

## CAM261 : Advanced 5-Axis Machining

### General Information

Author:	<ul style="list-style-type: none"><li>Jorge Palma</li></ul>
Course Code (CB01) :	CAM261
Course Title (CB02) :	Advanced 5-Axis Machining
Department:	CAM
Proposal Start:	Spring 2025
TOP Code (CB03) :	(0956.30) Machining and Machine Tools
CIP Code:	(48.0501) Machine Tool Technology/Machinist.
SAM Code (CB09) :	Clearly Occupational
Distance Education Approved:	No
Will this course be taught asynchronously?:	No
Course Control Number (CB00) :	CCC000626429
Curriculum Committee Approval Date:	05/22/2024
Board of Trustees Approval Date:	07/16/2024
Last Cyclical Review Date:	05/22/2024
Course Description and Course Note:	CAM 261 prepares students for advanced machining using 5-Axis Computer Numerical Control (CNC) machines. The course includes a review of 3+2 positioning and use of Mastercam software. Students will learn surface (solid face) and wireframe-based toolpaths. Also covered are methods of tool axis control, tilting strategies, and collision control, including how multiple methods of collision control can be combined.
Justification:	Mandatory Revision
Academic Career:	<ul style="list-style-type: none"><li>Credit</li></ul>
Mode of Delivery:	
Author:	
Course Family:	

### Academic Senate Discipline

Primary Discipline:	<ul style="list-style-type: none"><li>Machine Tool Technology (Tool and die making)</li></ul>
Alternate Discipline:	No value
Alternate Discipline:	No value

## Course Development

### Basic Skill Status (CB08)

Course is not a basic skills course.

Allow Students to Gain Credit by Exam/Challenge

### Course Special Class Status (CB13)

Course is not a special class.

### Pre-Collegiate Level (CB21)

Not applicable.

### Grading Basis

- Grade with Pass / No-Pass Option

### Course Support Course Status (CB26)

Course is not a support course

## General Education and C-ID

### General Education Status (CB25)

Not Applicable

### Transferability

Transferable to CSU only

### Transferability Status

Approved

## Units and Hours

### Summary

<b>Minimum Credit Units (CB07)</b>	4
<b>Maximum Credit Units (CB06)</b>	4
<b>Total Course In-Class (Contact) Hours</b>	180
<b>Total Course Out-of-Class Hours</b>	36
<b>Total Student Learning Hours</b>	216

### Credit / Non-Credit Options

#### Course Type (CB04)

Credit - Degree Applicable

#### Noncredit Course Category (CB22)

Credit Course.

#### Noncredit Special Characteristics

No Value

#### Course Classification Code (CB11)

Credit Course.

Variable Credit Course

#### Funding Agency Category (CB23)

Not Applicable.

Cooperative Work Experience

Education Status (CB10)

### Weekly Student Hours

	In Class	Out of Class
Lecture Hours	1	2
Laboratory Hours	9	0
Studio Hours	0	0

### Course Student Hours

<b>Course Duration (Weeks)</b>	18
<b>Hours per unit divisor</b>	54
<b>Course In-Class (Contact) Hours</b>	
Lecture	18
Laboratory	162
Studio	0

**Total** 180

**Course Out-of-Class Hours**

Lecture	36
Laboratory	0
Studio	0
<b>Total</b>	<b>36</b>

**Time Commitment Notes for Students**

No value

**Units and Hours - Weekly Specialty Hours**

Activity Name	Type	In Class	Out of Class
No Value	No Value	No Value	No Value

**Pre-requisites, Co-requisites, Anti-requisites and Advisories**

**Advisory**

CAM260 - Introduction to 5-Axis Machining (in-development)

**Objectives**

- Explain the steps for 5-Axis toolpath creation.
- Identify the zero position on a 5-Axis machine.
- Create various 5-Axis planes.
- Perform 5-Axis drilling.

**Entry Standards**

Entry Standards

## Course Limitations

Cross Listed or Equivalent Course

## Specifications

### Methods of Instruction

Methods of Instruction                      Lecture

Methods of Instruction                      Laboratory

Methods of Instruction                      Multimedia

Methods of Instruction                      Demonstrations

### Out of Class Assignments

- Create a part program from a blueprint, then upload it in a Mastercam file format
- Create a part program for a solid model, then upload it in a Mastercam file format

### Methods of Evaluation

#### Rationale

Exam/Quiz/Test

Quizzes

Exam/Quiz/Test

Final exam

Exam/Quiz/Test

Final project (e.g. multi-axis part with multiple set-up such as a worm gear or impeller)

### Textbook Rationale

2009 is the latest edition of this book

### Textbooks

Author	Title	Publisher	Date	ISBN
Apro, Carlo	Secrets of 5-Axis Machining	Industrial Press	2009	9780831133757

### Other Instructional Materials (i.e. OER, handouts)

No Value

**Materials Fee**

No value

**Learning Outcomes and Objectives****Course Objectives**

Explain the 3+2 machining process.

