

Western Technical College

31420375 CNC Setup Supportive Technologies

Course Outcome Summary

Course Information

Description	The fundamentals of carbide and cutting tool technology, workholding, and fixturing for CNC turning and milling are covered in this course. Learners will apply what they learn by determining workholding needs, recognizing problems with CNC machine operation, change and adjust tooling and fixtures and perform multiple part setups. In order to enroll in this course, students must have successful completion of the CNC Operation Certificate courses or instructor approval.
Career Cluster	Manufacturing
Instructional Level	Technical Diploma Courses
Total Credits	2.00
Total Hours	72.00

Types of Instruction

Instruction Type	Credits/Hours
Lecture	1 CR / 36 HR
Lab	1 CR / 36 HR

Course History

Last Approval Date	2/24/2016
---------------------------	-----------

Textbooks

No textbook 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.

Scientific calculator (recommend T1-36x Solar). **Vendor:** Campus Shop. 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 4. Perform basic machine tool equipment set-up and operation

Type *TSA* *Status* *Active*

Summative Assessment Strategies

- 2.1. in a performance demonstration
- 2.2. given an engineering drawing

Criteria

- 2.1. Select and load tools according to the requirements of the job
- 2.2. Select and set up work-holding devices for specific operations
- 2.3. Verify machine set-up
- 2.4. Verify proper application of speeds and feeds
- 2.5. Operate machine tools according to established procedures
- 2.6. Complete project within specified timeframe
- 2.7. Take action to optimize machine tool operation

3. MACH 5. Perform programming, set-up and operation of CNC Machine Tools

Type *TSA* *Status* *Active*

Summative Assessment Strategies

3.1. in a performance demonstration

Criteria

- 3.1. Write basic programs for specified CNC machine tools according to EIA-ISO standards
- 3.2. Load the correct program into the machine
- 3.3. Verify the accuracy of the CNC program
- 3.4. Verify work and tool offsets
- 3.5. Execute program
- 3.6. Adjust speeds and feeds to optimize CNC machining conditions

Course Competencies

1. Select cutting tools for CNC machining processes

Domain *Cognitive* *Level* *Analyzing* *Status* *Active*

Assessment Strategies

- 1.1. In the classroom, lab, or shop setting
- 1.2. In written and applied assignments
- 1.3. Individually or in groups
- 1.4. On tests and quizzes
- 1.5. Given references, diagrams, materials, and all available shop equipment and supplies

Criteria

Performance will be satisfactory when:

- 1.1. learner uses references to select correct carbide insert grade for specific CNC applications
- 1.2. learner uses references to select correct carbide insert shape for specific CNC operations
- 1.3. learner uses print specifications to select correct carbide end mill for specific CNC applications
- 1.4. learner uses references to select correct carbide cutting tool size for specific CNC applications
- 1.5. learner demonstrates the correct procedures for changing carbide inserts and tooling
- 1.6. learner demonstrates the proper care and storage of carbide cutting tools
- 1.7. learner completes all activities with a minimum of 70% accuracy
- 1.8. learner scores a minimum of 70% on assignments, tests, and quizzes

Learning Objectives

- 1.a. Describe the characteristics of carbide inserts
- 1.b. Explain the factors to consider when selecting carbide grades
- 1.c. Explain the factors to consider when selecting carbide insert radii
- 1.d. Describe the effect of carbide insert shape selection on machining considerations
- 1.e. Select carbide cutting tools for CNC turning applications
- 1.f. Select carbide cutting tools for CNC milling applications
- 1.g. 7 Describe how to use and care for carbide tooling

2. Describe material factors affecting cutting tool selection

<i>Domain</i>	<i>Cognitive</i>	<i>Level</i>	<i>Understanding</i>	<i>Status</i>	<i>Active</i>
			g		

Assessment Strategies

- 2.1. In the classroom, lab, or shop setting
- 2.2. In written and applied assignments
- 2.3. Individually or in groups
- 2.4. On tests and quizzes
- 2.5. Given references, diagrams, materials, and all available shop equipment and supplies

