

ADVM 0005E - CNC MILLING LEVEL 3

Catalog Description

Prerequisite: Completion of ADVM 0005D with a grade of "C" or better
Hours: 72 (18 lecture, 54 laboratory)

Description: Advanced applications of three-axis CNC surface contour machining. Students develop complex part geometry using Computer-Aided Design (CAD), import and process models in Computer-Aided Manufacturing (CAM) environments, and create machine code for 3-axis contour machining. Emphasis is placed on advanced workholding and fixture design, including the use of fixture clamps, locating devices, and modular fixturing systems for accurate and repeatable setups. Students plan machining operations, optimize toolpaths, and validate programs through simulation and verification. Projects culminate in the production of complex contoured components machined safely and accurately on 3-axis machining center. (not transferable)

Course Student Learning Outcomes

- CSLO #1: Demonstrate advanced machine and shop safety practices for Computer Numerical Controlled contour machining operations.
- CSLO #2: Generate and verify Computer Aided Manufacturing programs for 3-axis machining using advanced contour toolpath strategies.
- CSLO #3: Design and implement workholding fixtures using clamps, locating pins, and modular fixturing systems.

Effective Term

Fall 2026

Course Type

Credit - Degree-applicable

Contact Hours

72

Outside of Class Hours

36

Total Student Learning Hours

108

Course Objectives

Lecture Objectives

1. Recognize hazards associated with 3-axis contour machining
2. Identify Personal protective equipment (PPE) required for machine operators
3. Describe safe handling methods of tools, fixtures, and cutting fluids
4. Develop Advanced 3D models
5. Discuss design for manufacturability
6. Design fixtures for 3-axis operations

7. Identify different types of clamps, locators, and modular fixturing systems.
8. Discuss fixture design considerations for complex geometries
9. Describe the following toolpath strategies: roughing, semi-finishing, and finishing
10. Describe the following contouring methods: scallop, parallel, spiral, and pencil toolpaths
11. Plan inspection documentation to industry standards

Lab Objectives

1. Demonstrate safety procedures such as: Emergency stop and coolant handling procedures.
2. Perform machine startup and homing safety checks
3. Create 3D part geometry for assigned project
4. Verify alignment with dial indicators or probing routines
5. Create toolpaths for assigned part geometry
6. Create simulated tool motion and material removal
7. Prepare documentation for machining verification
8. Load and verify program on CNC control
9. Perform safe dry-run verification with fixture in place
10. Produce first article part using verified setup
11. Evaluate critical features
12. Record inspection results and corrective actions

General Education Information

- Approved College Associate Degree GE Applicability
- CSU GE Applicability (Recommended-requires CSU approval)
- Cal-GETC Applicability (Recommended - Requires External Approval)
- IGETC Applicability (Recommended-requires CSU/UC approval)

Articulation Information

- Not Transferable

Methods of Evaluation

- Objective Examinations
 - Example: Students will take a multiple-choice and fill-in examination on surface contour toolpath strategies. Standard Grading. Example; List the the names of four surface contour toolpath CAM strategies.
- Projects
 - Example: Successfully demonstrate the ability to process and plan a 3 axis machining project through the lab until completion. Using CAM application, proofing code in simulation, perform machining from raw stock to completed part, meeting specifications assigned in the course.
- Skill Demonstrations
 - Example: Demonstrate competency in Computer Aided Manufacturing by successfully creating programming code that proofs out with no mistakes in simulation

Repeatable

No

Methods of Instruction

- Laboratory
- Lecture/Discussion
- Distance Learning

Lab:

1. Following an instructor demonstration of verification of alignment with dial indicators and probing routines, students are expected to verify alignment with dial indicators and probing routines

Lecture:

1. Instructor presents a lecture on recognizing the hazards associated with 3-axis contour machining. Students are expected to identify hazards related to 3-axis contour machining..

Distance Learning

1. Following a brief instructor introduction video and reading assignment on design for manufacturability, students will complete an online quiz utilizing multiple-choice and essay questions. Students will be expected to know when design for manufacturability is appropriate for the application.

Typical Out of Class Assignments

Reading Assignments

1. Read material on advanced workholding vises used in three-axis machining applications, and types of workholding. Be prepared to outline each type. 2. Read material on methods of addressing three-axis machinery. Report on the advantages of 3-axis machining and compare to the add-on approaches.

Writing, Problem Solving or Performance

1. Diagram tooth style vs dovetail holding and compare sequence of manufacturing process of dovetail versus bite holding systems. Give examples of where each application has best use. 2. Identify the positive and negative aspects of each type of multi-axis CNC machines.

Other (Term projects, research papers, portfolios, etc.)

Required Materials

- Machining and CNC Technology
 - Author: Michael Fitzpatrick
 - Publisher: McGraw-Hill
 - Publication Date: 2024
 - Text Edition:
 - Classic Textbook?: No
 - OER Link:
 - OER:

Other materials and-or supplies required of students that contribute to the cost of the course.