

Computer Numerical Control

Milling



Course Outline and Syllabus

Course Title: Computer Numerical Control Milling

Instructor: TBD

Course Description: An introduction of machining principles and concepts related to computer numerical control (CNC) milling applications. Includes the use of the Cartesian coordinate system, programming codes and command, and tooling requirements for CNC/CAM machines.

Prerequisite: CNC Fundamentals

Course Length: 40 hrs.

Text: *Computer Numerical Control Milling by PEN Associates, LLC*

Methodology: Any and/or all of the following activities may be utilized by the instructor during the term to achieve the learning objectives for the course.

- A. Lecture
- B. Discussions
- C. Audio/Visual Instruction
- D. Individual and Group Projects/Presentations
- E. Laboratory Exercises
- F. Quizzes and Examinations

Course Objective:

Upon completion of this course, the participant will be able to:

- Plot coordinates on the Cartesian Coordinate System,
- Define the coordinate system of general milling and turning machine tools,
- Understand the axis motion of CNC Machine tools,
- Understand general machining operations,
- Identify associated tooling for specific CNC operations,
- Perform effective and accurate CNC offset input,
- Understand the importance of Feeds and Speeds.
- Develop CNC programs for turning centers
- Develop CNC programs for machining centers

Course Outline:

- I. Numerical Control CNC Milling Process

- A. Safety
 - B. CNC History
 - C. [The Critical Components that Comprise A CNC Milling Machine.](#)
- II. Types of CNC Milling Machines
- A. Vertical CNC Mills
 - B. Horizontal CNC Mills
- III. Milling Machine Coordinate System
- A. Coordinate System Concerns
 - B. Incremental and Absolute Programming
 - C. CNC Milling Machine Tool Configurations
- IV. Milling Operations
- A. Face Milling and End Milling
 - B. Drilling Type Operations
 - C. Center Drilling
 - D. Basic Drilling
 - E. Reaming
 - F. Countersinking
 - G. Counter Boring
 - H. [Spot Facing](#)
 - I. [Tapping](#)
- V. Tooling for Machining Centers
- A. Cutting Tools
 - B. Endmills
 - C. Drills, Taps, Reamers
 - D. Tool Holders
- VI. Fixtures
- VII. Lubricants and Coolants
- A. Coolant Types Advantages Vs. Disadvantages
- VIII. Speed and Feed Calculations for Milling
- A. Milling Feed Rate Calculation
 - B. Feed Rate Concerns
- IX. CNC Controls

- A. Modes
 - B. Manual Mode
 - C. Edit Mode
 - D. MDI Mode
 - E. Single Block
 - F. Auto Mode
 - G. [Emergency Stop](#)
- X. Programming Machining Centers
- A. Planning and Programming
 - B. G and M Codes
 - C. Tool Length Offset
- XI. Planning and Programming
- A. An Overview of The Process
 - B. Machining Center Example
 - C. Final Program
 - D. Hands on exercise

Student Learning Objectives: (Competences)

1. Describe CNC milling machining and uses, and applications of CNC program.
 - Describe the capabilities and limitations of computer numerical control (CNC)/computer assisted manufacturing (CAM) equipment.
 - Describe the general milling machining operations performed on CNC milling machine tools.
 - Describe the type of cutting tools used on CNC milling machine tools.
 - Describe the materials used to manufacture milling cutting tools.
 - Understand and utilize to calculate machining factors such as speeds, feeds, and depth of cuts.
 - Describe the importance of coolants and lubricants in the mill machining operation.
 - Describe the different types of coolant solutions used in machining.
 - Understand basic G, M codes

- Describe the Cartesian coordinate system as used in a CNC machine program.
- Calculate the coordinates position of geometric points of transition on and X and Y system.
- Describe the differences in absolute and incremental dimensioning as related to an ISO programming of a CNC machine.
- Review a mechanical drawing and determine the appropriate datum structure.
- Perform calculations to determine coordinates.
- Understand the elements of a CNC machine tool controller.
- Describe procedures for CNC machine start-up.
- Explain safety requirements.

Grades: Grades for this course will follow the following criteria.

Tests-	40%
Lab Activities-	40%
Final-	20%

Attendance Policy Statement

All students are expected to attend each class. Students are solely responsible for keeping up with their attendance.

If circumstances require an absence, then students should note that it may initiate starting the course from where the absence occurred when the course is presented again. Each case will be treated to ensure that the student receive the full benefit of the training.

If Machine Tools are Used

Safety Test: Each student enrolled in the CNC Fundamental Course must successfully pass a safety test. This test is based on knowledge and skills needed to safely perform duties and responsibilities within the chosen field of study. A score of 100% must be obtained before students will be allowed to perform and lab activities.

Classroom Safety/Security: All students are expected to be familiar with emergency evacuation procedures, emergency medical procedures, and potential classroom hazards. Your instructor should review these procedures at the beginning of

the semester, either orally or in writing. Please ask for clarification if your instructor fails to adequately review these procedures.

Student Responsibilities:

Students are expected to be responsible for their actions as they relate to in-class activities.

As a student, you are expected to:

- Arrive to the class/laboratory on time and enter with respect for others
- Remain attentive in class
- Prepare for each class. This means preparation of assignments as well as preparation for participation.
- Attend all classes (legitimate excuses are understood). (Letting the instructor know of the absence prior to class is good business on the part of the student.)
- Refrain from non-topic, side conversation.
- Be prompt on meeting scheduled times (class time, due date of reports, etc.)
- Work with others as assigned to complete an assignment carrying out his or her portion of the assignment to its fullest.
- Be respectful to the instructor and the other students.

Essential Functions:

1. Wear safety glasses at all times when in machine tool lab.
2. Wear proper protective equipment when performing lab activities.
3. Use small hand tools.
4. Use machinery in shop.
5. Use measuring instruments.
6. Read and understand technical literature.
7. Read and understand blueprints.
8. Reason and perform problem solving activities.
9. Work with others and communicate orally and in writing.
10. Exhibit behavior and social skills that is acceptable to the college.

The above list of essentials functions is not intended as a complete list.