

I. COURSE DESCRIPTION

Manufacturing Technology IV is a full-year capstone course in Manufacturing Technology. It is a continuation of Manufacturing Technology III. This fourth year course is a continuation of knowledge obtained from identifying and, understanding various related equipment and by producing custom made entities. The course continues to prepare the student for post high school training or entry level employment in the Machining Industry.

This fourth year course provides a comprehensive experience in the operation of various Computer Numerical Control equipment. It includes CNC Basic operations, programming, program loading, Turning, Set-Up, Operations, Milling and Turning. Included is the basic operations of all related CNC equipment. In addition, maintenance of related equipment and lubrication techniques are covered.

Students will develop their existing Core Skill Set within a manufacturing environment. By studying all of the aspects of the shop, students will not only prepare themselves for industry exams and additional training, but they will gain a competitive edge in the Machining industry.

Students of the Manufacturing Technology IV will add to their existing skill set and obtain additional machine skills. Related issues regarding shop safety and CNC equipment is reinforced. Students will reinforce their skills in the using Mastercam. The student will also reinforce their skill in speaking the correct vernacular, as well as how to perform in a professional machine shop setting.

II. COURSE OBJECTIVES/OUTLINE

Grade 12

- I. Careers in Machining Technology
 - A. Job Categories
 - B. Job Preparation
 - C. Keeping Skills Current
- II. Safety
 - A. Shop
 - B. OSHA Guidelines
 - C. Personal Protective Equipment
 - D. Guards and Barriers
 - E. Handling and Lifting
 - F. Compressed Air
 - G. Lockout and Tagout
 - H. Hazardous Materials
 - I. Fire Safety
 - J. Handtool Safety
 - K. Milling Machine Safety
 - L. CNC Safety
 - M. Lathe, Drilling Machine
- III. Drills and Drilling Machines
 - A. Basic Operation and Use
 - B. Drilling Machines and Drills
 - C. Drilling, Countersinking and Counterboring
 - D. Spotfacing, Tapping, Reaming and Microdrilling
- IV. Lathe
 - A. Basic Operation and Use
 - B. Lathes
 - C. Mandrels
 - D. Grinding and Milling on Lathe
- V. Milling Machine
 - A. Basic Operation and Use
 - B. Milling Operations
 - C. Thread Milling
 - D. High-Velocity Machining
- VI. Hand Tools
 - A. Basic Operation and Use
 - B. Hand Tool Maintenance
- VI. CNC
 - A. Basic CNC Milling
 - B. Basic CNC Turning
 - C. CNC Coordinate Systems
 - D. CNC Movement Systems
 - E. CNC Modal Commands

- VII. CNC Basics
 - A. Control Unit
 - B. Motion Control
 - C. Parts of a CNC Program
- VIII. CNC Milling
 - A. Function Codes
 - B. Work-Holding Devices
 - C. Program planning
 - D. Initial Programming and Machine Preparation
 - E. Programming the Machining Operations
- IX. CNC Turning Set-Up and Operations
 - A. Control Panel
 - B. Work Offset Settings
 - C. Types of Cutting Tools
 - D. Program Entry
 - E. Machine Operations
 - F. Tool Selection
 - G. Tool Set-up
- X. CNC Turning
 - A. Types of Turning Machines
 - B. Work-Holding Devices and Turning Centers
 - C. Planning for Turning Program
 - D. Initial Programming
- XI. Programming CNC
 - A. Coordinate Systems (X, Y, Z)
 - B. Basic CNC Programming Codes
 - C. G-Code and M-Code
 - D. Point-to-Point
 - E. Continuous-Path Positioning
 - F. Cartesian Coordinate Programming
 - G. Programming Subroutines
 - H. Program Loading
 - I. Program Troubleshooting
- XI. CNC Turning Programming
 - A. Turning program specifics
 - B. Conversational-Type Programming
 - C. Coordinate Positioning
 - D. Types of Motion
 - E. Non-Axis Motion Commands
 - F. Canned Cycles
- XII. CNC Milling Programming
 - A. Milling program specifics
 - B. Coordinate Positioning
 - C. Speed and Feed
 - D. Sequence Numbers
 - E. Types of Motion
 - F. Machining Operations

