

Western Technical College

## 31420325 CNC: Basic CAM 1

### Course Outcome Summary

#### Course Information

<b>Description</b>	Introduction to computer aided machining of 2.5 dimension parts using CAM software. Participants will use CAM software to create and machine pockets, slots, bosses, holes and engraved details in milled parts and to turn and face round parts in CNC lathes.
<b>Career Cluster</b>	Manufacturing
<b>Instructional Level</b>	Technical Diploma Courses
<b>Total Credits</b>	1.00
<b>Total Hours</b>	36.00

#### Types of Instruction

Instruction Type	Credits/Hours
Lecture	1 CR / 36 HR

#### Course History

##### Purpose/Goals

This course prepares learners to create basic programs for CNC machining centers and CNC turning centers using CAM software.

##### Target Population

This course is targeted toward individuals who would like to learn to use the basic functions of computer aided manufacturing (CAM) software. This course is designed for incumbent workers, displaced workers, workers who would like to improve employability and skills, high school graduates, and individuals in need of application based employer demanded skills. Additionally, this course is designed to help learners meet the requirements for Western Technical College's machine tool technical diploma program and the requirements to earn a "CNC Programmer" certificate as part of a CNC Skills Institute.

##### Pre/Corequisites

Prerequisite 31420302 Blueprint Reading

##### Textbooks

*Mastercam Training Guide, Mill 2D*. Publisher: Caminstructor Incorporated. **ISBN-13:** 978-1-927359-48-8.

Required.

*Mastercam Training Guide, Lathe*. Publisher: Caminstructor Incorporated. **ISBN-13:** 978-1-927359-58-7.

Required.

## Learner Supplies

Safety glasses with side eye protection that meet Z87 OSHA guidelines. **Vendor:** Campus Shop. Required.

Proper work boots - \$35.00-75.00. **Vendor:** To be discussed in class. Required.

## Program Outcomes

### 1. **MACH 2. Interpret industrial/engineering drawings**

*Type*      *TSA*                      *Status*      *Active*

#### Summative Assessment Strategies

1.1.      in a performance demonstration

#### Criteria

- 1.1.      Interpret orthographic projections
- 1.2.      Interpret lines, symbols, standards, and notations
- 1.3.      Interpret a Bill of Materials
- 1.4.      Interpret a title block
- 1.5.      Determine location of part features according to established specifications
- 1.6.      Calculate tolerances according to established specifications
- 1.7.      Develop drawings that follow view projection standards
- 1.8.      Interpret Geometric Dimensioning and Tolerancing

### 2. **MACH 5. Perform programming, set-up and operation of CNC Machine Tools**

*Type*      *TSA*                      *Status*      *Active*

#### Summative Assessment Strategies

2.1.      in a performance demonstration

#### Criteria

- 2.1.      Write basic programs for specified CNC machine tools according to EIA-ISO standards
- 2.2.      Load the correct program into the machine
- 2.3.      Verify the accuracy of the CNC program
- 2.4.      Verify work and tool offsets
- 2.5.      Execute program
- 2.6.      Adjust speeds and feeds to optimize CNC machining conditions

## Course Competencies

### 1. **Manage data files**

*Domain*      *Affective*                      *Level*      *Organizing*                      *Status*      *Active*

#### Assessment Strategies

- 1.1.      In the classroom, lab, or shop setting
- 1.2.      Using computer software
- 1.3.      In applied assignments
- 1.4.      Individually
- 1.5.      On tests and quizzes
- 1.6.      Given examples

#### Criteria

*Performance will be satisfactory when:*

- 1.1.      learner locates and opens files stored on computer hard drive

- 1.2. learner locates and opens files stored on servers
- 1.3. learner locates and opens files stored on removable devices
- 1.4. learner locates and opens files from course management system or Internet locations
- 1.5. learner creates new course folders in specified locations
- 1.6. learner correctly names and renames folders and files
- 1.7. learner locates and correctly attaches files to e-mail messages
- 1.8. learner correctly follows procedures for saving files and new CAM programs
- 1.9. learner follows proper protocol for saving files in specified format
- 1.10. learner selects and send the correct files to the instructor as e-mail attachments
- 1.11. learner selects and sends the correct files to the instructor via course management system drop box
- 1.12. learner establishes protocol for saving files in multiple locations when files are updated multiple times
- 1.13. learner completes all activities by the due date with a minimum of 70% accuracy
- 1.14. learner scores a minimum of 70% on tests and quizzes

