COLLEGE OF ENGINEERING
THE UNIVERSITY OF TOLEDO

University of Toledo
Mechanical Engineering Technology
Master Syllabus

Course Title: *Numerical Control Applications* **Course Code & Number:** *MET 2150*

Credit Hour Total: *4*

Lecture Contact Hours: *3* **Lab Contact Hours:** *2*

Prerequisite(s): *MATH 1330, MET 1050, MET 1110, MET 1120, MET 1250,*

Text: *Computer Numerical Control Simplified 1st Edition, Steve Krar, 2000*
Computer Numerical Control Simplified Lab Manual, Steve Krar, 2001

Software: *none*

Course Description: (Approved Catalog Description)
Survey of tooling and production activities adaptable to numerical control equipment and processes. Includes terminology, definitions and functions. Students will learn how to create part programs for CNC machinery.

Related Program Outcomes:
Outcome a. An ability to select and apply the knowledge, techniques, skills and modern tools to broadly defined ET activities.
Outcome c. An ability to conduct standard tests and measurements; to interpret experiments, and apply experimental results to improve processes.
Outcome f. An ability to identify, analyze, and solve broadly defined engineering problems.
Outcome i. An ability to understand and a commitment to address professional, ethical and social responsibilities, including a respect for diversity.

Course Objectives:
Upon completion of this course, the student will be able to:

1. Define the difference between accuracy and repeatability.
2. List and discuss the four basic phases of manufacturing.
3. Define X, Y, and Z axes on both vertical and horizontal CNC milling machines and lathes.
4. Discuss auxiliary axes and their designation on both vertical and horizontal machines.

5. Discuss how motion is transferred to the workpiece and spindle.
6. Define open and closed-loop control systems and discuss the differences.
7. Define point-to-point and contouring control systems and discuss the differences.
8. Define and discuss the differences between incremental and absolute programming.
9. Discuss different forms of program input media.
10. Discuss the significance of different controller formats.
11. Write and troubleshoot part programs for a CNC vertical milling machine and a horizontal lathe.
12. Understand and apply the standard programming codes for the FANUC controller.
13. Define and discuss tool length and cutter diameter offsets.
14. Define and discuss a language-based computer programming system.
15. Define and discuss a graphics-based (CAD/CAM) computer programming system.
16. Define and discuss a postprocessor.
17. Discuss the numerous cutting tools used with CNC equipment.
18. Discuss the advantages and disadvantages of various cutting tool materials and designs.
19. Calculate and apply the appropriate cutting feeds and speeds for various cutting tools and cutting tool materials.
20. Discuss various sound tooling practices.
21. Discuss the various options for and applications of CNC fixturing.
22. Define and discuss manufacturing cells and systems.
23. Work with a team of 4-5 students to develop a cost estimate and price quotation to produce a series of parts to be manufactured and combined into an assembly for manufacture/sale.
24. Give an oral presentation to a group on the quotation developed in #23 above.

Course Outline:

- Stress due to tensile load on bars
- Strain due to tensile load on bars
- Study of other properties of materials
- Stress and strain due to torsion on bars
- Shear, bearing, and tensile stress in riveted joints

- Stresses in welded joints
- Moment of a discrete force
- Moment of a uniformly distributed force
- Flexural stresses in beams
- Beam deflection computation
- Moment Axis Theorem
- Stress due to combined loadings
- Euler formula for buckling beams
- AISC formulas for buckling beams

Laboratory Topics:

- Drilling holes with a vertical mill
- Making a series of linear cuts with cutter radius offset
- Combining separate shorter programs into a larger program of multiple components
- Making internal cuts versus external cuts
- Considerations necessary for cutting a series of pockets with consideration for the entrance and exits angles and how they affect one another
- Calculations necessary to program angles such as a regular pentagon
- Students design and cut a part involving arcs with cutter offset
- Cutting a radiused part on the lathe with canned cycles
- Students design and cut a part with cutter offset, arcs, canned cycles, tapers on the lathe