Syllabus:
CNC Programming and Operations

Subject Code: 172302
Course Number: GM9001
CIP Code: 48.0501
SOC Code: 51-4041

C-TEC of Licking County
150 Price Road
Newark, Ohio 43055

Instructor:

Bob Bronkar

Instructor Contact:

- C-TEC 150 Price Road Newark, Ohio 43055
- Appointments as scheduled
- Office Telephone (740) 364-4251
- C-TEC Telephone (740) 364-2333
- Email Address: bobbronkar@c-tec.edu

Class Meeting Times:

- Monday –Thursday 5:00 p.m. - 10:00 p.m.

Class Location:

- Classroom 729 Lab 729E

Minimum Hours:

- 200Hours

Course Prerequisites:

- WorkKeys pretesting, copy of High School Diploma or GED
- Blueprint Reading GM9003 OR test out
- Basic Manual Machining GM9006 OR test out
- Advanced Manual Machining GM9006 OR test out

Required and Recommended Texts and Resources:

- Textbook: Precision Machine Technology, Second Edition, Delmar/ Cengage Publisher, 2015, 2012 Copyright ISBN 978-1-285-44454-3, Authors Hoffman, Hopewell, Janes, Sharp
- Textbook: Lathe Series Training Manual / Hass CNC Lathe Programming, Available online at Hass Factory Outlet (Revised 081213)
- Textbook: Mill Series Training Manual / Hass CNC Mill Programming, Available online at Hass Factory Outlet (Revised 081213)
- Reference Book: Machinery's Handbook, Industrial Press, Copyright 2016, 30th edition, ISBN 978-08311-30916, By Erik Oberg, Franklin Jones, Holbrook Horton, Henry Ryffel, and Chrstopher McCauley

Course Description:

This 200 hour course prepares students to learn to read, write, and edit G and M code programs, and to operate a CNC machine to run programs.
Classroom instruction and lab skills taught in this class. Classroom instruction covers all details needed for set-up and running equipment. This includes a CNC mill and a CNC lathe. The lab portion of the class consists of projects that become increasingly more difficult and require more advanced programming as the class progresses.

Course Objectives/Outcomes

The course objectives include:

- Preparing students for post-program success, both in the work force and in their educational pursuits.

- Preparing students to process information using higher order thinking skills and to engage in sound decision-making.

- Providing a rich learning environment utilizing research-based methods of instruction, and current resources and materials.

- Maintaining high expectations for all students regardless of educational needs and providing support necessary for achievement.

- Providing a challenging, worthwhile curriculum based on current industry/academic expectations. Specifically and upon successful completion of the program/course for CNC Programming and Operations the students will be able to demonstrate proficiency with:

A. CNC Machine Setup
B. Writing CNC Programs by Manually Entering G&M Codes C. 3-D Milling
D. Programming Controller
E. Writing Computer Programs for Milling & Lathe Operations
F. Machine Work Piece Squares
G. Machine Circular Cuts
H. Machine Circular Pockets
I. Drilling a Series of Holes
J. Drilling Bolt Circle
K. Machine Letters
L. Drills & Taps
M. Milling Keyways
N. Integrating CAD Drawing with CNC Programs

Grading:

Evaluation of student performance is based upon pupil performance objectives relating to course competencies study. The number of competencies mastered and the degree of mastery is translated into appropriate grades consistent with the C-TEC Board of Education policy on grading guidelines, practices, and procedures.

In the process of evaluation, instructors obtain several grades for each student within the time frame of the program/course. These grades may include, but are not limited to, performance on tests, quizzes, homework, assignments, special research projects,

classroom participation, lab competency mastery and/or improvement and the demonstration of positive employability traits.

Journal Summary: A journal summary should begin with an introductory paragraph that introduces the main topic of the article and summarizes its content. Following the introduction, a several paragraphs should be written detailing insights, implications, and how the information might be applied in your career. In addition, the summary should include your thoughts and opinions concerning the content of the article. Summaries should be approximately 1 1/2 to 2 pages in length.

Grades:

- 11 Quizzes – 5 pts.
- 1 Final – 25 pts.
- Lab Projects – 80 pts.
- Lab Final – 40 pts.

TOTAL- 200 pts.

Grading Scale:

- 180-200 pts. = A
- 160-180 = B
- 140-160 = *C*
- <140 = unacceptable

Credentialing:

- With the completion of BOTH Basic and Advanced Manual Machining - NIMS Credential Machining I

Course Policies:

- **Disruptive Behavior** – Disruptive behavior of any type is NOT permitted and may result in dismissal from the program. Sleeping during class, tardiness to class, excessive talking during class and disrespectful behavior are examples of disruptive behavior.

- **Plagiarism** – Submitting plagiarized work for an academic requirement is considered academic misconduct. Plagiarism is the representation of another's work or ideas as one's own; it includes the unacknowledged word-for-word use and/or paraphrasing of another person's work, and/or inappropriate unacknowledged use of another person's ideas.

- **Diversity** - It is the responsibility of the instructor and the students to foster and maintain a harmonious, non-threatening and non-discriminating environment in the classroom. Therefore, all individuals are to be respected as equal and contributing partners of our society.