Criteria

- 2.1. learner correctly matches workpiece material to specific physical properties
- 2.2. learner correctly matches workpiece material to preferred cutting tool materials
- 2.3. learner correctly selects tools for roughing operations on various materials
- 2.4. learner correctly selects tools for finishing operations on various materials
- 2.5. learner correctly calculates speeds and feeds for various workpiece materials based on specific cutting tool material
- 2.6. learner correctly selects cutting tools to achieve specified finish on various materials
- 2.7. learner correctly selects speeds and feeds to achieve specified finishes on various materials
- 2.8. learner completes all activities with a minimum of 70% accuracy
- 2.9. learner scores a minimum of 70% on assignments, tests, and quizzes

Learning Objectives

- 2.a. List commonly used workpiece materials
- 2.b. Describe the properties of various workpiece materials
- 2.c. List common types of cutting tool materials
- 2.d. Describe the properties of commonly used cutting tool materials
- 2.e. Describe workpiece factors affecting cutting tool selection
- 2.f. Describe the differences between roughing and finishing tooling
- 2.g. Explain the effect of speeds and feeds on workpiece finish
- 2.h. Explain the effect of speeds and feeds on cutting tool selection

3. Calculate cutting speeds and feeds

<i>Domain</i>	<i>Cognitive</i>	<i>Level</i>	<i>Applying</i>	<i>Status</i>	<i>Active</i>

Assessment Strategies

- 3.1. In the classroom, lab, or shop setting
- 3.2. In written and applied assignments
- 3.3. Individually or in groups
- 3.4. On tests and quizzes
- 3.5. Given references, diagrams, materials, and all available shop equipment and supplies

Criteria

Performance will be satisfactory when:

- 3.1. learner calculates correct cutting speeds, feeds, and depths of cut to maximize tool life for specific applications
- 3.2. learner calculates correct cutting speeds, feeds, and depths of cut to achieve specified finishes
- 3.3. learner calculates correct depth of cut for milling operations in various materials for specified cutting tools
- 3.4. learner calculates correct depth of cut for turning operations in various materials for specified cutting tools
- 3.5. learner accurately calculates cutting time for specific CNC turning applications
- 3.6. learner accurately calculates cutting time for specific CNC milling applications
- 3.7. learner correctly solves problems to improve cutting efficiency for specific applications
- 3.8. learner completes all activities with a minimum of 70% accuracy
- 3.9. learner scores a minimum of 70% on assignments, tests, and quizzes

Learning Objectives

- 3.a. Explain the importance of correct cutting speeds and feeds on workpiece finish
- 3.b. Explain the importance of correct cutting speeds and feeds on tool life
- 3.c. Explain the importance of correct cutting speeds and feeds on production efficiency
- 3.d. Calculate cutting speeds and feeds for CNC turning operations
- 3.e. Calculate cutting speeds and feeds for CNC milling operations
- 3.f. Determine cutting depth for CNC turning operations
- 3.g. Determine cutting depth for CNC milling operations

4. Describe types of workholding for CNC machines

<i>Domain</i>	<i>Cognitive</i>	<i>Level</i>	<i>Understandin</i>	<i>Status</i>	<i>Active</i>
---------------	------------------	--------------	---------------------	---------------	---------------

g

Assessment Strategies

- 4.1. In the classroom, lab, or shop setting
- 4.2. In written and applied assignments
- 4.3. Individually or in groups
- 4.4. On tests and quizzes
- 4.5. Given references, prints, materials, and all available shop equipment and supplies

Criteria

Performance will be satisfactory when:

- 4.1. learner analyzes drawings and operations and selects the correct jig or fixture for each application
- 4.2. learner correctly identifies specified workholding devices in the machine tool lab or shop
- 4.3. learner correctly states the three primary types of modular workholding systems
- 4.4. learner correctly matches the type of modular workholding system to a description
- 4.5. learner correctly identifies various types of fixtures
- 4.6. learner correctly identifies the components of modular workholding systems
- 4.7. learner correctly explains the function of pallet changing systems
- 4.8. learner selects workholding devices for given applications
- 4.9. learner completes all activities with a minimum of 70% accuracy
- 4.10. learner scores a minimum of 70% on assignments, tests, and quizzes

Learning Objectives

- 4.a. Describe jigs
- 4.b. Describe fixtures
- 4.c. Explain the types and functions of various jigs
- 4.d. Explain the types and functions of various fixtures
- 4.e. Identify various workholding devices
- 4.f. Describe other types of workholding devices used for CNC machines
- 4.g. Identify modular workholding systems
- 4.h. Describe power workholding methods
- 4.i. Discuss modular systems, components, and configurations
- 4.j. Describe safety considerations for installing new fixtures and workpieces
- 4.k. Define pallet changing
- 4.l. Describe the types of pallet systems and the benefits
- 4.m. Identify tombstone workholding fixtures