- XIII. CNC Set-Up and Operations
 - A. Part Loading
 - B. Work Settings and Offsets
 - C. Tool Settings and Offsets
 - D. Workholding
 - E. Coordinate Systems
 - F. Power-Up and Homing
 - G. Work Offset Setting
 - H. Cutting Tool Set-Up
 - I. Program entry
 - J. Machine Operations
 - K. CNC Troubleshooting
 - L. CNC Machine Maintenance
 - M. Tool Maintenance and Replacement
- XIV. Computer Aided Design/ Computer Aided Manufacturing
 - A. CAD Software Use
 - B. CAM Software Use
 - C. CAD and CAM Software
- XV. Automated Manufacturing
 - A. Flexible Manufacturing Systems
 - B. Robotics
 - C. Rapid Prototyping Techniques
 - D. The Future of Automated Manufacturing
- XVI. Quality Control
 - A. History of Quality Control
 - B. Types of Quality Control
 - C. Nondestructive Testing Techniques
- XVII. Nontraditional Machining
 - A. Chemical Machining
 - B. Hydrodynamic Machining (HDM)
 - C. Ultrasonic Machining
 - D. Electron-Beam Machining (EBM)
 - E. Laser Beam Machining
- XVIII. Other Processes
 - A. Plastics
 - B. Chipless Machining
 - C. Powder Metallurgy
- XIX. Metrology
 - A. Dimensioning and Tolerancing
 - B. Dimensioning and Tolerancing Symbols
 - C. Applications and Calculation Methods

- XX. Mastercam
 - A. Basic Understanding and Use
 - B. Machine the part complete to validate programming
 - C. Edit Mastercam File to match finished part
 - D. Mill – 3Axis
 - E. Importing – Files, Models, Layers
 - F. Set-up and Prove-out Program

A. THE PATH OF THE MANUFACTURING EQUIPMENT OPERATOR

The student will be able to:

1. Continue development in becoming a machine professional.
2. Recognize the importance of safety throughout the shop environment.
4. Understand metal composition and classification.
7. Understand drawings and measurement systems
9. Demonstrate the use of Saws and Cutoff Machines
10. Demonstrate the use of Drilling Machines and Saws
10. Understand the aspects of Grinding
10. Demonstrate the use of a Lathe
10. Demonstrate the use of a Band Machine
10. Demonstrate the use of Milling Machine
10. Understand various Metal Characteristics
10. Understand various aspects and components of CNC Machines
10. Understand and Demonstrate knowledge of CNC Programming
10. Demonstrate the use of CNC Machines
11. Demonstrate the use of Mastercam.

New Jersey Core Curriculum Content Standards

- 9.1.4.A.2 Evaluate available resources that can assist in solving problems.
- 9.1.8.A.4 Design and implement a project management plan using one or more problem-solving strategies.
- 9.1.4.D.3 Demonstrate an awareness of one's own culture and other cultures during interactions within and outside of the classroom.
- 9.1.4.F.3 Explain the importance of understanding and following rules in family,