- **Attendance:** Must maintain at least **90% rate of attendance**. You are required to attend all classes. However, you may miss up to 2 classes and still pass the course. Any other absences must be approved by the program supervisor.

Sequence:

Week 1- Precision Machining Textbook Section 8 and Haas-Lathe Series Training Manual

Section 8, Unit 1- CNC Basics

1. CNC Machine Control Unit
2. CNC Motion Control
3. Coordinate Systems
4. Absolute and incremental
5. Codes
6. Conversational-type programming
7. Parts of a CNC

Haas-Lathe Series Training Manual

1. The Coordinate System
2. Machine Home
3. Absolute and Incremental Positioning
4. Programming
5. Alphabet Address Codes
6. Preparatory Functions (G Codes
7. Miscellaneous Functions (M Codes)

Lab work:

1. Power up and reference CNC mill and lathe
2. Computer applications
3. Entering and editing programs

Quizzes:

1. Safety
2. Cartesian Coordinate system

Week 2- Precision Machining Textbook Section 8 and Haas-Lathe Series Training Manual

Section 8, Unit 2- Introduction to CNC Turning

1. Types of turning machines
2. Tool mounted adapters
3. Workholding
4. Process planning

Lab work:

1. Set tools in mill and lathe
2. Start CTEC mill project
3. Load program on mill
4. Plot program

Quizzes:

1. G and M code
2. Section 8, unit 1 quiz from Examview bank
3. Feeds and speeds

Week 3- Precision Machining Textbook Section and Haas-Lathe Series Training Manual

Section 8, Unit 3- CNC Turning: Programming

1. Coordinate positioning for turning
2. Types of Motion for Turning
3. Non-axis Motion Commands
4. Machining Operations
5. Canned Cycles

Section 8, Unit 4- CNC Turning: Setup and Operation

1. Machine Control Panel
2. Setups
3. Machine and Work Coordinate Systems
4. Work Offset Setting
5. Cutting Tools for Turning
6. Program Entry
7. Machine Operation

Hass-Lathe Series Training Manual (continued from week 1)

1. Lathe Programming
2. Machining Cycles for the Lathe
3. Linear/Circular Movement-Creating Tool Paths
4. Interpolation Commands
5. Manually Programming Tool Nose Compensation
6. Tool Nose Radius Calculation Diagram
7. Miscellaneous G Codes

Lab Work:

1. Lathe Project
2. Use Simulator
3. Roughing and Finishing Canned Cycles
4. Change Program and Plot

Quizzes:

1. Section 8, Unit 2 Quiz from Examview
2. Section 8, Unit 3 Quiz from Examview
3. Section 8, Unit 4 Quiz from Examview

Week 4- Precision Machining Textbook Section and Haas-Lathe Series Training Manual

Section 8, Unit 5- Introduction to CNC Milling

1. Types of CNC Milling Machines
2. Toolholding
3. Process Planning

Section 8, Unit 6- CNC Milling: Programming

1. Coordinate Positioning for Milling
2. Speeds and Feeds
3. Sequence Numbers
4. Types of Motion for Milling
5. Machining Operations
6. Cutter Radius Compensation

Haas-Mill Series Training Manual

1. Machine Home with Work Offsets
2. Tool Length Compensation G43
3. Absolute and Incremental Positioning
4. Alphabet Word Address Assignment
5. Preparatory Functions (G Codes)
6. Machine Funtions (M Codes)
7. Program Structure and Format
8. Linear and Circular Tool Paths
9. Cutter Compensation (G41, G42)

Lab Work:

1. G-code program lettering for a plaque (approved by instructor)
2. Engrave using mill
3. Mill machining project

Week 5 - Precision Machining Textbook Section 8 and Haas-Mill Series Training Manual

Section 8, Unit 7- CNC Milling: Setup and Operation

1. Machine Control Panel
2. Workholding Setup
3. Homing the Machine
4. Cutting Tools
5. Program Entry
6. Work Offsets

Haas-Mill Series Training Manual

1. Formulas – Tapping Boring Canned Cycles
2. Canned Cycles
3. Looping Command Cycles
4. Bolt Hole Patterns
5. Additional G Codes
6. Milling Circles with Cutter Comp
7. Circular Pocket Milling Using G12 and G13
8. General Purpose Pocket Milling (G150)

Quizzes:

9. Section 8, Unit 5 Quiz from Examview
10. Section 8, Unit 6 Quiz from Examview
11. Section 8, Unit 7 Quiz from Examview

Week 6- Programming on Machines

Lab Work:

1. Finish first Lathe Project
2. New Mill Project
3. New Lathe Project
4. Load Programs and Start Machining

Week 7- Programming on Machines

Lab Work:

1. Finish Mill Project
2. Finish Lathe Project
3. Load Programs and Start Machining

Week 8- Programming on Machines

Lab Work:

1. Research New Project that includes Lathe and Mill

2. Specify Materials and Tooling Needed for Project
3. Write Programs

Week 9- Finish Projects and Prepare for Finals

Classroom:

1. Review Textbook Section 8, Units 1 through 7
2. Prepare for Hands-on Finals

Lab Work:

1. Write Programs for Project
2. Plot Programs
3. Test run, prove out and machine parts

Week 10- Finals

Tests:

1. Written Final
2. Hands-on Turning Center Final
3. Hands-on Machining Center Final