4.n. Describe applications for tombstone fixtures

5. Determine workholding support and location methods

Domain **Cognitive** **Level** **Applying** **Status** **Active**

Assessment Strategies

- 5.1. In the classroom, lab, or shop setting
- 5.2. Using CNC machine tools
- 5.3. In written and applied assignments
- 5.4. Individually or in groups
- 5.5. On tests and quizzes
- 5.6. Given references, prints, parts, materials, and all available shop equipment and supplies

Criteria

Performance will be satisfactory when:

- 5.1. learner analyzes drawings and operations and selects the correct locator or support for each application
- 5.2. learner correctly matches diagrams of locators to descriptors
- 5.3. learner sets up work in correct orientation on a table grid plate
- 5.4. learner demonstrate correct method for locating and securing workpiece on a table grid plate
- 5.5. learner completes all activities with a minimum of 70% accuracy
- 5.6. learner scores a minimum of 70% on assignments, tests, and quizzes

Learning Objectives

- 5.a. Identify the types of locators and supports used for jigs and fixtures
- 5.b. Specify the use of locators and supports
- 5.c. Explain the importance of using baselines or datums for locating and supporting workpieces
- 5.d. Explain how to locate work using the primary datum
- 5.e. Explain how to locate work using the secondary datum
- 5.f. Describe securing or supporting work using the tertiary datum
- 5.g. Identify location methods using table grid plates
- 5.h. Set up workpiece on a table grid plate
- 5.i. Select locating and supporting devices for specific applications

6. Determine workholding and clamping methods

Domain **Cognitive** **Level** **Applying** **Status** **Active**

Assessment Strategies

- 6.1. In the classroom, lab, or shop setting
- 6.2. Using CNC machine tools
- 6.3. In written and applied assignments
- 6.4. Individually or in groups
- 6.5. On tests and quizzes
- 6.6. Given references, prints, parts, materials, and all available shop equipment and supplies

Criteria

Performance will be satisfactory when:

- 6.1. learner demonstrates safe setup habits 100% of the time when setting up workholding devices in CNC machines
- 6.2. learner correctly identifies specified clamping devices available in the machine tool lab or shop
- 6.3. learner demonstrates correct method for setting up work in CNC milling machines
- 6.4. learner demonstrates correct method for setting up work in CNC turning machines
- 6.5. work set ups allow for machining clearance
- 6.6. work set ups hold work securely and safely
- 6.7. work set ups are appropriate for work size
- 6.8. work set ups are appropriate for machining operations to be performed on work pieces
- 6.9. work set ups are aligned correctly
- 6.10. learner demonstrates correct set up procedures using angle plates and clamps
- 6.11. learner demonstrates correct set up procedures using vises
- 6.12. learner demonstrates correct set up procedures using v-blocks and clamps
- 6.13. learner demonstrates correct set up procedures using clamps and the mill table

- 6.14. learner demonstrates correct set up procedures using tailstocks
- 6.15. learner accurately calculates tailstock requirements for turning operations
- 6.16. learner completes all activities with a minimum of 70% accuracy
- 6.17. learner scores a minimum of 70% on assignments, tests, and quizzes

Learning Objectives

- 6.a. Identify safety concerns related to workholding
- 6.b. Explain basic principles related to workholding
- 6.c. Describe workholding and machining clearance requirements
- 6.d. Describe workholding and rigidity
- 6.e. Identify differences between hydraulic and manual chucks
- 6.f. Determine mathematically when tailstocks are required for CNC turning operations
- 6.g. Select workholding and clamping devices for specific applications

7. Build fixtures for CNC machining

Domain Psychomotor Level Practicing Status Active

Assessment Strategies

- 7.1. In the classroom, lab, or shop setting
- 7.2. In written and applied assignments
- 7.3. Individually or in groups
- 7.4. On tests and quizzes
- 7.5. Given references, prints, parts, materials, and all available shop equipment and supplies

Criteria

Performance will be satisfactory when:

