Syllabus:
Basic Manual Machining

Subject Code: 172302
Course Number: GM9006
CIP Code: 48.0501
SOC Code: 51-4041

C-TEC of Licking County
150 Price Road
Newark, Ohio 43055
Instructor:  
Bob Bronkar

Instructor Contact:  
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Class Meeting Times:  
- Monday – Thursday 5:00 p.m. - 10:00 p.m.

Class Location:  
- Classroom 727 Lab 729

Minimum Hours:  
- 140 Hours

Course Prerequisites:  
- WorkKeys pretesting, copy of High School Diploma or GED  
- Blueprint Reading GM9003 OR test out

Required and Recommended Texts and Resources:  

Websites for Gathering Information and Research:

Course Description:  
The 140 hour Basic Manual Machining Program provides students with knowledge and skills through classroom instruction and completing industry like projects requiring the integrated use of lathes, vertical milling machines, surface grinders and other various shop equipment. Students develop skill in working with a variety of metals and various types of cutting tools. Use of precise measuring tools and making accurate setups is taught. Lab projects become increasingly complex and require tighter tolerance as the course progresses. Instruction includes set up and running of machines as well as safety, blueprint reading, related math and finishing techniques. Successful completion of the course prepares students for entry level positions in general machine shops.
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 Basic Manual Machining the students will be able to demonstrate proficiency with:

I. Bench Work 30 Hours
A. Layout Work
   - 1. Prepare Surfaces for Layout
   - 2. Scribing and Marking
   - 3. Using and Caring for Surface Plates
   - 4. Using Angle Plates
   - 5. Using V-Blocks
   - 6. Using the Combination Square
   - 7. Using the Sine Bar
   - 8. Using the Surface Gauge
B. Precision Measurement and Inspection
   - 1. Reading and Using the Scale
   - 2. Using Thread Gauges
   - 3. Using Radius Gauges
   - 4. Reading and Using Micrometers
   - 5. Reading and Using the Bevel Protractor
   - 6. Reading and Using the Vernier--Caliper
   - 7. Reading and Using the Height Gauge
   - 8. Using Gauge Blocks
C. Hand Tools
   - 1. Taps and Tapping
   - 2. Cutting Threads with Dies
   - 3. Hand Reaming
II. Drill Press Operation 10 Hours
A. Center Drilling and Drilling
B. Reaming
C. Counter Boring
D. Spot Facing
E. Tapping
  ▪  1. Oiling and Caring for the Drill Press
  ▪  2. Operating the Controls
  ▪  3. Setting Speeds and Feeds
  ▪  4. Changing Chucks and Sleeves
  ▪  5. Mounting and Using Work holding Devices
  ▪  6. Grinding Drills and Tool Bits
  ▪  7. Adjusting Coolants

III. Lathe Operation 120 Hours
A. Straight Turning
B. Facing
C. Drilling and Center Drilling
D. Knurling
E. Reaming
F. Cutting Off
G. Tapping
H. Boring
I. Turning Shoulders
J. Radius Turning
K. Filing and Polishing
L. Chasing Threads
M. Grinding Tool Bits
N. Turn Tapers
  ▪  1. Oiling and Caring for the Machine
  ▪  2. Operating Controls
  ▪  3. Setting Speeds and Feeds
  ▪  4. Removing and Replacing Chucks
  ▪  5. Removing and Replacing Centers
  ▪  6. Removing and Replacing Dog and Face Plates
  ▪  7. Chucking and Centering Work in the Independent 4-Jaw Chuck
  ▪  8. Chucking Work in a Universal Chuck
  ▪  9. Chucking Work in Collets
  ▪  10. Holding Work between Centers
  ▪  11. Using a Mandrel
  ▪  12. Using Steady and Follower Rests
  ▪  13. Aligning Centers
  ▪  14. Using a Dial Indicator
IV. Power Saw Operation 10 Hours
A. Clamping Work
B. Starting and Making Cuts
   1. Oiling and Caring for the Saws
   2. Changing Blades on the Saws
   3. Operating the Controls
   4. Setting Speeds and Feeds
   5. Engaging Coolant Pump and Adjusting