### Learning Objectives

- 1.a. Retrieve data files
- 1.b. Manage data files
- 1.c. Save files
- 1.d. Set up course folders

## 2. Identify components of the CAM software user interface

<i>Domain</i>	<i>Cognitive</i>	<i>Level</i>	<i>Application</i>	<i>Status</i>	<i>Active</i>
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### Assessment Strategies

- 2.1. In the classroom, lab, or shop setting
- 2.2. Using computer software
- 2.3. In applied assignments
- 2.4. Individually
- 2.5. On tests and quizzes
- 2.6. Given handouts, tutorials, and course reference materials

### Criteria

*Performance will be satisfactory when:*

- 2.1. learner accurately completes follow-along exercises
- 2.2. learner correctly locates and labels interface components
- 2.3. learner correctly identifies the steps toolbox
- 2.4. learner correctly identifies the part view toolbox
- 2.5. learner correctly identifies components within the steps toolbox
- 2.6. learner correctly identifies components within the part view toolbox
- 2.7. learner correctly identifies the operations list results
- 2.8. learner correctly identifies the manufacturing details results
- 2.9. learner correctly identifies the tool list results
- 2.10. learner correctly identifies the assistance bar
- 2.11. learner correctly identifies the geometry dialog bar
- 2.12. learner correctly identifies the status bar components
- 2.13. learner correctly identifies the components of the basic toolbar
- 2.14. learner correctly identifies het components of the advanced toolbar
- 2.15. learner correctly identifies the components of the principal view menu
- 2.16. learner correctly identifies the components of the snap mode toolbar
- 2.17. learner correctly identifies the components of the geometry toolbar
- 2.18. learner correctly identifies the components of the simulation toolbar
- 2.19. learner completes all activities by the due date and scores a minimum of 70% on each assignment
- 2.20. learner scores a minimum of 70% on tests and quizzes

### Learning Objectives

- 2.a. Identify the basic components of the user interface
- 2.b. Identify components of the toolbox menus
- 2.c. Identify components of the results menu
- 2.d. Identify components of the status bar
- 2.e. Identify components of commonly used toolbars
- 2.f. Participate in class follow-along exercises

### 3. Create geometry using CAM software

*Domain Cognitive Level Application Status Active*

#### Assessment Strategies

- 3.1. In the classroom, lab, or shop setting
- 3.2. Using computer software
- 3.3. In applied assignments
- 3.4. Individually
- 3.5. On tests and quizzes
- 3.6. Given prints, files, tutorials, and course reference materials

#### Criteria

*Performance will be satisfactory when:*

- 3.1. learner correctly selects the geometry tool required for specific applications
- 3.2. learner completes the lines creation tutorial
- 3.3. learner completes the circle creation tutorial
- 3.4. learner completes the arc creation tutorial
- 3.5. learner completes the fillet creation tutorial
- 3.6. learner completes the dimensions creation tutorial
- 3.7. learner accurately reproduces geometry from prints
- 3.8. prints are drawn completely and accurately
- 3.9. prints are completely and accurately dimensioned
- 3.10. learner are drawn completely and accurately
- 3.11. learner scores a minimum of 70% on rubric criteria for each assignment
- 3.12. learner completes all activities by the due date
- 3.13. learner scores a minimum of 70% on tests and quizzes

#### Learning Objectives

- 3.a. Utilize geometry toolbar fly-out menus
- 3.b. Create lines using CAM software
- 3.c. Create circles using CAM software
- 3.d. Create fillets using CAM software
- 3.e. Create arcs using CAM software
- 3.f. Create dimensions using CAM software
- 3.g. Trim and extend geometry using CAM software
- 3.h. Utilize the snap mode toolbar
- 3.i. Reproduce prints using CAM geometry tools