- 7.1. learner correctly lists the seven objectives of tool design
- 7.2. learner designs a simple fixture for a given application
- 7.3. learner designs a fixture for holding multiple parts
- 7.4. fixture designs include complete part lists
- 7.5. fixture designs are completely dimensioned
- 7.6. fixture designs contains all necessary views
- 7.7. learner builds a simple fixture
- 7.8. learner builds a multi-part fixture
- 7.9. fixtures accurately align and locate parts
- 7.10. fixtures are correctly labeled for specified applications
- 7.11. fixtures are built according to print and part specifications
- 7.12. learner completes all activities with a minimum of 70% accuracy
- 7.13. learner scores a minimum of 70% on assignments, tests, and quizzes

Learning Objectives

- 7.a. Describe basic construction considerations
- 7.b. Design a simple fixture
- 7.c. Construct a simple fixture
- 7.d. Design a fixture for holding multiple parts
- 7.e. Construct a fixture for holding multiple parts

8. Determine workholding needs for CNC machining

Domain Cognitive Level Applying Status Active

Assessment Strategies

- 8.1. In the classroom, lab, or shop setting
- 8.2. Using CNC machine tools
- 8.3. In written and applied assignments
- 8.4. Individually or in groups
- 8.5. On tests and quizzes
- 8.6. Given references, prints, parts, materials, and all available shop equipment and supplies

Criteria

Performance will be satisfactory when:

- 8.1. learner creates workholding layouts for CNC machining center jobs

- 8.2. workholding layouts specify the workholding devices to be used
- 8.3. workholding layouts specify the workpiece location and locating devices to be used
- 8.4. workholding layouts specify workpiece and workholding orientation relative to machine coordinates and axes
- 8.5. workholding layouts specify clamping mechanisms to be used for securing work
- 8.6. workholding layouts indicate part or work set up details that must be avoided to prevent collisions
- 8.7. learner completes all activities with a minimum of 70% accuracy
- 8.8. learner scores a minimum of 70% on assignments, tests, and quizzes

Learning Objectives

- 8.a. Discuss the selection of workholding devices and the variables involved
- 8.b. Discuss the location of the workholding device relative to the machine size
- 8.c. Describe precision grid plates as an alternative to dedicated fixtures
- 8.d. Explain considerations related to preventing collisions during tool changes
- 8.e. Explain the use of stops and locating blanks with regard to precision
- 8.f. Explain problems that can occur from excessive clamping forces
- 8.g. Determine workholding requirements for specific applications

9. Recognize problems with CNC machine operation related to tooling and workholding

Domain Cognitive Level Evaluating Status Active

Assessment Strategies

- 9.1. In the classroom, lab, or shop setting
- 9.2. Using CNC machine tools
- 9.3. In written and applied assignments
- 9.4. Individually or in groups
- 9.5. On tests and quizzes
- 9.6. Given references, prints, materials, and all available shop equipment and supplies

Criteria

Performance will be satisfactory when:

- 9.1. learner correctly identifies problems by analyzing machined parts
- 9.2. learner correctly identifies overclamping problems of machined parts
- 9.3. learner correctly identifies chatter problems when inspecting machined parts
- 9.4. learner correctly identifies part finish and size problems related to tool wear
- 9.5. learner correctly identifies set up problems with parts that have been incorrectly set up in CNC machines
- 9.6. learner accurately completes problem analysis documentation
- 9.7. problem analysis documentation contains recommendations for corrective actions
- 9.8. learner completes all activities with a minimum of 70% accuracy
- 9.9. learner scores a minimum of 70% on assignments, tests, and quizzes

Learning Objectives

- 9.a. Explain the relationship between chatter and part length
- 9.b. Explain machining forces relative to rigidity of workholding
- 9.c. Describe the effects of overclamping workpieces
- 9.d. Describe setup and machining problems related to part thickness, shape, and size
- 9.e. Recognize the effects of tool wear on surface finish
- 9.f. Recognize the effects of tool wear on part finish
- 9.g. Identify machine operation problems using auditory methods
- 9.h. Determine if tool wear has occurred
- 9.i. Determine when to change tools or inserts

Course Learning Plans and Performance Assessment Tasks

Type	Title	Source	Status
LP	Tool and Tooling Selection	Course	Active
LP	Work Holding	Course	Active
LP	Jigs	Course	Active

