STARK STATE COLLEGE

GENERAL SYLLABUS

Course Information

Course Name: CNC Fixtures, Macros, and Probes
Course Number: ARL243

Required Materials

Textbook(s): CNC Fixtures, Macros, and Probes Handbook Ariel Corp.
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: Workholding Fundamentals	Introduction to workholding, types of fixtures, and the principles of locating and clamping. Design and assemble a basic vise fixture for a simple block part.
2: Modular and Custom Fixtures	Explore modular, hydraulic, and pneumatic fixture systems. Discuss when to use custom versus off-the-shelf fixtures. Develop a modular fixture setup to hold multiple parts for a single operation.
3: Fixture Design For Complex Parts	Techniques for fixturing irregularly shaped parts and minimizing distortion. Learn to reference critical surfaces for precision. Design a custom soft-jaw setup or 3D-printed fixture for a complex part.
4: CAD/CAM For Fixture Design	Utilize CAD/CAM software to design and simulate fixture performance. Understand swarf evacuation and material selection. Use CAM software to program the machining of a soft jaw or custom fixture body.
5: Macro Programming Basics	Introduction to variables (# variables), macro functions, and expressions. Understand the structure of macro programs. Write a simple macro to calculate and display a formula, such as speeds and feeds based on variables.
6: Program Flow and Logic	Learn conditional statements (IF, WHILE) and loops (DO, END), and how to use them for decision-making in a program. Create a macro program that uses a loop to drill a series of holes based on variable inputs.
7: Subprograms and Program Structure	Master the use of subprograms and subroutines to manage complex operations and create organized code. Write and call a subprogram to create a pre-defined pocket feature at multiple locations.
8: Practical Macro Applications	Develop family-of-parts macros, which allow a single program to machine multiple variations of a design by changing key variables. Create a family-of-parts macro for a stepped shaft or pocket feature.
9: Probe Hardware and Theory	Overview of different probe types (e.g., touch, tool) and their applications. Learn how to set up a probe and edit the probe table. Calibrate a machine tool probe and set its offset values.

Week	Chapter/Topic/Lab
10: Automated Workpiece Setup	Use probing cycles to automatically establish work offsets and locate part features. Write and execute a macro program to probe a workpiece and update the work coordinate system (WCS).
11: In-Cycle Gauging	Implement probing routines to measure critical dimensions during a machining cycle. Integrate conditional logic to compensate for tool wear or stop the process if a part is out of tolerance. Write a macro to measure a feature and update a tool wear offset based on the measurement.
12: Custom Probing Macros	Develop custom macro cycles to probe and inspect complex geometries, such as bores, bosses, and angles. Create a custom macro to find the center of a bore by probing three points along its inside diameter.
13: 4th and 5th Axis Workholding and Programming	Understand advanced fixturing for multi-axis machining and how to program rotational movements (A and B axes). Design a multi-sided fixture and program a basic multi-axis part using G-code and CAM software.
14: Complex Macro Development	Learn advanced macro techniques, including using system variables to react to machine status and external factors. Program a macro that automatically handles different scenarios, such as creating an alarm if a variable is out of range.
15: Integrated Project: Family of Parts	Combine fixturing, macros, and probing to create a fully automated system for machining a "family of parts". Complete an integrated project from CAD model to finished part, using macros and probing for an automated, repeatable process.
16: Integrated Project: Automation	Enhance the family-of-parts project with further automation, such as integrating tool-life monitoring or automated part destruction for bad parts. Present and document the final automated project, including setup, programs, and a process overview.