.
- Apply CAD modeling skills to basic parts
- Identify and create elements of a detailed drawing.
- Demonstrate knowledge and skills in Fusion 360 CAM.
- Explain foundational knowledge of practical CNC machining.

Each module is listed below along with suggested time allocations for instruction. The referenced demonstrations are based on the step-by-step instruction included in the course. Review the video tutorials and step-by-step print guides for the detailed instruction in each module.

This course teaches several topics covered in the Autodesk Certified Associate in CAM for 2.5 Axis Milling certification exam. We've included relevant certification exam objectives covered within each module.

Getting started

Total time required for module: 20 minutes

Discuss objectives: 3 minutes

Demonstrate: 10 minutes

- Review course overview and learning objectives
- Download the course resources and software
- Create an Autodesk ID
- Install the software
- Review the starter activity and articles

Hands-on time: 5 minutes

Review objectives: 2 minutes

Blueprint Basics

Total time required: 150 minutes

Discuss objectives: 3 minutes

Demonstrate: 15 minutes

- Identify parts of a blueprint.
- Identify GD&T symbols and datums.
- Interpret title block information.
- Interpret dimension types and tolerances.

Hands-on time: 40 minutes

Review objectives: 2 minutes

Datasets:

123 Block Drawing.f3z
Simple Block.f3d

Assignments:

- **Practice exercise:** 15 minutes
  - o Standard Drawing Views – Practice.f3d
- **Challenge exercise:** 60 minutes
  - o Complete Blueprint - Challenge.f3d
- **Module quiz:** 15 minutes

Certification exam objectives:

- 1.1.a.   Identify and Explain GD&T Symbols
- 1.1.d.   Identify tolerance-controlled features

CAD Modeling for Machinists

Total time required: 165 minutes

Discuss objectives: 3 minutes

Demonstration: 15 minutes

- Use foundational CAD concepts in sketching and part modeling.
- Reproduce a 3D model from a 2D blueprint.
- Use direct modeling tools to prepare a 3D model.
- Create fixtures and soft jaws in 3D.

Hands-on time: 65 minutes

Review objectives: 2 minutes

Datasets:

Engine Assembly – Intro to CAD CAM CNC.f3d
Engine Case RH – Drawing ENG-1008.pdf
Engine Case RH – No Timeline.f3d
Soft Jaw.f3d
Generic Vise w Parallels.f3d

Assignments:

- **Practice exercise:** 20 minutes
  - Direct Edit Plate – Practice.f3d
- **Challenge exercise:** 45 minutes
  - Soft Jaw Drawing – Challenge.pdf
- **Module quiz:** 15 minutes

Certification exam objectives:

- 1.2.b. Identify or define work holding device requirements
- 2.1.a. Create a new sketch on a plane or face
- 2.1.b. Create a new construction plane
- 2.1.c. Edit a sketch
- 2.1.d. Modify sketch display options
- 2.1.e. Apply dimensions to a sketch
- 2.1.f. Apply and remove sketch constraints
- 2.2.a. Create extrude features using driven height options
- 2.2.c. Apply fillets and chamfers to a model
- 2.3.a. Recognize the application of Press Pull to modify a feature
- 2.3.b. Recognize the application of Move/Copy to move a feature
- 2.3.c. Identify the use of Delete to remove a feature
- 2.4.a. Create a component
- 2.4.b. Apply Joints to create motion
- 2.4.c. Manage an assembly
- 3.3.a. Import a CAD file
- 3.3.b. Locate digital work holding

Introduction to CNC Milling

Total time required: 120 minutes

Discuss objectives: 3 minutes

Demonstration: 15 minutes

Assignments:

- **Practice exercise:** 25 minutes
- **Challenge exercise:** 45 minutes

- Identify how a vertical 3-axis CNC mill moves.
- Identify various milling tools and holders.
- Discuss how to set up a vise for squareness.

Hands-on time: 15 minutes

Review objectives: 2 minutes

- **Module quiz:** 15 minutes

Certification exam objectives:

- 1.2.b. Identify or define work holding device requirements
- 1.3.a. Identify and source applicable tools for manufacture
- 1.3.b. Identify and source tool holders for manufacture

Introduction to CAM Milling

Total time required: 240 minutes

Discuss objectives: 3 minutes

Demonstration: 15 minutes

- Create a CAM setup to CNC mill a 3D model.
- Import and create a digital tool library.
- Set up feeds and speeds for tooling.
- Use 2D toolpaths to rough and finish a simple part.
- Verify tool motion through simulation.
- Create required setup sheet and NC program.

Hands-on time: 120 minutes

Review objectives: 2 minutes

Datasets:

Engine Case RH – Ready To Program.f3d
Process Plan Sample – Mill.xls
Intro to CNC.tools
220527_Intro-to-CNC-Cutting-Data.ppt
220527_Intro-to-CNC-Process-Plan.ppt

Certification exam objectives:

- 1.5.b. Infer information from a process plan form
- 3.1.a. Create a digital tool library
- 3.1.b. Create a custom digital tool
- 3.1.c. Copy and modify a digital tool
- 3.1.d. Define tool parameters
- 3.2.b. Create stock
- 3.2.c. Select a box point to locate a working coordinate system
- 3.2.d. Define a coordinate reference
- 3.4.a. Create a basic pocket toolpath for roughing
- 3.4.b. Create an adaptive toolpath for roughing
- 3.5.a. Create a facing toolpath
- 3.5.b. Create a 2D contour toolpath
- 3.5.c. Create chamfer and 2D contour chamfer toolpaths
- 3.5.d. Create a drilling and tapping toolpath
- 3.6.a. Simulate a single toolpath
- 3.6.b. Simulate a setup

Assignments:

- **Practice exercise:** 25 minutes
    - Collision Check – Practice.f3d
- **Challenge exercise:** 60 minutes
    - Program and Verify – Challenge.f3d
- **Module quiz:** 15 minutes

- 4.1.a. Create a setup sheet with tool list
- 4.2.a. Export NC Code for a single coordinate system with an appropriate post processor

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Assignments:

- **Course Assessment:** 45 minutes
- **Course Challenge:** 120 minutes
    - Intro to CAD CAM CNC – Course Challenge.pdf

Module: Next steps

Total time required: 30 minutes

Review individual student outcomes for end of course test: 10 minutes

Create a student study plan: 10 minutes

Retest using the end of course test: 5 minutes

Review certification objectives: 5 minutes