



## Multi-Axis CAM Certification Prep

### Instructor guide

Course duration: ~845 minutes

Level: Advanced

Product: Autodesk® Fusion®

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 Skills in the Multi-Axis CAM Certification Prep 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:

- Identify workholding devices for multi-axis CNC Milling.
- Create a process plan for multi-axis milling.
- Create a CAM setup for CNC milling.
- Create and manage a tool library.
- Create multi-axis toolpaths for roughing and finishing.
- Verify toolpaths with simulation.
- Create setup sheets and output G-Code.
- Use probing routines to inspect machined parts.

Each module is listed below along with suggested time allocations for instruction. Review the video tutorials for the detailed instruction in 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

**Datasets:**

**Assignments:**

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## Plan and Setup Work

**Total time required:** 100 minutes

**Discuss objectives:** 3 minutes

**Demonstrate:** 15 minutes

- Analyze drawings and select the appropriate manufacturing process.
- Perform stock selection.
- Determine fixturing methods to ensure tool access and collision avoidance.
- Create a CAM setup.

**Hands-on time:** 30 minutes

**Review objectives:** 2 minutes

**Datasets:**

*4X Wrap FSAE Hub.f3d*  
*3+2 Milling.f3d*  
*3+1.f3d*  
*Spline coupler rtp.f3z*  
*Housing Probing example.f3d*  
*Multi axis positioning.f3d*  
*5x bracket.f3d*  
*Mounting adapter setup.f3d*

**Assignments:**

- **Practice exercise:** 15 minutes
  - *CAM Setup.f3d*
- **Challenge exercise:** 30 minutes
- *Order of Ops.f3d*
- **Module quiz:** 15 minutes

### Exam objectives

- 1.1. Interpret supplied drawing to select and plan orders of operations based on multi-axis availability.
  - 1.2. Apply procedural concepts required to perform stock prep for multi-axis fixturing.
  - 1.3. Determine how to design fixturing method, ensure collision avoidance, and evaluate cutting forces for multi-axis processes.
  - 1.4. Apply procedural concepts required to use multi-axis capabilities to optimize operations.
  - 1.5. Perform CAM setup within Fusion for multi-axis fixturing.
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### Machine Setup

**Hands-on time:** 35 minutes

**Total time required:** 115 minutes

**Review objectives:** 2 minutes

**Discuss objectives:** 3 minutes

**Demonstration:** 15 minutes

**Datasets:**

*Mounting adapter setup.f3d*

- Plan tools needed for each operation.
- Plan tool holders required for each tool.
- Assemble physical and digital tooling required for all operations.
- Establish work offsets and operation parameters for multi-axis machines.

**Assignments:**

- **Practice exercise:** 15 minutes
- **Challenge exercise:** 30 minutes
- **Module quiz:** 15 minutes

### Exam objectives

- 2.1. Plan and assemble tools and holders digitally to ensure agreement between physical tool and digital representation.
  - 2.2. Plan and assemble workholding digitally to ensure agreement between physical and digital representation.
  - 2.3. Establish work offsets and operation parameters for multi-axis machines.
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## Program Toolpaths

**Total time required:** 140 minutes

**Discuss objectives:** 3 minutes

**Demonstration:** 15 minutes

- Select an appropriate machining strategy.
- Define tool orientation for multi-axis positioning.
- Determine toolpath containment geometry and approach.
- Define tool orientation for simultaneous multi-axis machining.
- Determine collision avoidance strategy.
- Determine strategies to optimize individual multi-axis machining toolpaths.

## Exam objectives

- 3.1. Select the appropriate machining strategy.
  - 3.2. Define tool orientation for multi-axis positioning.
  - 3.3. Determine toolpath containment geometry and approach.
  - 3.4. Define tool orientation for simultaneous multi-axis machining.
  - 3.5. Determine collision avoidance strategy.
  - 3.6. Determine strategies to optimize individual multi-axis machining
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**Hands-on time:** 65 minutes

**Review objectives:** 2 minutes

## Datasets:

*Machining strategies.f3d*

*4X Wrap FSAE Hub.f3d*

*Spline coupler steep shallow.f3d*

*Rotary Tool Angle.f3d*

*Rotary Wrap.f3d*

## Assignments:

- **Practice exercise:** 20 minutes
  - *Tool Orientation.f3d*
- **Challenge exercise:** 20 minutes
  - *Lead and Lean.f3d*
- **Module quiz:** 15 minutes

## Verify and Simulate

**Total time required:** 105 minutes

**Discuss objectives:** 3 minutes

**Demonstration:** 15 minutes

- Validate stock removal strategies and verify removal of material as intended.
- Evaluate lessons learned from verification of toolpaths.
- Review collisions for toolpath adjustments.

**Hands-on time:** 30 minutes

**Review objectives:** 2 minutes

**Datasets:**

*Machining Strategies.f3d*

*3+2 Milling.f3d*

**Assignments:**

- **Practice exercise:** 20 minutes
  - *Machine Simulation.f3d*
- **Challenge exercise:** 20 minutes
  - *Toolpath Warnings.f3d*
- **Module quiz:** 15 minutes

**Exam objectives**

- 4.1. Apply concepts required to perform toolpath and machine simulation.
  - 4.2. Validate and confirm stock removal strategies for multi-axis.
  - 4.3. Review collisions for toolpath adjustments and confirm tool holder clearance.
  - 4.4. Apply lessons learned from verifications to toolpaths.
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**Output code and Part Inspection**

**Total time required:** 110 minutes

**Discuss objectives:** 3 minutes

**Demonstration:** 15 minutes

- Select NC program settings, post configurations, and properties.
- Identify critical components of a setup.
- Post machine readable G-code.
- Use probing to validate machined feature size and location.

**Hands-on time:** 40 minutes

**Review objectives:** 2 minutes

**Datasets:**

*Machining Strategies.f3d*

*3+2 Manufacture.f3d*

*Mounting Adapter Setup.f3d*

**Assignments:**

- **Practice exercise:** 15 minutes
  - *Probe Pocket with Island.f3d*
- **Challenge exercise:** 20 minutes
  - *Probe Pocket with Island.f3d*
- **Module quiz:** 15 minutes

## Exam objectives

- 5.1. Verify the axis work coordinate system setup against the posted code.
  - 5.2. Troubleshoot output errors.
  - 5.3. Given features in a multi-axis domain, validate feature location and size, update machine parameters based on probing cycle output.
  - 5.4. Apply concepts required to perform program prove out in a multi-axis machine.
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### Assignments:

- **Course Assessment:** 45 minutes
- **Course Challenge:** 180 minutes

**Module:** Next steps

**Total time required:** 30 minutes