Course Number and Title: MET 235 Computer Numerical Control Machining

Campus Location:
Stanton

Effective Date:
2019-51

Prerequisite:
MET 225, EDD 131, MAT 180

Co-Requisites:
None

Course Credits and Hours:
4.00 credits
3.00 lecture hours/week
2.00 lab hours/week

Course Description:
This course is designed for the first-time user of computer numerical control (CNC) equipment. Topics explored include the history, applications programming, and operations of CNC.

Required Text(s):
Obtain current textbook information by viewing the campus bookstore - https://www.dtcc.edu/bookstores online or visit a campus bookstore. Check your course schedule for the course number and section.

Additional Materials:
None

Schedule Type:
Classroom Course

Disclaimer:
None

Core Course Performance Objectives (CCPOs):

1. Explain the history and applications of CNC machine tools. (CCC 1, 5; PGC 1, 5)
2. Given an engineering drawing of a simple part with linear features such as slots and linear edges, steps, and drill holes, generate a CNC program to machine the part. (CCC 1, 2, 6; PGC 1, 3, 4)
3. Given a correct program, set up and operate the CNC mill resulting in a correctly machined part. (CCC 1, 2, 3, 4, 5, 6; PGC 1, 3, 5)
4. Given an engineering drawing of a complex part, program the CNC mill to produce the part using advanced capabilities. (CCC 1, 2, 3, 4, 6; PGC 1, 3, 5)
5. Given an engineering drawing of a turning job, program the CNC lathe to do simple outside diameter (OD) operations. (CCC 1, 2, 3, 6; PGC 1, 3, 5)
6. Correctly and safely operate the CNC lathe to produce geometrically correct turned parts. (CCC 1, 2, 3, 4, 5, 6; PGC 1, 3, 5)
7. Given an engineering drawing of a complex part, program the CNC lathe appropriately. (CCC 1, 2, 4, 6; PGC 1, 2, 3, 4, 5)

See Core Curriculum Competencies and Program Graduate Competencies at the end of the syllabus. CCPOs are linked to every competency they develop.

Measurable Performance Objectives (MPOs):
Upon completion of this course, the student will:

1. Explain the history and applications of CNC machine tools.
    1. Describe the evolution of numerical control (NC) and CNC machine tools.
    2. State the main advantages of CNC equipment as compared to conventional equipment.
    3. Describe the basic operation of the typical CNC machine tool.
    4. State the safety requirements for CNC operations.
2. Given an engineering drawing of a simple part with linear features such as slots and linear edges, steps, and drill holes, generate a CNC program to machine the part.
    1. Use the G00 (rapid traverse) command while programming the part for the CNC mill.
    2. Use the G01 (linear interpolation) command while programming parts on the CNC mill.
    3. Use the G81 command (drill cycle) while programming the part for the CNC mill.
    4. Use the M functions while programming the part for the CNC mill.
    5. Use the F command (feed rate) while programming the part for the CNC mill.
    6. Use the S command (spindle speed) while programming the part for the CNC mill.
    7. Program tool changes.
    8. Assign X and Y coordinates while programming a part.
    9. Choose the correct tooling.
    10. Calculate the speed for all tools to be used in machining.
    11. Determine an appropriate method for clamping the part before programming the part's geometry in the CNC language.
3. Given a correct program, set up and operate the CNC mill resulting in a correctly machined part.
    1. Perform the start-up procedures described in the CNC operators manual.
    2. Generate correct program file using the Predator CNC Editor program.
    3. Describe and use the functions of the CNC control panel.
    4. Preset the X=0, Y=0 points according to the procedure outlined in the operators manual.
    5. Safely execute a dry run of all programs prior to actual machining.
    6. Operate the CNC during normal machining operations.
    7. Edit an incorrect program.
    8. Locate the corners of a vise or fixture to the nearest .001 of an inch using the manual controls of the CNC.
4. Given an engineering drawing of a complex part, program the CNC mill to produce the part using advanced capabilities.
    1. Program contours using the G02 and G03 (circular interpolation) commands.
    2. Correctly program bores or large diameter holes
    3. Program special drilling cycles (peck and deep hole).
    4. Program bolt circle using the polar coordinate commands.
    5. Program arcs and radii using the polar coordinate commands.
    6. Recognize situations where the dwell function (G04) is needed, and apply the dwell function correctly.
    7. Use the manual data input (MDI) keyboard to input tool length offset data.
5. Given an engineering drawing of a turning job, program the CNC lathe to do simple outside diameter (OD) operations.
    1. Correctly input the home and index positions for the turret of the CNC lathe.
    2. Choose the tool best suited for the operations that are programmed.
    3. Choose the correct cutting speed and feed rate to ensure adequate tool life.
    4. Correctly program OD turning operations, tapering, grooving, and cut off operations.
6. Correctly and safely operate the CNC lathe to produce geometrically correct turned parts.
    1. Correctly power up the CNC lathe according to the lathe operator’s manual.
    2. Call into present NC memory any current program using the control panel.
    3. Demonstrate the functions of the NC control panel to the instructor prior to solo use of the CNC lathe.
    4. Correctly adjust the jaws of the power chuck to accept various blank diameters.
    5. Correctly load tools into the turret.
    6. Correctly replace carbide inserts on turning tools.
    7. Prove new programs prior to machining using the dry run function.
    8. Operate the CNC lathe in the automatic mode under actual machining conditions.
    9. Adjust the offset functions to bring out of tolerance parts into tolerance.
    10. Edit NC programs using the edit function of the FANUC control.
7. Given an engineering drawing of a complex part, program the CNC lathe appropriately.
    1. Program threads, OD contours, and radii correctly.
    2. Correctly program drilling operations.
    3. Correctly program internal diameter (ID) turning operations.