### 4. Modify geometry using CAM software

*Domain Cognitive Level Application Status Active*

#### Assessment Strategies

- 4.1. In the classroom, lab, or shop setting
- 4.2. Using computer software
- 4.3. In applied assignments
- 4.4. Individually
- 4.5. On tests and quizzes
- 4.6. Given prints, tutorials, files, and course reference materials

#### Criteria

*Performance will be satisfactory when:*

- 4.1. learner identifies and describes the function of the transform tool
- 4.2. learner correctly selects the geometry or curve to be transformed
- 4.3. learner completes the part rotation tutorial
- 4.4. learner completes the part scaling tutorial
- 4.5. learner completes the part mirroring tutorial
- 4.6. learner completes the part creation tutorial
- 4.7. learner correctly transforms geometry per print specifications
- 4.8. learner correctly transforms curves per print specifications

- 4.9. learner demonstrates the use of the transform tool in applied assignments
- 4.10. learner scores a minimum of 70% on rubric criteria for each assignment
- 4.11. learner completes all activities by the due date
- 4.12. learner scores a minimum of 70% on tests and quizzes

**Learning Objectives**

- 4.a. Utilize the transform function in CAM program
- 4.b. Translate geometry using CAM software
- 4.c. Rotate geometry using CAM software
- 4.d. Scale geometry using CAM software
- 4.e. Reflect geometry using CAM software

**5. Chain boundary curves using CAM software**

<i>Domain</i>	<i>Cognitive</i>	<i>Level</i>	<i>Application</i>	<i>Status</i>	<i>Active</i>
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**Assessment Strategies**

- 5.1. In the classroom, lab, or shop setting
- 5.2. Using computer software
- 5.3. In applied assignments
- 5.4. Individually
- 5.5. On tests and quizzes
- 5.6. Given prints, tutorials, files, and course reference materials

**Criteria**

*Performance will be satisfactory when:*

- 5.1. learner correctly describes the type of geometry that requires a boundary chaining process
- 5.2. learner identifies and describes the function of the boundary curve tools
- 5.3. learner correctly selects the geometry to be chained into a boundary
- 5.4. learner completes the curve chaining tutorial
- 5.5. learner completes the text creation tutorial
- 5.6. learner correctly chains open boundaries
- 5.7. learner correctly chains closed boundaries
- 5.8. learner correctly chains complex curves using the pick pieces curve tool
- 5.9. learner correctly chains part geometry per print specifications
- 5.10. learner correctly changes the names of curves
- 5.11. learner correctly names new curves
- 5.12. learner selects the correct curve from the part view menu to create features
- 5.13. learner demonstrates the use of the curve tool in applied assignments
- 5.14. learner scores a minimum of 70% on rubric criteria for each assignment
- 5.15. learner completes all activities by the due date
- 5.16. learner scores a minimum of 70% on tests and quizzes

**Learning Objectives**

- 5.a. Define the term curve as it relates to a machining boundary
- 5.b. Describe the types of geometry that require boundaries for machining
- 5.c. Chain closed boundaries
- 5.d. Chain open boundaries
- 5.e. Create curves using the curve wizard
- 5.f. Chain boundaries that cross other boundaries
- 5.g. Name boundary curves
- 5.h. Locate curves in the step toolbox
- 5.i. Locate curves in the part view toolbox

**6. Set stock properties and setups for CAM programs**

<i>Domain</i>	<i>Cognitive</i>	<i>Level</i>	<i>Application</i>	<i>Status</i>	<i>Active</i>
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**Assessment Strategies**

- 6.1. In the classroom, lab, or shop setting
- 6.2. Using computer software
- 6.3. In applied assignments
- 6.4. Individually

- 6.5. On tests and quizzes
- 6.6. Given prints, tutorials, files, and course reference materials

