



STARK STATE COLLEGE

GENERAL SYLLABUS

Course Information

Course Name: CNC Mill Operations
Course Number: ARL122

Required Materials

Textbook(s): None
Required Readings: None
Additional Materials: Scientific Calculator, Laptops, Note Pads, Writing Utensils, Web Links, Handouts and related items as provided in class.

Course Outline/Calendar

The date of coverage and order of coverage may be modified based on the faculty member and events beyond the control of faculty members that interfere with class times and teaching.

Week	Chapter/Topic/Lab
1-4 Foundation Skills and Safety	<p>The initial weeks establish the core principles necessary for safe and effective machine operation.</p> <ul style="list-style-type: none"> • Safety and equipment introduction: Comprehensive review of machine shop safety protocols, including emergency stops, proper workholding, and material handling. • Measurement and blueprint reading: Instruction on how to use precision measuring tools such as calipers and micrometers. Students will also learn to interpret engineering blueprints, including geometric dimensioning and tolerancing (GD&T). • Manual mill operation: Introduction to manual milling to help students understand basic milling operations, machine construction, and the Cartesian coordinate system in a manual setting. • Tooling and materials: Overview of common cutting tools (end mills, drills, taps) and materials (e.g., aluminum, steel, brass) used in CNC milling. Students will learn about tool geometry and selection.
5-8 Introduction to CNC Programming	<p>This segment focuses on the fundamental concepts of CNC control and programming.</p> <ul style="list-style-type: none"> • CNC machine basics: Introduction to the parts of a CNC mill, the controller interface, and the differences between manual and CNC operation. • Coordinate systems: In-depth explanation of the CNC mill's coordinate system (X, Y, Z axes), including work offsets and tool length offsets. • G-code and M-code basics: Introduction to the most common G-codes (e.g., G00, G01, G02, G03) and M-codes (e.g., M03, M05, M08, M30) for basic movements and machine functions.

Week	Chapter/Topic/Lab
	<ul style="list-style-type: none"> Simple part programming and simulation: Students write and simulate basic programs for simple part geometry, such as creating straight lines, arcs, and simple pockets.
9-12 Intermediate Programming and CAM	<p>The middle portion of the course bridges manual programming with modern Computer-Aided Manufacturing (CAM) software.</p> <ul style="list-style-type: none"> Advanced G-code cycles: Study of more complex canned cycles for drilling (G81, G83), tapping, and pocketing. Speeds and feeds: Learning how to calculate and apply appropriate cutting speeds and feed rates for different materials and tools to optimize the machining process. Introduction to CAM software: First exposure to CAM software like Fusion 360 or Mastercam. Students will learn to set up manufacturing settings and define stock material. Toolpath generation: Using CAM software, students generate toolpaths from 2D or 3D models. They will apply different cutting techniques for roughing and finishing.
13-16 Advanced Applications and Project-Based Learning	<p>The final weeks are dedicated to advanced techniques, troubleshooting, and a capstone project.</p> <ul style="list-style-type: none"> Advanced CAM and simulation: Students refine their CAM skills, learn to verify toolpaths, and check for collisions using simulation features. First part run and optimization: Focus on the practical steps of running a program for the first time, including transferring the program, setting offsets, and performing minor adjustments. Capstone project: A cumulative project where students take a design from a blueprint or CAD model to a finished, machined part. This reinforces skills in planning, programming, setup, and inspection. Troubleshooting and maintenance: Discussion of common CNC issues, such as tool wear and machine errors, along with basic machine maintenance procedures.