

**Western Technical College**

**31444300 CNC Production Lathe - Operation**

**Course Outcome Summary**

**Course Information**

<b>Description</b>	Operation of CNC (Computer Numerical Control) turning centers includes calling up programs, loading and unloading parts, inspection, and the recognition of tool wear. Procedural processes, inspection of parts, and the use of inspection sheets and guides will be covered.
<b>Career Cluster</b>	Manufacturing
<b>Instructional Level</b>	Technical Diploma Courses
<b>Total Credits</b>	1
<b>Total Hours</b>	36

**Textbooks**

No textbook required.

**Learner Supplies**

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

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

Scientific calculator (recommend T1-36x Solar). **Vendor:** Campus Shop. Required.

**Success Abilities**

1. Apply mathematical concepts.
2. Demonstrate ability to think critically.
3. Demonstrate ability to value self and work ethically with others in a diverse population.
4. Make decisions that incorporate the importance of sustainability.
5. Transfer social and natural science theories into practical applications.
6. Use effective communication skills.
7. Use technology effectively.

**Program Outcomes**

1. MACH 1. Apply basic safety practices in the machine shop

2. MACH 2. Interpret industrial/engineering drawings
3. MACH 3. Apply precision measuring methods to part inspection
4. MACH 5. Perform programming, set-up and operation of CNC Machine Tools

## Course Competencies

### 1. Identify various types of CNC turning machines

#### Assessment Strategies

- 1.1. In written and applied assignments
- 1.2. On tests and quizzes

#### Criteria

*You will know you are successful when*

- 1.1. you list the common brands of CNC turning machines
- 1.2. you match brands to control models
- 1.3. you identify brands and controllers in the shop or lab
- 1.4. you participate in lab or shop orientation
- 1.5. learner successfully completes MasterTask CNC lathes Module 1 interactive test
- 1.6. learner completes all activities with a minimum of 70% accuracy
- 1.7. learner scores a minimum of 70% on assignments, tests, and quizzes

#### Learning Objectives

- 1.a. Describe safety procedures for CNC turning centers
- 1.b. Identify CNC turning machine brands
- 1.c. Describe control models within machine brands
- 1.d. Explain differences in CNC turning machine features
- 1.e. Explain the use of chucks and collets, spindles, and bar feeding cycles
- 1.f. Explain the operation of turrets and automatic tool handling mechanisms
- 1.g. Identify multi-turret CNC lathes

### 2. Describe the coordinate movements of CNC turning centers

#### Assessment Strategies

- 2.1. In written and applied assignments
- 2.2. On tests and quizzes

#### Criteria

*You will know you are successful when*

- 2.1. you diagram CNC lathe axis coordinate movements
- 2.2. you demonstrate tool movement relative to coordinate system using models
- 2.3. you diagram part reference zero and machine home locations
- 2.4. you complete MasterTask CNC lathes Module 2 interactive test
- 2.5. you complete MasterTask CNC lathes Module 3 interactive test
- 2.6. learner completes all activities with a minimum of 70% accuracy
- 2.7. learner scores a minimum of 70% on assignments, tests, and quizzes

#### Learning Objectives

- 2.a. Describe safety procedures for CNC turning centers
- 2.b. Identify basic operating principles of CNC turning machines
- 2.c. Explain the use of chucks and collets, spindles, and bar feeding cycles
- 2.d. Explain the operation of turrets and automatic tool handling mechanisms
- 2.e. Describe driven or power tooling
- 2.f. Identify multi-turret CNC turning machines
- 2.g. Describe CNC turning machine axis movements relative to the Cartesian coordinate system
- 2.h. Explain tool movement control relative to the coordinate system
- 2.i. Describe the part reference zero locations on a CNC turning center
- 2.j. Describe the location of the machine home or machine zero