**Criteria**

*Performance will be satisfactory when:*

- 6.1. learner demonstrates three methods of locating and opening stock properties
- 6.2. learner demonstrates three methods of locating and opening stock setup properties
- 6.3. learner locates the UCS menu
- 6.4. learner enters the stock size specified
- 6.5. learner changes the stock size per specifications
- 6.6. learner resizes stock per directions in both X and Y directions
- 6.7. learner solves problems by transforming and relocating stock
- 6.8. learner selects the correct stock material
- 6.9. learner creates part setups per specifications
- 6.10. learner edits part setups per specifications
- 6.11. learner creates multiple part setups within one program
- 6.12. learner scores a minimum of 70% on rubric criteria for each assignment
- 6.13. learner completes all activities by the due date
- 6.14. learner scores a minimum of 70% on tests and quizzes

**Learning Objectives**

- 6.a. Create new part documents
- 6.b. Set and edit stock size
- 6.c. Set and edit stock material
- 6.d. Set and edit part setups
- 6.e. Set and reset UCS

**7. Create 2.5D milling features using CAM software**

<i>Domain</i>	<i>Cognitive</i>	<i>Level</i>	<i>Application</i>	<i>Status</i>	<i>Active</i>
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**Assessment Strategies**

- 7.1. In the classroom, lab, or shop setting
- 7.2. Using computer software
- 7.3. In applied assignments
- 7.4. Individually
- 7.5. On tests and quizzes
- 7.6. Given prints, tutorials, process sheets, specification sheets, and course reference materials

**Criteria**

*Performance will be satisfactory when:*

- 7.1. learner selects the appropriate feature to machine specified part detail
- 7.2. learner creates facing features per print specifications and directions
- 7.3. learner creates hole features per print specifications and directions
- 7.4. learner creates patterns for hole features
- 7.5. learner creates pocket features per print specifications and directions
- 7.6. learner creates boss features per print specifications and directions
- 7.7. learner creates groove features per print specifications and directions
- 7.8. learner creates side features per print specifications and directions
- 7.9. learner creates multiple features per print specifications and directions
- 7.10. learner edits feature properties to adhere to logical machining principles
- 7.11. learner sets the appropriate Z offset for milling features
- 7.12. learner sends all milling program files to instructor per directions
- 7.13. features are created for machining efficiency
- 7.14. learner scores a minimum of 70% on rubric criteria for each assignment
- 7.15. learner completes all activities by the due date
- 7.16. learner scores a minimum of 70% on tests and quizzes

**Learning Objectives**

- 7.a. Describe the types of milling features that can be created in CAM programs
- 7.b. Utilize the milling Features menu

- 7.c. Create milling features from dimensions
- 7.d. Create milling features from curves
- 7.e. Create patterns from milling features
- 7.f. Locate milling features in programs
- 7.g. Set milling feature dimensions
- 7.h. Select milling feature strategies

## 8. Create 2D turning features using CAM software

<i>Domain</i>	<i>Cognitive</i>	<i>Level</i>	<i>Application</i>	<i>Status</i>	<i>Active</i>
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### Assessment Strategies

- 8.1. In the classroom, lab, or shop setting
- 8.2. Using computer software
- 8.3. In applied assignments
- 8.4. Individually
- 8.5. On tests and quizzes
- 8.6. Given prints, tutorials, process sheets, specification sheets, and course reference materials

### Criteria

*Performance will be satisfactory when:*

- 8.1. learner selects the appropriate feature to machine specified part detail
- 8.2. learner creates hole features per print specifications and directions
- 8.3. learner creates outer diameter turning features per print specifications and directions
- 8.4. learner creates inner diameter turning features per print specifications and directions
- 8.5. learner creates boring features per print specifications and directions
- 8.6. learner creates groove features per print specifications and directions
- 8.7. learner creates facing features per print specifications and directions
- 8.8. learner creates cutoff features per print specifications and directions
- 8.9. learner creates multiple features per print specifications and directions
- 8.10. learner edits feature properties to adhere to logical machining principles
- 8.11. learner sets the appropriate Z offset for turning features
- 8.12. features are created for machining efficiency
- 8.13. learner sends all turning program files to instructor per directions
- 8.14. learner scores a minimum of 70% on rubric criteria for each assignment
- 8.15. learner completes all activities by the due date
- 8.16. learner scores a minimum of 70% on tests and quizzes