- classroom, and community settings.
- 9.2.4.A.1 Explain the difference between a career and a job, and identify various jobs in the community and the related earnings.
 - 9.3.4.A.4 Identify qualifications needed to pursue traditional and nontraditional careers and occupations.
 - 9.3.4.A.5 Locate career information using a variety of resources.
 - 9.4.12.B.(1).1 Demonstrate communication skills and strategies that are used to work effectively with potential clients and others
 - 9.4.12.A.(3).1 Recognize and employ universal construction signs and symbols to function safely.
 - 9.4.12.A.(3).2 Use troubleshooting procedures when solving a maintenance problem to maintain project.
 - 9.4.12C.19 Employ technological tools to expedite workflow.
 - 9.4.12C.36 Demonstrate knowledge of personal and jobsite safety rules and regulations to maintain safe and healthful working conditions and environments.
 - 9.4.12C.37 Demonstrate knowledge of employee rights and responsibilities and employers' obligations to maintain workplace safety and health.
 - 9.4.12.M.8 Use correct grammar, punctuation, and terminology to write and edit documents.
 - 9.4.12.M.39 Maintain safe and healthful working conditions and environments to ensure employee safety.
 - 9.4.12.M.30 Describe and use quality control systems and practices to ensure quality products and services.
 - 9.4.12.M.32 Analyze and summarize how manufacturing businesses improve performance to demonstrate an understanding of various methods for enhancing production.
 - 9.4.12.M.44 Employ leadership skills to accomplish goals and objectives.
 - 9.4.12.M.46 Employ teamwork skills to achieve collective goals and use team members' talents effectively.
 - 9.4.12.M.50 Apply ethical reasoning to a variety of situations in order to make ethical decisions.
 - 9.4.12.M.52 Identify and demonstrate positive work behaviors and personal qualities needed to succeed in the classroom and/or to be employable.
 - 9.4.12.M.53 Develop a Personalized Student Learning Plan to meet career goals and objectives.
 - 9.4.12.M.54 Demonstrate skills related to seeking and applying for employment in a desired job.
 - 9.4.12.M.55 Maintain a career portfolio to document knowledge, skills, and experience in a career field.
 - 9.4.12.M.56 Demonstrate skills in evaluating and comparing employment opportunities in order to accept employment positions that match career goals.
 - 9.4.12.M.57 Identify and exhibit traits for retaining employment.
 - 9.4.12.M.58 Identify and explore careers in one or more career pathways to build an understanding of the opportunities available in the cluster.
 - 9.4.12.M.(1).2 Research new manufacturing processes to manage production of new and/or improved products.

- 9.4.12.M.(1).3 Develop quality improvement processes to maintain quality during the manufacturing production process.
- 9.4.12.M.(1).4 Develop a continuous improvement plan to ensure production of high quality products that meet customer expectations.
- 9.4.12.M.(2).1 Demonstrate how to communicate with others to ensure production meets business requirements.
- 9.4.12.M.(2).9 Design a product that satisfies a customer's desires to demonstrate the relationship between production processes and meeting customer needs.
- 9.4.12.M.(3).5 Develop hands-on knowledge of equipment operation to identify maintenance needs and maximize performance.
- 9.4.12.M.(3).6 Analyze and select installation, customization, or upgrade techniques in order to ensure the proper functioning of manufacturing equipment.
- 9.4.12.M.(3).7 Create a preventive maintenance schedule to maintain manufacturing equipment, tools, and workstations.
- 9.4.12.M.(3).8 Describe predictive and preventive maintenance strategies used to ensure that production processes run smoothly.
- 9.4.12.M.(3).9 Identify and diagnose equipment problems in order to effectively repair manufacturing equipment.
- 9.4.12.M.(4).2 Analyze and select strategies for coordinating work teams to produce a product that meets quality assurance standards.
- 9.4.12.M.(4).3 Evaluate production operations for product and process quality to maintain quality assurance.
- 9.4.12.M.(4).4 Demonstrate understanding of ways to enhance product and process to meet quality standards.
- 9.4.12.M.(4).5 Develop continuous improvement activities for use in the manufacturing environment to enhance the quality of products or processes.
- 9.4.12.M.(4).6 Employ processes, data, and tools to produce a product that satisfies customer needs for quality, value-added products.
- 9.4.12.M.(4).7 Analyze and select continuous improvement processes to maintain quality products and processes.
- 9.4.12.M.(4).8 Inspect manufacturing materials, report quality issues, and release only manufacturing materials that meet quality specifications.
- 9.4.12.N.74 Employ information management techniques and strategies to assist in decision-making.
- 9.4.12.N.75 Employ planning and time management skills and tools to enhance results and complete work tasks.
- 9.4.12.N.76 Understand tools and strategies used to access, process, maintain, evaluate, and disseminate marketing information to assist with business decision-making.