### 3. Identify common CNC turning center programming methods

### **Assessment Strategies**

- 3.1. In written and applied assignments
- 3.2. On tests and quizzes

### **Criteria**

*You will know you are successful when*

- 3.1. learner correctly identifies types of controls on specific CNC turning machines in the machine tool lab or shop
- 3.2. learner describes the differences in programming requirements for specific CNC turning machines in the machine tool lab or shop
- 3.3. learner correctly selects tools for CNC turning machines for given applications
- 3.4. learner successfully completes MasterTask CNC lathes Module 5 interactive test
- 3.5. learner successfully completes MasterTask CNC lathes Module 6 interactive test
- 3.6. learner successfully completes MasterTask CNC lathes Module 7 interactive test
- 3.7. learner successfully completes MasterTask CNC lathes Module 8 interactive test
- 3.8. learner successfully completes MasterTask CNC lathes Module 9 interactive test
- 3.9. learner completes all activities with a minimum of 70% accuracy
- 3.10. learner scores a minimum of 70% on assignments, tests, and quizzes

### **Learning Objectives**

- 3.a. Identify CNC turning machine models of controls
- 3.b. Identify common languages used in CNC turning machine programming
- 3.c. Differentiate conversational controls and EIA controls on CNC turning machines
- 3.d. Describe various machining operations performed on CNC turning machines
- 3.e. Select tools for various machining operations
- 3.f. Identify basic function universal EIA programming codes
- 3.g. Identify the universally common elements of a conversational program
- 3.h. Describe the difference between online and offline programming

## **4. Operate controls on CNC turning machines**

### **Assessment Strategies**

- 4.1. In the classroom, lab, or shop setting
- 4.2. Using interactive computer software and/or actual CNC machine tools
- 4.3. In written and applied assignments
- 4.4. Individually
- 4.5. On tests and quizzes
- 4.6. Given prints, diagrams, materials, and all available shop equipment and supplies

### **Criteria**

*Performance will be satisfactory when:*

- 4.1. learner locates and correctly identifies the main controls on CNC turning machines in the lab
- 4.2. learner locates and correctly identifies CNC control components on CNC turning machines in the machine tool lab or shop
- 4.3. learner sequentially lists the steps required to turn on each type of CNC turning machine in the machine tool lab or shop
- 4.4. learner correctly demonstrates the steps required to turn on each type of CNC turning machine in the machine tool lab or shop
- 4.5. learner correctly navigates between menus, chapters, and pages on each type of CNC turning center control in the machine tool lab or shop
- 4.6. learner correctly demonstrates the use of cursors and control buttons on CNC control monitors in the machine tool lab or shop
- 4.7. learner correctly demonstrates the use of manual jog controls on each type of CNC turning machine in the machine tool lab or shop
- 4.8. learner correctly describes the purpose of each machine control button and the emergency stop
- 4.9. learner correctly describes typical information found on each page of the CNC turning center monitor
- 4.10. learner successfully completes MasterTask CNC lathes Module 12 interactive test
- 4.11. learner completes all activities with a minimum of 70% accuracy
- 4.12. learner scores a minimum of 70% on assignments, tests, and quizzes

### **Learning Objectives**

- 4.a. Identify main controls on various CNC turning machines
- 4.b. Identify the CNC control components on various machines
- 4.c. List the steps required to turn on CNC turning machines
- 4.d. Demonstrate the procedure to turn on CNC machines
- 4.e. Differentiate CNC operating modes of manual and automatic
- 4.f. Identify control variations
- 4.g. Demonstrate the navigation of menus, chapters, and pages on CNC control monitors
- 4.h. Demonstrate the navigation between position, program, and offset pages on CNC control monitors
- 4.i. Describe the information found on each page of the CNC control monitor
- 4.j. Demonstrate the use of cursors and control buttons on CNC control monitors
- 4.k. Explain the use of Emergency Stop button on CNC turning machines
- 4.l. Describe the variations between Handle Jog controls on various machines
- 4.m. Demonstrate the use of Handle Jog controls on various machines

## **5. Call up programs on CNC turning machines**

### **Assessment Strategies**

- 5.1. In the classroom, lab, or shop setting
- 5.2. Using interactive computer software and/or actual CNC machine tools
- 5.3. In written and applied assignments
- 5.4. Individually
- 5.5. On tests and quizzes
- 5.6. Given prints, diagrams, materials, and all available shop equipment and supplies