Evaluation Criteria/Policies:
Students must demonstrate proficiency on all CCPOs at a minimal 75 percent level to successfully complete the course. The grade will be determined using the Delaware Tech grading system:

92	–	100	=	A
83	–	91	=	B
75	–	82	=	C
0	–	74	=	F

Students should refer to the Student Handbook - https://www.dtcc.edu/handbook for information on the Academic Standing Policy, the Academic Integrity Policy, Student Rights and Responsibilities, and other policies relevant to their academic progress.

Final Course Grade:
Calculated using the following weighted average

Evaluation Measure	Percentage of final grade
Projects (6) (equally weighted) (formative)	50%
Exams (3) (summative) (equally weighted)	50%
TOTAL	100%

Core Curriculum Competencies (CCCs are the competencies every graduate will develop):

1. Apply clear and effective communication skills.
2. Use critical thinking to solve problems.
3. Collaborate to achieve a common goal.
4. Demonstrate professional and ethical conduct.
5. Use information literacy for effective vocational and/or academic research.
6. Apply quantitative reasoning and/or scientific inquiry to solve practical problems.

Program Graduate Competencies (PGCs are the competencies every graduate will develop specific to his or her major):

1. Use effective problem-solving skills and make appropriate decisions relative to the technical field.
2. Design basic mechanical systems with the use of computer-aided drafting equipment.
3. Demonstrate basic computer literacy and knowledge of computer software applications in both the business and technical fields.
4. Use hand and power tools for standard manufacturing operations.
5. Conduct basic machining and welding operations; and perform basic programming of computer/numerically-controlled machines.
6. Calculate forces, properly size structures and mechanical components, and perform standard materials testing procedures.
7. Demonstrate an understanding of basic AC and DC electrical control circuits.
8. Select appropriate materials for basic mechanical applications.
9. Review and/or design basic hydraulic/pneumatic power systems.
10. Select basic machine components for mechanical systems.
11. Exhibit professional traits, including the ability to work with minimal supervision, willingness to learn new skills, and contributing to team project efforts.

Disabilities Support Statement:
The College is committed to providing reasonable accommodations for students with disabilities. Students are encouraged to schedule an appointment with the campus Disabilities Support Counselor to request an accommodation needed due to a disability. A listing of campus Disabilities Support Counselors and contact information can be found at the disabilities services - https://www.dtcc.edu/disabilitysupport web page or visit the campus Advising Center.