STARK STATE COLLEGE

GENERAL SYLLABUS

Course Information

Course Name: CNC Turning Center Programming in EIA Format
Course Number: ARL130

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
1-2 Introduction to CNC Turning	This module covers the core concepts of CNC programming, emphasizing shop safety and fundamental mechanics. • Safety and shop procedures: Proper operation of CNC equipment, material handling, and safety protocols. • Introduction to CNC turning centers: History, construction, and key components of a CNC lathe. • Machine controls and start-up: Basic operations, control panel layout, and powering up the machine. • Machining terminology: Introduction to basic operations, such as turning, facing, grooving, and boring. • Measurement and inspection: Use of precision measuring instruments like calipers and micrometers.
3-4 Coordinate Systems and Motion	Students learn how to define tool and workpiece positions, which is critical for writing accurate programs. • Cartesian coordinate system for turning: Understanding the X and Z axes, machine zero, and part zero. • Absolute (G90) vs. incremental (G91) programming: Distinguishing between fixed and relative positioning. • Rapid positioning (G00): Using the fastest possible motion to move the tool between cutting operations. • Linear interpolation (G01): Commanding controlled, straight-line movements for cutting. • Basic motion practice: Writing short programs to face and turn simple diameters.

Week	Chapter/Topic/Lab
5-6 Cutting Parameters and Tool Control	This module focuses on how to control the cutting action of the machine. • Spindle speed (S-code): Specifying the rotational speed of the workpiece. • Feed rate (F-code): Setting the rate at which the tool moves during cutting. • Tool function (T-code): Calling and changing specific tools in the turret. • Miscellaneous functions (M-codes): Using commands for spindle rotation (M03/M04), coolant (M08/M09), and program stops (M00/M01). • Tool and geometry offsets: Calibrating the machine to account for tool length and wear.
7-8 Blueprint Interpretation and Program Structure	Students learn to translate engineering drawings into a structured EIA program. • Blueprint reading for turnings: Interpreting geometric dimensions and tolerances. • Program block structure: Understanding the sequence of program start, tool selection, and toolpath. • Safe start-up block: Creating a standard header for each program to ensure safety. • Manual programming for simple parts: Developing full, manually written programs for basic turning projects. • Simulations and testing: Using software to verify program toolpaths before running on the machine.
9-10 Canned Cycles and Turning	This module introduces efficient, pre-programmed cycles that simplify complex turning operations. • Rough turning cycle (G71): Automating stock removal for external diameters. • End face roughing cycle (G72): Automating stock removal for the face of the part. • Grooving cycles (G75): Programming both internal and external grooves. • Drilling cycles (G74, G83): Using peck drilling and other cycles for drilling operations. • Finishing cycle (G70): Automating the final pass to achieve the desired surface finish.
11-12 ircular Interpolation and Thread Cutting	Students learn to program arcs and threads, which are essential for many precision parts. • Circular interpolation (G02/G03): Programming clockwise and counter-clockwise arcs. • Programming radii: Using R-codes or I and K vectors to define circular motion. • Threading cycles (G76, G92): Programming internal and external threading. • Chamfer and fillet programming: Creating specific edge conditions as defined on a blueprint. • Complex profile programming: Combining linear, arc, and canned cycle moves.
13-14 Advanced Programming Techniques	This module introduces methods for streamlining and optimizing programs. • Subprograms: Creating reusable subroutines for repetitive tasks. • Use of macros: Introducing the concept of custom macro B for more advanced automation (machine-dependent). • Multiple tool programming: Creating a full program that utilizes multiple cutting tools for a single part. • Bar puller integration: Programming the machine to automatically pull bar stock for subsequent parts. • Workholding and setup sheets: Documenting the tooling, workholding, and part setup for reproducibility.
15-16 Practical Application and Assessment	The course concludes with hands-on practice, troubleshooting, and a final project. • Final project: Students apply all learned skills to program and machine a complex part from a blueprint.