### **Criteria**

*Performance will be satisfactory when:*

- 5.1. learner sequentially lists the steps for calling up programs on various types of CNC turning machines
- 5.2. learner correctly identifies the buttons and modes for calling up programs on various CNC turning machines in the machine tool lab or shop
- 5.3. learner sequentially lists the steps required for showing graphical plotting of programs
- 5.4. learner correctly demonstrates the steps for calling up programs in conversational control CNC turning machines
- 5.5. learner correctly demonstrates the steps for calling up programs in EIA/ISO controlled CNC turning centers
- 5.6. learner correctly verifies programs in the graphical interface of conversational controlled CNC turning centers
- 5.7. learner correctly verifies programs in EIA/ISO controlled CNC turning centers
- 5.8. learner completes all activities with a minimum of 70% accuracy
- 5.9. learner scores a minimum of 70% on assignments, tests, and quizzes

### **Learning Objectives**

- 5.a. List the steps for calling up programs on various CNC turning machines
- 5.b. Identify the buttons on the CNC machine control for calling up programs
- 5.c. Demonstrate the procedure for calling up programs on CNC turning machines
- 5.d. Call up programs on conversational and EIA controlled CNC turning machines
- 5.e. Verify programs in graphical interface

## **6. Perform scheduled machine maintenance**

### **Assessment Strategies**

- 6.1. In the classroom, lab, or shop setting
- 6.2. Using interactive computer software and/or actual CNC machine tools
- 6.3. In written and applied assignments
- 6.4. Individually
- 6.5. On tests and quizzes
- 6.6. Given diagrams, logs, materials, and all available shop equipment and supplies

### **Criteria**

*Performance will be satisfactory when:*

- 6.1. learner correctly locates coolant tanks on all CNC turning machines in the machine tool lab or shop

- 6.2. learner states the correct mixture and concentration for coolant tank fluid
- 6.3. learner correctly identifies situations when the coolant tank needs to be filled
- 6.4. learner correctly demonstrates the process of filling the coolant tank
- 6.5. learner correctly locates and identifies the way oil system components on all CNC turning machines in the machine tool lab or shop
- 6.6. learner correctly demonstrates the process for fluid level maintenance after machine warm up
- 6.7. learner maintains and completes a maintenance log during the course
- 6.8. learner successfully completes MasterTask CNC lathes Module 22 interactive test
- 6.9. learner completes all activities with a minimum of 70% accuracy
- 6.10. learner scores a minimum of 70% on assignments, tests, and quizzes

#### **Learning Objectives**

- 6.a. Identify coolant tank locations
- 6.b. Describe procedures for coolant tank inspections
- 6.c. Describe the process for filling coolant tanks
- 6.d. Describe the components of the hydraulic system
- 6.e. Describe the procedures for inspecting hydraulic systems
- 6.f. Describe the way oil system components
- 6.g. Describe the process for maintaining fluid levels after machine warmup
- 6.h. Demonstrate the procedures for maintaining CNC turning machines

### **7. Set up tools in CNC turning machines**

#### **Assessment Strategies**

- 7.1. In the classroom, lab, or shop setting
- 7.2. Using interactive computer software and/or actual CNC machine tools
- 7.3. In written and applied assignments
- 7.4. Individually
- 7.5. On tests and quizzes
- 7.6. Given prints, specification sheets, and all available shop equipment and supplies

#### **Criteria**

*Performance will be satisfactory when:*

- 7.1. learner correctly identifies and selects tools for CNC turning machines from tool list specifications
- 7.2. learner correctly uses CNC turning center controls to rotate turret
- 7.3. learner correctly demonstrates ability to control the speed of the turret
- 7.4. learner correctly demonstrates the process for changing tools in CNC turning machines with manual tool changers
- 7.5. learner correctly demonstrates the process for changing and loading tools in CNC turning machines with automatic turrets
- 7.6. learner successfully completes MasterTask CNC lathes Module 4 interactive test
- 7.7. learner successfully completes MasterTask CNC lathes Module 37 interactive test
- 7.8. learner completes all activities with a minimum of 70% accuracy
- 7.9. learner scores a minimum of 70% on assignments, tests, and quizzes

#### **Learning Objectives**

- 7.a. Describe tool holding systems in various types of CNC turning machines
- 7.b. Identify tools for CNC turning machines
- 7.c. Select tools for CNC turning machines
- 7.d. Demonstrate the procedure for changing tools in CNC turning machines without turrets
- 7.e. Identify control button to move the turret
- 7.f. Describe the safe location of the turret for rotation
- 7.g. Demonstrate rotating the turret to tool positions
- 7.h. Demonstrate the procedure for changing tools in CNC turning machine turrets
- 7.i. Interpret a tool drawing to determine axis direction relative to spindle centerline
- 7.j. Identify tool angle and dimensions