III. METHODS OF STUDENT EVALUATION

Students are evaluated using the following criteria:

1. Class participation
2. Periodic quizzes and tests
3. Shop work
4. Shop Projects
5. Notebook
6. Finished Products

IV. TEXTBOOKS AND INSTRUCTIONAL MATERIALS

Precision Machining Technology, Peter J, Hoffman, Eric Hopewell, Brian Janes, Kent Sharp.Jr. Delmar Cengage Learning, United States 2012 ISBN: 13 978-1-4354-4767-7

Machining Fundamentals, Ninth Edition, John R. Walker and Bob Dixon, The Goodheart-Willcox Company, Inc. Tinley Park, IL. 2004 ISBN: 978-1-61960-209-0

Machining Fundamentals, Workbook, John R. Walker. The Goodheart-Willcox Company, Inc. Tinley Park, IL. 2014 ISBN: 978-1-61960-214-4

Mastercam, CNC Software, Inc., Tolland, Connecticut

V. INSTRUCTIONAL STRATEGIES

Various teaching methods are used in this course. Classroom instruction will be given using prepared worksheets, class notes, instructional videos, and textbook exercises. Hands-on demonstrations, Direct Instruction, Independent Practice and Small-Group Instruction will be the primary teaching methods. Computer instruction will include demonstrations, examples and independent practice. Linking prior knowledge and skills will enable students to demonstrate their variety of skills in all aspects of a typical production machine shop.

VI. SCOPE AND SEQUENCE CHART

KEY: I = INTRODUCED D = DEVELOPED IN DEPTH R = REINFORCED

Grade 12

I.	Careers in Machining Technology			R
II.	Safety		D	R
III.	Drills and Drilling Machines			R
IV.	Lathe			R
V.	Milling Machine			R
VI.	CNC	I	D	R
VII.	CNC Basics	I	D	R
VIII.	CNC Milling	I	D	R
IX.	CNC Turning Set-Up and Operations	I	D	R
X.	CNC Turning	I	D	R
XI.	CNC Turning Programming	I	D	R
XII.	CNC Milling Programming	I	D	R
XIII.	CNC Set-Up	I	D	R
XIV.	Computer Aided Design/Computer Aided Manufacturing	I	D	R
XV.	Automated Manufacturing	I	D	
XVI.	Quality Control		D	R
XVII.	Nontraditional Machining		D	R
XVIII.	Other Processes		D	R
XIX.	Metrology		D	R
XX.	Mastercam			R

VII. PACING CHART

I.	Careers in Machining Technology	Week 1
II.	Safety	Week 2 - 3
III.	Drills and Drilling Machines	Week 4
IV.	Lathe	Week 5
V.	Milling Machine	Week 6
VI.	CNC	Week 7 - 9
VII.	CNC Basics	Week 10 - 12
VIII.	CNC Milling	Week 13 - 15
IX.	CNC Turning Set-Up and Operations	Week 16 - 19
X.	CNC Turning	Week 20 - 22
XI.	CNC Turning Programming	Week 23 - 25
XII.	CNC Milling Programming	Week 25 - 28
XIII.	CNC Set-Up	Week 29
XIV.	Computer Aided Design/Computer Aided Manufacturing	Week 30
XV.	Automated Manufacturing	Week 31
XVI.	Quality Control	Week 32
XVII.	Nontraditional Machining	Week 33
XVIII.	Other Processes	Week 34
XIX.	Metrology	Week 35
XX.	Mastercam	Week 35 - 36

VIII. STUDENT HANDOUT

COURSE OVERVIEW

Manufacturing Technology IV

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Students of the Manufacturing Technology IV will add to their existing skill set and obtain additional machine skills. Related issues regarding shop safety and CNC equipment is reinforced. Students will reinforce their skills in the using Mastercam. The student will also reinforce their skill in speaking the correct vernacular, as well as how to perform in a professional machine shop setting.

PROFICIENCIES

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