



Western Technical College

## 10444223 Programming for CNC Milling (CBE)

### Course Outcome Summary

#### Course Information

<b>Description</b>	Requires the learner to create G&M code programs manually for machining center.
<b>Career Cluster</b>	Manufacturing
<b>Instructional Level</b>	One-Year Technical Diploma
<b>Total Credits</b>	1
<b>Total Hours</b>	36

#### Textbooks

*Mastercam Mill 2D & Lathe Combo*. Copyright 2022. Mastercam. Publisher: Caminstructor Inc. **ISBN-13:** 978-1-988-76679-9. 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.

Three-ring binder. **Vendor:** Campus Shop. Required.

Clipboard. **Vendor:** Campus Shop. Required.

Pens/Pencils/Black Sharpie Marker. **Vendor:** Campus Shop. Required.

Minimum 4GB USB Flash Drive. **Vendor:** Campus Shop. Required.

## Success Abilities

1. Cultivate Passion: Increase Self-Awareness
2. Live Responsibly: Foster Accountability
3. Refine Professionalism: Improve Critical Thinking
4. Refine Professionalism: Practice Effective Communication

## High Impact Practices

1. Community Based Learning Project: a key learning outcome of this course is to connect academic learning and civic development while simultaneously addressing a community partner's needs, interests, or problems.

## Program Outcomes

1. Apply basic safety practices in the machine shop
2. Interpret industrial/engineering drawings
3. Apply precision measuring methods to part inspection
4. Perform programming, set-up and operation of CNC Machine Tools

## Course Competencies

### 1. Associate the Cartesian coordinate system with CNC machining center axes.

#### Assessment Strategies

- 1.1. Applied assignments
- 1.2. Project

#### Criteria

*You will know you are successful when*

- 1.1. you select correct CNC milling machine axis when plotting coordinates.
- 1.2. you use prints to plot coordinate points for CNC machining centers.
- 1.3. you incorporate the three Z positions appropriately into programs.
- 1.4. you select the correct relationship to part zero reference for X and Y coordinates in programs.

#### Learning Objectives

- 1.a. Discuss the purpose of the Cartesian coordinate system in CNC machining center machining.
- 1.b. Identify coordinate axes of CNC mills and machining centers.
- 1.c. Describe the three Z position relationships between the workpiece and tool.
- 1.d. Explain the X and Y coordinate relationships to the part zero reference location.
- 1.e. Locate coordinate points graphically for CNC machining center axes.

### 2. Apply terminology associated with CNC machining center programming.

#### Assessment Strategies

- 2.1. Applied assignments
- 2.2. Project

#### Criteria

*You will know you are successful when*

- 2.1. you use the correct terms for CNC machining center system components.
- 2.2. you identify print symbols as they relate to CNC machining.
- 2.3. you describe the function of CNC general preparatory codes for machining centers.
- 2.4. you describe the function of miscellaneous CNC codes for machining centers.
- 2.5. you interpret prints to write CNC machining center programs.
- 2.6. you select appropriate tools for CNC milling machine processes.
- 2.7. you describe CNC machining center codes other than G and M codes.

#### **Learning Objectives**

- 2.a. Identify terms related to CNC milling machines.
- 2.b. Describe CNC machining center word address terms.
- 2.c. Explain G and M code terms related to CNC machining center programming.
- 2.d. Identify print terms related to CNC machining.
- 2.e. Differentiate tooling terms as they relate to CNC machining centers.

### **3. Classify tooling for CNC machining centers.**

#### **Assessment Strategies**

- 3.1. Applied assignments
- 3.2. Project

#### **Criteria**

*You will know you are successful when*

- 3.1. you identify the types of face and end mills used in CNC milling machines.
- 3.2. you identify the types of hole cutting tools used in milling operations.
- 3.3. you identify tools used inside holes in milling operations.
- 3.4. you recognize tool wear.
- 3.5. you differentiate types of materials used for cutting tools.
- 3.6. you describe the purpose of various materials used for cutting tools.
- 3.7. you calculate correct speeds and feeds for various tool materials and workpiece material.
- 3.8. you explain the benefits and disadvantages of climb and conventional machining as they relate to CNC milling machines.
- 3.9. you describe the types of cutting fluids used in CNC operations.
- 3.10. you explain how cutting fluids are selected for CNC milling operations.
- 3.11. you determine correct spindle rotation based on tooling.

#### **Learning Objectives**

- 3.a. Identify CNC milling machine tooling.
- 3.b. Select appropriate tools for hole operations.
- 3.c. Select appropriate tools for milling operations.
- 3.d. Describe types of materials used for cutting tools.
- 3.e. Calculate speeds and feeds for CNC milling applications.
- 3.f. Explain the purpose of cutting fluids in CNC milling applications.

### **4. Write basic programs with G and M codes for CNC mills or machining centers.**

#### **Assessment Strategies**

- 4.1. Project

#### **Criteria**

*You will know you are successful when*

- 4.1. you describe the three basic sections of a CNC machining center program.
- 4.2. you develop a start sequence format based on class lessons.
- 4.3. you use start sequence correctly in all programs written.
- 4.4. you develop an ending sequence format based on class lessons.
- 4.5. you use ending sequence in all programs written.
- 4.6. you write absolute positioning linear interpolation program from part print.
- 4.7. you write linear interpolation name program using absolute positioning.
- 4.8. you write absolute positioning circular interpolation program from part print.
- 4.9. you write circular interpolation name program using absolute positioning.

- 4.10. you incorporate Z position moves in programs.
- 4.11. you use rapid moves for Zc movements in programs.
- 4.12. you find and correct errors in programs.
- 4.13. you develop programs proofed to run in CNC machining centers without errors.
- 4.14. you develop programs accurate enough to run in CNC machining centers.

**Learning Objectives**

- 4.a. Incorporate G and M code in programs.
- 4.b. Write program start sequences for CNC machining centers.
- 4.c. Write linear interpolation programs for CNC machining centers.
- 4.d. Write circular interpolation programs for CNC machining centers.
- 4.e. Write a program ending sequence for CNC machining centers.
- 4.f. Write absolute positioning programs for CNC machining centers.
- 4.g. Write incremental positioning programs for CNC machining centers.
- 4.h. Explain the parts of a CNC machining center program.