Western Technical College

31420347 Programming/CAM for CNC Milling

Course Outcome Summary

Course Information

Description	This course will include instruction and practice in writing programs for CNC milling machines. Instruction will begin with manually writing G&M code programs and advance to creating programs with CAM software.
Career Cluster	Manufacturing
Instructional Level	One-Year Technical Diploma
Total Credits	2
Total Hours	72

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.

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

Assessment Strategies
1.1.   Applied assignments
1.2.   Tests & quizzes
1.3.   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. Tests & quizzes
2.3. Project

Criteria

You will know you are successful when

2.1. you participate in classroom discussion on terminology related to CNC machining.
2.2. you score 70% or greater on terminology quiz.
2.3. you use the correct terms for CNC machining center system components.
2.4. you correctly identify print symbols as they relate to CNC machining.
2.5. you correctly describe the function of CNC general preparatory codes for machining centers.
2.6. you correctly describe the function of miscellaneous CNC codes for machining centers.
2.7. you interpret prints to write CNC machining center programs.
2.8. you select appropriate tools for CNC milling machine processes.
2.9. you complete assignments with an accuracy of 70% or higher.
2.10. 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. Tests & quizzes
3.3. Project

Criteria

You will know you are successful when

3.1. you correctly identify the types of face and end mills used in CNC milling machines.
3.2. you correctly identify the types of hole cutting tools used in milling operations.
3.3. you correctly identify tools used inside holes in milling operations.
3.4. you accurately recognize tool wear.
3.5. you differentiate types of materials used for cutting tools.
3.6. you correctly 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 correctly 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.

3.12.   you complete assignments on time and have accuracy of 70% or better.
3.13.   you complete quizzes and tests with an accuracy of 70% or better.

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.   Applied assignments
4.2.   Tests & quizzes
4.3.   Project

Criteria

You will know you are successful when

4.1.   you correctly 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.

5.   Create a working program using CAM software.

Assessment Strategies
5.1.   Applied assignments
5.2.   Tests & quizzes
5.3.   Project

6.   Write multiple function programs for CNC machining centers.

Assessment Strategies
6.1.   Applied assignments
6.2.   Tests & quizzes
6.3.   Project

Criteria

You will know you are successful when

6.1.   you write programs using manual cutter compensation.
6.2.   you write programs using G code cutter compensation.

6.3.　　　you enter cutter compensation offsets in machine tool per program specifications.
6.4.　　　you incorporate at least three tool changes in programs for CNC machining centers.
6.5.　　　you incorporate at least three canned cycles in programs for CNC machining centers.
6.6.　　　you write a program that uses at least two subprogram calls.
6.7.　　　you write a program the incorporates cutter compensation, multiple tool changes, and subprograms.
6.8.　　　you identify and correct program errors.
6.9.　　　you proof multiple-function programs in simulator.
6.10.　　multiple function programs are run in CNC machining centers.
6.11.　　multiple function programs are accurate enough to run in CNC machining centers.
6.12.　　multiple function programs have an accuracy of 90% or higher.
6.13.　　your assignments have an accuracy of 90% or higher.

Learning Objectives
6.a.　　　Write CNC machining center programs using cutter compensation.
6.b.　　　Write CNC machining center programs with multiple tool changes.
6.c.　　　Write CNC machining center programs that use canned cycle programs.
6.d.　　　Write CNC machining center programs that incorporate subprograms.