V. Milling Machine Operation 120 Hours
A. Plane Milling on Horizontal and Vertical
B. Slotting and Sawing
C. Key Seating
D. Form Milling
E. Angle Milling with Angle Cutters
F. Angle Milling by Inclination and Swivel
G. Drilling and Reaming
H. Boring
I. Countersinking and Counter Boring
J. Spot Facing
K. Direct and Simple Indexing
L. Gang Milling
M. Straddle Milling
N. Use of Rotary Table
O. Indicating and Tramming the Head
   1. Oil and Care of the Mill
   2. Operating the Controls
   3. Setting Speeds and Feeds
   4. Removing and Replacing Work Holders
   5. Removing and Replacing Arbors
   6. Removing and Replacing Cutters
   7. Clamping Work in the Vice
   8. Clamping Work to the Table
   9. Clamping Work on an Angle Plate
   10. Engaging Coolant Pump and Adjusting Coolant
   11. Locating Edge of Work with an Edge Finder
   12. Locating Edge of Work with a Dial Indicator
VI. Grinder Operation 19 Hours
• A. Bench Grinder
• B. Sharpening Tool Bits
• C. Chamfering Work
• D. Sharpening Drills
• 1. Oil and Caring for the Grinder
• 2. Selecting and Maintaining the Wheel
• 3. Dressing and Truing Grinding Wheels
• 4. Surface Grinders
  • a. Plain Surface Grinding
  • b. Face Grinding Work
  • c. Step Grinding Work
  • d. Angular Grinding Work
  • e. Cutoff Grinding
  • f. Form Grinding
• 1. Oiling and Caring for the Grinder
• 2. Operating the Controls
• 3. Selecting, Mounting, and Balancing Wheels
• 4. Turning and Dressing Grinding Wheels
• 5. Setting-up Work Holding Devices
• 6. Setting Speeds and Feeds
• 7. Engaging Coolant Pumps and Adjusting
• 8. Adjusting Table Dogs

VIII. Testing 20 Hours
A. Metal Identification and Characteristics
B. Heat Treating Equipment
C. Steel Hardening Methods
• 1. Water
• 2. Oil
• 3. Air
• 4. Case
D. Tempering Steel
E. Hardness Testing Equipment
F. Testing of Various Steels
IX. Blueprint Reading and Mathematical Computations Employment and Job Search Preparation 20 Hours

A. Industrial Communication
   - 1. Team Problem Solving/Decision Making
   - 2. Time Management/Goal-Setting in a Team-based Organization
   - 3. TQM & SPC
   - 4. Values and Attitudes
   - 5. Interpersonal Communications on the Job
   - 6. ISO - 9000

B. Self-Directed Job Search
   - 1. Job Search Strategies (Choosing and Using)
   - 2. Identifying and Communicating Personal Employability Assets
   - 3. Developing Portfolios
      a. Resumes
      b. Correspondence
   - 4. Preparing for Interviews

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.

Grading Scale
90-100% - A
80-89% - B
70-79% - C<70 = unacceptable
60-69% - D
59% or below – F
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:

**Section 2, Unit 1- Introduction to Safety**

1. Define OSHA and NIOSH and define their purpose
2. Identify appropriate PPE used in a machining environment
3. Define the term MSDS and interpret the information contained on one
4. Describe proper housekeeping for the lab

**Section 2, Unit 8- Maintenance, Lubrication, and Cutting Fluid Overview**

1. Describe the importance of a routine maintenance program
2. Identify methods of machine tool lubrication
3. Describe the purpose of cutting fluids, and define the types used
Section 3, Unit 2- Layout

1. Define layout and explain its purpose
2. Identify and use common layout tools
3. Perform typical mathematical calculations required to perform layout
4. Perform basic layout procedures

Section 3, Unit 4- Saws and Cutoff Machines

1. Identify the various sawing machines in the shop
2. Operate saws safely
3. Explain terms associated with different types of saw blades
4. Demonstrate blade changing procedure

Section 3, Unit 5- Offhand Grinding

1. Identify uses of offhand grinding
2. Select the type of wheel to be used
3. Install and dress a grinding wheel
4. Safely use an offhand grinder

Section 4, Unit 1- Introduction to the Drill Press

1. Identify types of drill presses
2. Identify the major components of a drill press and their functions

Section 4, Unit 2- Tools, Toolholding, and Workholding for the Drill Press

1. Identify the major parts of a twist drill and their function
2. Explain the various toolholding and workholding devices used and their selection criteria

Section 4, Unit 3- Drill Press Operations

1. Describe drill press safety procedures
2. Define cutting speeds and feed rates calculations
3. Explain procedures for drilling operations
4. Explain procedures for reaming operations
5. Explain procedures for countersinking operations
6. Explain procedures for counterboring, spotfacing operations
7. Explain procedures for tapping operations
Lab work:

1. Workbook page 163 Layout Project: T-slot cleaner
2. Workbook page 167 Layout Project: Soft Jaws for Bench Vise
3. Sharpen drill bit

Week 2- Textbook Sections 5 and 6

Section 5, Unit 1- Introduction to the Lathe

1. Explain the principal operation of a lathe
2. Identify and explain the functions of the parts of the lathe
3. Explain how lathe size is specified

Section 5, Unit 2- Workholding and Toolholding Devices for the Lathe

1. Explain the types of chucks
2. Explain the function and application of collets
3. Identify and explain the types of toolholders used

Section 5, Unit 3- Machining Operations on the Lathe part 1

1. Explain the relationship between depth of cut and diameter
2. Roughing versus finishing
3. Calculate speeds and feeds

Section 6, Unit 1- Introduction to the Vertical Milling Machine

1. Identify the components
2. Explain the function of the components

Section 6, Unit 2- Tools, Toolholding, and Workholding for the Vertical Milling Machine

1. Identify and explain the use of various cutting tools and toolholders
2. Explain applications of a mill vise and various hold-down clamps
3. Demonstrate proper tool changing techniques
Section 6, Unit 3- Vertical Milling Machine Operations part 1

1. Vertical milling machines safety practices
2. Tramming the milling head
3. Calculate speeds and feeds
4. Using an edge finder to establish a reference

Lab Work:

1. Mill and lathe demos with hands-on practice

Quiz 1- Sections 2, 3, and 4 (Quiz made in Examview program, question bank from author)

Week 3- Textbook Units Sections 5 and 6

Section 5, Unit 3- Machining Operations on the Lathe part 2

1. Demonstrate types of cuts and define the tools used
2. Describe and explain lathe holemaking operations
3. Define and explain form cutting
4. Describe and explain grooving, cutoff, knurling, and thread cutting on the lathe

Section 6, Unit 3- Vertical Milling Machine Operations part 2

1. Explain how to use an indicator to locate center
2. Explain the use of ORO's
3. Define conventional and climb milling
4. Explain pockets, slots, steps, and angle cuts on a mill

Labwork:

1. Aluminum Ariel PET lathe part
2. Aluminum Ariel PET mill part
3. Steel Ariel mill part
4. Steel Ariel lathe part 1st operation

Quiz 2- Section 5 Lathes (Examview quiz)
**Week 4- Textbook Sections 5 and 6**

**Section 5, Unit 4- Manual Lathe Threading**

1. Identify the parts of a thread
2. Explain classes of fits
3. Read a thread reference chart
4. Perform calculations required for thread cutting
5. Describe various methods of thread measurement

**Section 6, Unit 4- Indexing and Rotary Table Operations**

1. Identify processes used on a rotary table or a dividing head
2. Understand the basic setup and operation
3. Perform calculations used for indexing

**Quiz 3- Section 6 Milling**

(Examview quiz) **Labwork**

1. Steel Ariel lathe part 2nd operation
2. Workbook page 213 project- Mill Angles
3. Workbook page 193 project- Tapping Block
4. Workbook page 253 project- Threading
5. Mill hex on round stock using indexing head

**Week 5- Textbook Section 5**

**Section 5, Unit 5- Taper Turning**

1. Define a taper
2. Perform taper calculations
3. Understand setup procedures for taper turning methods

**Lab work:**

1. Steel Ariel lathe part 3rd operation
2. Keyseat project
3. Workbook page 233 project- Punch Set
4. Workbook page 171 project- C-Ciamp
**Week 6- Textbook Section 7**

Section 7, Unit 1- Introduction to Precision Grinding Machines

1. Explain the benefits of precision grinding
2. Identify various types of grinders and their capabilities
3. Identify the parts of a surface grinder

Section 7, Unit 2- Grinding Wheels for Precision Grinding

1. Identify grinding wheel shapes
2. Explain wheel identification system
3. Explain grain size and structure
4. Describe applications

Section 7, Unit 3- Surface Grinding Operations

1. Describe safety guidelines
2. Mounting and dressing wheels
3. Workholding devices
4. Grinding parallel, perpendicular, and angular surfaces
5. Describe common grinding problems and solutions

**Lab work:**

1. Continue on projects c-clamp and punch sets
2. Heat treat punch sets
3. Aluminum popper
4. Grinding project

**Week 6-Wrap up and Tests**

**Lab Work:**

1. Complete all projects needed for grade
2. Review of all procedures on each piece of equipment