Machine Technology
CIP Code 480501
Grade 9
Northern Berkshire Vocational Regional School District
McCann Technical School
70 Hodges Cross Road
North Adams, MA 01247

Gary Wood
Instructor

Tom Matuszak
Instructor

Scott Botto
Instructor

Course Philosophy

The availability of skilled workers in the machinist trade is a national crisis. To be competitive in the global economy, the United States of America must train workers for the ever- changing world. Students in the ninth grade at McCann Technical School are immersed in the basics of the machine technology trade. Students are introduced to manufacturing processes through the use of common manual machining tools. Students learn about machining and manufacturing through a project- based curriculum that is aligned with the Massachusetts VTE Curriculum Frameworks. While this course meets the standards identified in the Massachusetts VTE Curriculum Frameworks, the main goal of the 9th grade course is to explore the ability to safely create from raw materials functional products. There is an emphasis on eye-hand coordination and thought processes in problem solving situations. Students will be introduced to how technology defines the modern world.

Course Description

The Machine Technology 9th grade course is based on projects that utilize traditional manual machines. These projects will include the following concepts:

1. Safe usage of machine tools.
2. Manufacturing products using blueprints on the Lathe.
3. Manufacturing products using blueprints on a Milling Machine.
4. Measuring tools for inspection of finished products.
5. Layout tools for machining procedures.

Safety is among the first lessons for students in the machine shop. All students are safety tested on the following machines: Lathe, Mills, and Power Saws. Students learn the rules of safety in both the shop and school as indicated in the student handbook. *Students locate all safety equipment in the shop to familiarize them to the layout and in case of emergencies*.

Students learn basic lathe and milling concepts. Based on this knowledge, students build projects that meet the shop competencies along with the VTE framework standards embedded in them.

Students learn how to properly use and read a variety of measurement tools specific to the machining industry. Based on this knowledge students inspect their projects that are built on the machine tools.

Students also learn to layout projects before machining so to eliminate errors and costly mistakes.

Course Syllabus

The Machine Technology curriculum was developed by the machine shop instructors at McCann Technical School. This curriculum is project- based and is aligned with the Massachusetts VTE Curriculum Frameworks. The shop is also certified by the National Institutes of Machining Skills (NIMS). The curriculum was approved by an advisory committee representing local industry, parents and machine technology instructors.

Using state standards, the instructors developed projects-based learning experiences that:

- Actively engages students in solving manufacturing problems using traditional machining tools, general mathematics and problem-solving techniques.
- Provide opportunities to work individually or in teams where communication, both verbal and written, is an intrinsic part of the learning process.
- Allows students to individualize the learning experience to meet their needs and abilities. Working at their own pace allows students to adapt to the working environment in a non-stressful method.

Each project was developed based on the following important concepts:

- Safety is the top priority.
- There is no prior knowledge of machining.
- Machining techniques taught through tasks are repetitive in order to stay current.

The main projects developed include Vise stop, Straight Shank Center, Center punch, Toolmakers Clamp, C-Clamp, Brass End Mallet and Scriber. *With extra projects if all others are completed Ball Peen Hammer and Spring Loaded Centers*

COURSE ASSESSMENT PLAN

For the Machine Technology students at McCann Technical High School the following assessment plan will be followed:

GRADING SYSTEM:

"Report cards are issued quarterly and serve as a guideline for students and their parents to measure achievement. Progress reports are issued once a quarter so students can have adequate time for remediation. Parents are encouraged to contact teachers and counselors to ensure a continuing participation in student progress. Courses are graded alphabetically in accordance with the following values." (2010-2011 McCann Student Handbook)

97-100 A+	70-73 C-
94-96 A	67-69 D+
90-93 A-	65-66 D
87-89 B+	0-64 F
84-86 B	
80-83 B-	
77-79 C+	
74-76 C	

Machine Technology Grading Policy:

Theory (30%)
Performance (70%)

FINAL EXAMINATIONS:

"Final examinations must be taken when scheduled. A grade of "F" will be given for any examination missed unless previously approved by the Principal. Final examinations will be by course title for all students. No exemptions will be given. (2010-2011 McCann Student Handbook)

TIMELINE FOR PROGRAM ACTIVITIES

- Machine Technology: Grade 9
  - Second Quarter (Theory)
    - Safety- Personal and Shop
    - Machine Identification
    - Measuring tools
    - Math assessment
    - Blueprint reading

    Shop Safety

    Machine safety check off
    - Locating and identifying safety equipment
    - Machine tool operation training
    - Measuring Tools

- Skills USA Competition project

Projects

- Lathe: Straight Shank Center, Center Punch and all appropriate tasks.
- Milling: Vice Stop and all appropriate tasks.