### Learning Objectives

- 8.a. Describe the types of turning features that can be created in CAM programs
- 8.b. Utilize the turning Features menu
- 8.c. Create turning features from dimensions
- 8.d. Create turning features from curves
- 8.e. Locate turning features in programs
- 8.f. Set turning feature dimensions
- 8.g. Select turning feature strategies

## 9. Set machining parameters for machining features

<i>Domain</i>	<i>Cognitive</i>	<i>Level</i>	<i>Application</i>	<i>Status</i>	<i>Active</i>
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### Assessment Strategies

- 9.1. In the classroom, lab, or shop setting
- 9.2. Using computer software
- 9.3. In applied assignments
- 9.4. Individually
- 9.5. On tests and quizzes
- 9.6. Given prints, tutorials, process sheets, specification sheets, and course reference materials

### Criteria

*Performance will be satisfactory when:*

- 9.1. learner selects strategies for specific machining applications

- 9.2. learner selects correct roughing and finishing tools for material
- 9.3. learner selects correct roughing and finishing tools for application
- 9.4. learner selects tools that are commonly available in the machine shop
- 9.5. learner creates new tools per specifications
- 9.6. learner selects multiple roughing tools when required
- 9.7. learner sets the appropriate finish allowance
- 9.8. learner sets the appropriate depth of cut increments
- 9.9. learner determines the appropriate feeds and speeds for specific materials, tools, and operations
- 9.10. learner sets the appropriate tool stepover distance for specific applications
- 9.11. learner sets the appropriate machining priority
- 9.12. machining parameters are set to perform operations efficiently
- 9.13. learner scores a minimum of 70% on rubric criteria for each assignment
- 9.14. learner completes all activities by the due date
- 9.15. learner scores a minimum of 70% on tests and quizzes

**Learning Objectives**

- 9.a. Modify feature properties
- 9.b. Select rough and finish tools for feature machining
- 9.c. Select speeds and feeds for tools for rough and finish tools
- 9.d. Select milling parameters for CAM features
- 9.e. Select turning parameters for CAM features
- 9.f. Set machining priority for CAM features

**10. Select appropriate post processor and generate NC code**

*Domain Cognitive Level Application Status Active*

**Assessment Strategies**

- 10.1. In the classroom, lab, or shop setting
- 10.2. Using computer software
- 10.3. In applied assignments
- 10.4. Individually
- 10.5. On tests and quizzes
- 10.6. Given prints, tutorials, files, and course reference materials

**Criteria**

*Performance will be satisfactory when:*

- 10.1. learner locates and opens post processor options
- 10.2. learner browses computer to find correct post processor
- 10.3. learner selects the correct post processor for a specific CNC machine tool
- 10.4. learner demonstrates the process to generate NC code
- 10.5. learner saves NC code with the correct name and in the correct locations
- 10.6. learner uses the correct application to open NC code text files
- 10.7. learner edits NC code text files as required for specific CNC machine tools
- 10.8. learner sends all NC code text files to instructor per directions
- 10.9. learner scores a minimum of 70% on rubric criteria for each assignment
- 10.10. learner completes all activities by the due date
- 10.11. learner scores a minimum of 70% on tests and quizzes

**Learning Objectives**

- 10.a. Locate post processor options
- 10.b. Select the required post processor
- 10.c. Generate NC code
- 10.d. Save NC code
- 10.e. Open and view NC code
- 10.f. Edit NC code text file

**11. Prove-out CAM programs using 3D simulation and CNC machine graphical interface**

*Domain Psychomotor Level Practice Status Active*

**Assessment Strategies**

- 11.1. In the classroom, lab, or shop setting



- 11.2. Using computer software and actual CNC machine tools
- 11.3. In applied assignments
- 11.4. Individually and in groups
- 11.5. On tests and quizzes
- 11.6. Given diagrams, materials, and all available shop equipment and supplies

