STARK STATE COLLEGE

GENERAL SYLLABUS

Course Information

Course Name: CNC Grinding Operations
Course Number: ARL123

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- Introduction to CNC Grinding	• Safety protocols: OSHA standards, personal protective equipment (PPE), safe machine operation, and emergency procedures. • Machine anatomy: Key components of CNC grinding machines, including the spindle, workhead, tailstock, and coolant systems. • Basic grinding theory: The purpose of grinding and fundamental grinding processes. • Laboratory: Initial machine familiarization and safety checklist walkthrough.
2 - Materials and Abrasives	• Workpiece materials: Characteristics and grindability of various materials, such as ferrous and non-ferrous metals. • Grinding wheel selection: Grinding wheel nomenclature, specifications, and how wheel type affects grinding results. • Abrasive types: Understanding different abrasives (e.g., aluminum oxide, silicon carbide) and their applications. • Laboratory: Practice selecting appropriate grinding wheels for different materials.
3 - Workholding and Setup	• Workholding devices: Chucks, collets, and fixtures used to secure workpieces for grinding. • Setup sheets: How to read and follow setup documentation for a grinding operation. • Datums and reference points: Importance of establishing a part's origin and coordinate system. • Laboratory: Hands-on practice setting up workholding for basic parts.
4 - Precision Measurment and Inspection	• Measurement tools: Calipers, micrometers, dial indicators, and other precision instruments for measuring grinding tolerances.

Week	Chapter/Topic/Lab
	• Geometric dimensioning and tolerancing (GD&T): Interpretation of engineering drawings and specifications. • Surface finish analysis: Using profilometers to measure and verify surface roughness. • Laboratory: Measure and inspect finished parts, comparing them to blueprint specifications.
5 - CNC Control and Interface	• CNC controls: Navigating machine controls and the human-machine interface (HMI). • Inputting programs: Methods for loading programs into the machine, such as USB or direct transfer. • Manual data input (MDI): Manually entering single-line code for simple machine functions. • Laboratory: Running simple programs and practicing MDI on a simulator or machine.
6 - G-Code and M-Code Programming	• G-codes: Understanding preparatory codes for grinding movements, such as rapid traverses and controlled feeds. • M-codes: Interpreting miscellaneous codes for machine functions like coolant and spindle control. • Basic programming exercises: Writing and simulating simple grinding programs. • Laboratory: Write, simulate, and execute a basic grinding program.
7 - Grinding Wheel and Dressing and Truing	• Dressing vs. truing: Understanding the distinction between these two critical processes. • Preventative measures: Best practices for avoiding common defects. • Laboratory: Introduce common grinding defects and guide students in diagnosing and correcting them.
8 - Basic Cylindrical and Surface Grinding	• Cylindrical grinding principles: Grinding outside and inside diameters (OD/ID). • Surface grinding techniques: Creating flat, parallel surfaces. • Feeds and speeds: Calculating and applying correct parameters for basic grinding applications. • Laboratory: Grind parts to specification using both surface and cylindrical techniques.
9- Creep-Feed and Multi-Axis Grinding	• Creep-feed grinding: High-material-removal technique for difficult parts. • Multi-axis workholding: Specialized fixtures for complex, multi-sided parts. • Multi-axis programming: Introducing toolpaths for parts requiring multiple axes of motion. • Laboratory: Practice programming multi-axis movements on a simulator.
10 - Process Optimization and Cycle Time Reduction	• Material removal rate: Calculating and optimizing grinding rates. • High-efficiency grinding strategies: Techniques to reduce cycle time without sacrificing part quality. • Optimizing feeds and speeds: Adjusting parameters for maximum productivity. • Laboratory: Compare different grinding strategies and analyze the resulting cycle times.
11 - Grinding Fluids and Colants	• Fluid types: Water-based, oil-based, and synthetic coolants. • Application and delivery: Proper methods for directing fluid to the grinding zone. • Maintenance: How to maintain fluid concentration and cleanliness for optimal results. • Laboratory: Experiment with different coolants and assess their effects on finish and wheel life.
12 - Troubleshooting and Problem-Solving	• Common issues: Chatter, burning, wheel loading, and dimensional errors. • Diagnosis and solutions: Systematic approach to identifying and correcting grinding problems. • Preventative measures: Best practices for avoiding common defects. • Laboratory: Introduce common grinding defects and guide students in diagnosing and correcting them.
13- CNC Part-Programming Project (Part 1)	• Part analysis: Students receive an engineering drawing for a complex part requiring multiple grinding operations. • Process planning: Students develop a full manufacturing plan, including tooling, workholding, and grinding sequence. • CAD/CAM integration: Students use software like Mastercam or Fusion 360 to generate toolpaths. • Laboratory: Students work on their programming and simulation.
14- CNC Part Programming Project (Part 2)	• Program refinement: Students finalize their code, including offsets and automated cycles. • Machine setup: Students set up the CNC grinder with the required workholding and tooling. • First part run: Students run their program to produce the first part, making necessary adjustments. • Laboratory: Supervised machine setup and production of the project part.

Week	Chapter/Topic/Lab
15 - Machine Maintenance and Preventive Care	• Routine checks: Daily and weekly maintenance procedures for CNC grinders. • Error codes and diagnostics: Interpreting machine error codes and basic troubleshooting. • Mechanical and electrical: Introduction to basic maintenance of mechanical and electrical components. • Laboratory: Perform a preventative maintenance routine on the equipment.
16 - Final Review and Certification	• Final project submission: Students present their completed parts and project documentation. • Theory exam: Comprehensive exam covering all course material. • Practical exam: Hands-on assessment of a student's ability to set up and grind a part to specification.