### **8. Set up work in CNC turning machines**

#### **Assessment Strategies**

- 8.1. In the classroom, lab, or shop setting
- 8.2. Using interactive computer software and/or actual CNC machine tools

- 8.3. In written and applied assignments
- 8.4. Individually
- 8.5. On tests and quizzes
- 8.6. Given prints, stock, and all available shop equipment and supplies

**Criteria**

*Performance will be satisfactory when:*

- 8.1. learner correctly demonstrates the procedures to start up and home CNC turning machines in the machine tool lab or shop
- 8.2. learner recognizes overtravel alarms within time period specified and participates in discussion to solve the problem
- 8.3. learner observes safety procedures 100% of the time while setting up work in CNC turning
- 8.4. learner correctly demonstrates the process of securing work in conversationally controlled CNC turning machines
- 8.5. learner correctly demonstrates the process of securing work in automatic CNC turning centers
- 8.6. learner correctly demonstrates the procedures for using stock stops for production machining
- 8.7. learner successfully completes MasterTask CNC lathes Module 23 interactive test
- 8.8. learner successfully completes MasterTask CNC lathes Module 24 interactive test
- 8.9. learner completes all activities with a minimum of 70% accuracy
- 8.10. learner scores a minimum of 70% on assignments, tests, and quizzes

**Learning Objectives**

- 8.a. Describe the procedures for homing various CNC turning machines
- 8.b. Demonstrate the procedures for homing various CNC turning machines
- 8.c. Describe the conditions that cause and overtravel alarm
- 8.d. Demonstrate the process of securing work in CNC turning machines
- 8.e. Demonstrate the procedures for using stock stops for production machining

**9. Run programs in CNC turning machines**

**Assessment Strategies**

- 9.1. In the classroom, lab, or shop setting
- 9.2. Using interactive computer software and/or actual CNC machine tools
- 9.3. In written and applied assignments
- 9.4. Individually
- 9.5. On tests and quizzes
- 9.6. Given prints, diagrams, stock, and all available shop equipment and supplies

**Criteria**

*Performance will be satisfactory when:*

- 9.1. learner observes safety procedures 100% of the time while running CNC turning machines
- 9.2. learner creates an accurate checklist for the steps required to setup and perform a production run on CNC turning machines
- 9.3. learner demonstrates ability to call up programs in each type of CNC turning machine in the machine tool lab or shop
- 9.4. learner correctly follows standard procedures for setting up work and tools in the CNC turning machines
- 9.5. learner correctly locates offset screens in each type of CNC turning machine in the machine tool lab or shop
- 9.6. learner correctly demonstrates ability to set tool to Z face of part
- 9.7. learner correctly demonstrates ability to set tool X to the diameter of the part
- 9.8. learner correctly demonstrates the ability to locate button on machine control to run programs
- 9.9. learner correctly demonstrates ability to start and run programs
- 9.10. learner correctly demonstrates procedures for checking and removing parts from the CNC turning machines after program has ran
- 9.11. learner demonstrates production steps to continue a production part run
- 9.12. learner completes all activities with a minimum of 70% accuracy
- 9.13. learner scores a minimum of 70% on assignments, tests, and quizzes

**Learning Objectives**

- 9.a. Practice safe operating procedures for running CNC turning machines
- 9.b. List the procedures for setting up and performing a production run on CNC turning machines

- 9.c. Call up programs that will be ran in CNC turning machines
- 9.d. Follow procedures for securing work in CNC turning machines
- 9.e. Demonstrate how to locate offset screens using various machine controls
- 9.f. Set tool length and diameter offsets
- 9.g. Run programs in various CNC turning machines
- 9.h. Perform production steps required after first part is ran

## 10. Perform quality inspections on CNC turned parts

### Assessment Strategies

- 10.1. In the classroom, lab, or shop setting
- 10.2. Using interactive computer software and/or actual CNC machine tools
- 10.3. In written and applied assignments
- 10.4. Individually
- 10.5. On tests and quizzes
- 10.6. Given prints, diagrams, pictures, inspection sheets, materials, and all available shop equipment and supplies