**Criteria**

*Performance will be satisfactory when:*

- 11.1. learner identifies a minimum of three locations to open the simulation toolbar
- 11.2. learner correctly describes the centerline, 2D, and 3D simulation tools
- 11.3. learner demonstrates playing and stopping simulation
- 11.4. learner proofs programs using center line simulation
- 11.5. learner proofs programs using 2D simulation
- 11.6. learner proofs programs using 3D simulation
- 11.7. learner views simulation in multiple views
- 11.8. learner demonstrates the use of single step simulation
- 11.9. learner correctly identifies errors in programs using simulation tools
- 11.10. learner proofs programs in CNC turning center graphical simulators
- 11.11. learner proofs programs in CNC machining center graphical simulators
- 11.12. learner correctly identifies errors in programs ran in CNC machine tool graphical simulators
- 11.13. learner accurately documents program errors discovered in CNC machine tool graphical simulators
- 11.14. learner edits programs to correct errors
- 11.15. programs are corrected to run safely in CNC machine tools
- 11.16. learner scores a minimum of 70% on rubric criteria for each assignment
- 11.17. learner completes all activities by the due date
- 11.18. learner scores a minimum of 70% on tests and quizzes

**Learning Objectives**

- 11.a. Describe the types of CAM simulation tools
- 11.b. Utilize the CAM simulation menu
- 11.c. Demonstrate the use of CAM simulation tools
- 11.d. Determine the accuracy of CAM programs using simulation tools
- 11.e. Utilize the CNC machine tool graphical simulation function
- 11.f. Demonstrate the use of CNC machine tool graphical simulators
- 11.g. Determine the accuracy of CAM programs using CNC machine tool graphical simulators
- 11.h. Edit programs as required to run in CNC machine tool graphical simulators

**12. Prove-out CAM programs in CNC machine tools**

<i>Domain</i>	<i>Psychomotor</i>	<i>Level</i>	<i>Practice</i>	<i>Status</i>	<i>Active</i>
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**Assessment Strategies**

- 12.1. In the classroom, lab, or shop setting
- 12.2. Using computer software and actual CNC machine tools
- 12.3. In applied assignments
- 12.4. Individually and in groups
- 12.5. On tests and quizzes
- 12.6. Given prints, stock, process sheets, diagrams, materials, and all available shop equipment and supplies

**Criteria**

*Performance will be satisfactory when:*

- 12.1. learner selects correct stock for CNC project
- 12.2. learner correctly sets up stock in CNC machine tool
- 12.3. learner selects correct tools for CNC program
- 12.4. learner sets up tools in correct locations in CNC machine tool turret, carousel, or magazine
- 12.5. learner correctly sets all tool and work coordinate offsets
- 12.6. learner uses dry run or single block to prove programs prior to cutting stock
- 12.7. learner selects correct speeds and feeds for material and operations
- 12.8. learner runs program to cut part programs
- 12.9. learner produces a minimum of one turned project
- 12.10. learner produces a minimum of one milled project

- 12.11. learner verifies part dimensions prior to removing machined part from CNC machining center
- 12.12. learner accurately completes process plans for each CNC project
- 12.13. learner accurately completes set up sheets for each CNC project
- 12.14. learner accurately completes quality inspection sheets for each CNC project
- 12.15. learner scores a minimum of 70% on rubric criteria for each assignment
- 12.16. learner completes all activities by the due date
- 12.17. learner scores a minimum of 70% on tests and quizzes

**Learning Objectives**

- 12.a. Adhere to machine shop safety procedures
- 12.b. Adhere to CNC machine tool safe operating procedures
- 12.c. Prove-out CAM milling programs in CNC machining centers
- 12.d. Prove-out CAM turning programs in CNC turning centers
- 12.e. Complete CNC/CAM process sheets