Explain simultaneous 5-Axis machining.

Demonstrate the use of Tool Center Point Control (TCPC).

Identify the application of Dynamic Work Offset (DWO).

Employing the 5-axis post processor.

Designing work holding and fixturing for 5-axis machining.

**SLOs****Create planes and toolpath for 5-Axis machines.**

Expected Outcome Performance: 70.0

*ILOs*  
Core ILOs

Analyze and solve problems using critical, logical, and creative thinking; ask questions, pursue a line of inquiry, and derive conclusions; cultivate creativity that leads to innovative ideas.

Demonstrate depth of knowledge in a course, discipline, or vocation by applying practical knowledge, skills, abilities, theories, or methodologies to solve unique problems.

*CAM*  
A.S. Computer Numerical  
Control Technician

Discuss the techniques used to read and evaluate an engineering drawings.

**Generate programs for 5-Axis positioning and toolpath using Mastercam.**

Expected Outcome Performance: 70.0

*ILOs*  
Core ILOs

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*CAM*  
A.S. Computer Numerical  
Control Technician

Apply various software programs to write CNC code for the production of manufactured parts.

**Verify machine G-code by applying the appropriate software.**

Expected Outcome Performance: 70.0

ILOs  
Core ILOs

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CAM  
A.S. Computer Numerical  
Control Technician

Apply various software programs to write CNC code for the production of manufactured parts.

## Additional SLO Information

**Does this proposal include revisions that might improve student attainment of course learning outcomes?**

No

**Is this proposal submitted in response to learning outcomes assessment data?**

No

**If yes was selected in either of the above questions for learning outcomes, explain and attach evidence of discussions about learning outcomes.**

No Value

**SLO Evidence**

No Value

## Course Content

### Lecture Content

#### General Introduction (1 hour)

- Scope of curriculum
- Course requirements
- Methods of preparation

#### 5-Axis Machining and Set Up in Mastercam (2 hours)

- Setting up Mastercam configuration
- Orientation of the part Part zero in Mastercam using DWO and TCPC
- Tool zero in Mastercam

#### 3+2 Machining (3 hours)

- Creating planes
- Set-up tools
- Clearance plane
- Creating solids for fixturing

#### Simultaneous 5-Axis Toolpath (3 hours)

- Creating curves
- Setting up proper planes
- Tool axis control
- Cut pattern
- Collision control
- Defining lead/lag angle
- Defining side tilt angle

#### 5-Axis Drilling (3 hours)

- Creating hole geometry
- Creating hole axis vector line
- 5-Axis drilling toolpath
- Clearance plane set-up
- Retracting plane

**Set-up for Haas UMC-750 5-Axis Machine (3 hours)**

- Part loading
- Finding part zero using Renishaw probe
- Setting up tools using 3D touch-trigger tool setter
- Verifying the program in Vericut
- Machining the programmed part

**Vericut (3 hours)**

- Introduction to Vericut interface
- Loading the machine and using Vericut to control
- Importing work piece, stock, and fixtures
- Verifying the program
- Modifying the Mastercam program

**Total hours: 18****Laboratory/Studio Content****5-Axis Machining and Set Up in Mastercam (27 hours)**

- Setting up Mastercam configuration
- Orientation of the part Part zero in Mastercam using DWO and TCPC
- Tool zero in Mastercam

**3+2 Machining (27 hours)**

- Creating planes
- Set-up tools
- Clearance plane
- Creating solids for fixturing

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**Total hours: 162****Additional Information**

Is this course proposed for GCC Major or General Education Graduation requirement? If yes, indicate which requirement in the two areas provided below.

No

GCC Major Requirements

No Value

**GCC General Education Graduation Requirements**

No Value

**Repeatability**

Not Repeatable

**Justification (if repeatable was chosen above)**

No Value

**Resources**

**Did you contact your departmental library liaison?**

No

**If yes, who is your departmental library liaison?**

No Value

**Did you contact the DEIA liaison?**

No

**Were there any DEIA changes made to this outline?**

No Value

**If yes, in what areas were these changes made:**

No Value

**Will any additional resources be needed for this course? (Click all that apply)**

No Value

**If additional resources are needed, add a brief description and cost in the box provided.**

No Value