### Criteria

*Performance will be satisfactory when:*

- 10.1. learner observes safety procedures 100% of the time while inspecting parts in CNC turning machines
- 10.2. learner uses specifications on documents to correctly identify part dimensions to measure and inspect
- 10.3. learner uses specifications on documents to correctly identify part finishes to inspect
- 10.4. learner correctly identifies the frequency with which to inspect parts
- 10.5. learner accurately performs inspections on parts
- 10.6. learner correctly follows directions for inspection frequency
- 10.7. learner accurately records inspection results on documentation sheets
- 10.8. learner correctly identifies problems with part quality
- 10.9. learner follows the correct procedures for reporting part quality problems
- 10.10. learner completes all activities with a minimum of 70% accuracy
- 10.11. learner scores a minimum of 70% on assignments, tests, and quizzes

### Learning Objectives

- 10.a. Analyze part prints or specifications to determine part dimensions to inspect
- 10.b. Demonstrate safe procedures for inspecting parts
- 10.c. Perform inspections on parts per specified frequency
- 10.d. Record inspection results
- 10.e. Explain the procedure for reporting problems with part quality

## 11. Recognize problems related to CNC machine operation

### Assessment Strategies

- 11.1. In the classroom, lab, or shop setting
- 11.2. Using interactive computer software and/or actual CNC machine tools
- 11.3. In written and applied assignments
- 11.4. Individually or 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 observes safety procedures 100% of the time while running CNC turning machines
- 11.2. learner correctly identifies problems with part quality
- 11.3. learner correctly identifies problems with part quality as a result of chatter
- 11.4. learner correctly identifies machine vibration sounds
- 11.5. learner correctly demonstrates the use of override controls to reduce or correct chatter problems
- 11.6. learner correctly identifies finish problems associated with tool wear, failure, or location problems
- 11.7. learner correctly lists potential causes of broken cutter inserts and suggests preventative actions
- 11.8. learner successfully completes MasterTask CNC lathes Module 25 interactive test
- 11.9. learner completes all activities with a minimum of 70% accuracy
- 11.10. learner scores a minimum of 70% on assignments, tests, and quizzes

### **Learning Objectives**

- 11.a. Identify visual and sound indicators of chatter
- 11.b. Describe causes of vibration
- 11.c. Explain ways to correct vibration using overrides
- 11.d. Describe potential sources of chatter problems
- 11.e. Associate chatter sources with part or tool conditions
- 11.f. Identify causes of finish problems other than from vibration
- 11.g. Explain the relationship between tool wear and rough or finish operations
- 11.h. Describe the causes of broken cutting inserts
- 11.i. Describe how to isolate the cause of broken cutting inserts
- 11.j. Explain how to maintain proper surface finish and correct dimensions

## **12. Change CNC turning machine tools and inserts**

### **Assessment Strategies**

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

### **Criteria**

*Performance will be satisfactory when:*

- 12.1. learner correctly identifies inserts that are damaged or worn and need to be changed
- 12.2. learner correctly identifies cutting tools that are damaged or worn and must be replaced
- 12.3. learner selects the correct insert shape and style for replacement
- 12.4. learner correctly demonstrates the procedure for changing inserts
- 12.5. learner selects the correct cutting tool for replacement
- 12.6. learner correctly demonstrates the procedure for changing cutting tools
- 12.7. learner accurately completes documentation stating the insert or tool that was changed and the likely cause of the damage
- 12.8. learner demonstrates the correct procedures for adjusting offsets in the CNC turning machine control
- 12.9. learner follows correct procedures for notifying specified supervisor or setup person after changing inserts
- 12.10. learner successfully completes MasterTask CNC lathes Module 27 interactive test
- 12.11. learner completes all activities with a minimum of 70% accuracy
- 12.12. learner scores a minimum of 70% on assignments, tests, and quizzes

### **Learning Objectives**

- 12.a. Explain the procedure for changing tools and inserts in the CNC turning center
- 12.b. Perform inspections of tooling and inserts
- 12.c. Identify the effect of damaged or worn inserts on workpiece finish
- 12.d. Identify damaged or worn inserts
- 12.e. Explain the most likely causes of insert failure
- 12.f. Demonstrate the process of changing inserts
- 12.g. Adjust offsets as needed
- 12.h. Explain operator responsibility after changing inserts