- Third Quarter (Theory)

  - Blueprint reading
  - Math
  - ToolingU
  - Inspection and measuring tools

  Shop

  - Lathe: Brass End Mallet and Scribe and all appropriate tasks
  - Milling: Toolmakers Clamps and all appropriate tasks

- Fourth Quarter (Theory)
  - ToolingU
  - Blueprint reading
  - Math
  - Final exam preparation

  Shop

  - Complete all required projects and work on outside projects.
  - Clean-up

Standards

Validated Competency Listing

The competencies for Machine Technology at McCann Technical School have been approved by the Machine Technology Advisory board. The curriculum has employability skills built into every day working environment and Skills USA PDP. The following competencies are integrated through theory and shop projects. Individual competencies that are associated with particular projects are listed with that project under Instructional Activities.

Massachusetts Manufacturing, Engineering and Technology: Machine Tool Technology Curriculum Framework
Learning Standards for a Full First-Year Course: Grade 9 (September 2011)
2.B.02c Use the design process to identify, problem solve and evaluate a solution
2.B.03c Read and interpret detail blue prints or technical processes

2.D.01c Identify appropriate person(s) for maintenance and repair of equipment
2.D.02c Monitor equipment indicators to insure that equipment is operating correctly
2.F.01c Define attributes, units, and systems of measurement used in MET fields
2.F.02c Apply a variety of techniques, tools, and formulas for determining measurements
2.F.05c Use measurement systems to solve problems
2.G.04 Measure the depth of a work piece using a depth micrometer within a tolerance of +/- .001
2.G.05 Measure work piece with a vernier caliper within a tolerance of at least +/- .005
2.G.06 Measure radius on a work piece using a radius gage within a tolerance of at least +/- 1/32
2.G.08 Use a protractor to measure the angle(s)
2.H.04 Follow inspection procedures to accurately measure a finished part
2.H.07 Select, wring, and use gage blocks to determine if finished part meets specifications
2.I.01 Layout flat and/or round stock
2.I.02 Cut material using hacksaw to appropriate length and size
2.J.01 Draw file flat surface
2.J.02 File and blend angles and radii on work piece
2.J.03 Mark work piece with identification information
2.J.04 Deburr work piece
2.J.05 Finish work piece as required
2.J.06 Disassemble and assemble mechanical/machine parts
2.K.01 Drill a hole to proper size, depth and location
2.K.02 Hand tap a hole to proper thread size and depth
2.K.04 Thread shaft using a die to proper size and length
2.L.01 Identify types of metals and related materials
2.L.04 Perform heat treatment processes: harden, temper, anneal, normalize, and case harden
2.M.01 Read and interpret detail drawings
2.M.03 Make a sketch of an existing work piece including detailed measurements to be machined
2.N.01 Select proper materials
2.N.02 Determine size and amount of material needed to complete product(s)
2.N.03 Develop an order of operations
2.N.04 List tools to be used
2.N.06 Select appropriate machine tools
2.P.01 Drill a hole to proper size and location to a tolerance +/- 1/64 and diameter of +/- .005
2.P.02 Counter sink a hole to depth and diameter specified by blueprint to a tolerance of +/- 1/64
2.P.03 Ream a hole to size specified by blue print to a tolerance of +/- .001
2.P.04 Tap a hole to proper depth and thread size
2.P.05 Counter bore a hole to proper diameter and depth according to blue print
2.Q.02 Cut material using horizontal saw to length
2.Q.03 Use a vertical band saw to layout lines

Safety

The following Massachusetts standards are associated with Safety

1.B.03a Identify, describe and demonstrate personal, shop and job site safety practices and procedures
1.B.04a Demonstrate safe dress and use of relevant safety gear and personal protective equipment (PPE), including wrist rests, adjustable workspaces and equipment, gloves, boots, earplugs, eye protection, and breathing apparatus
1.B.05a Illustrate appropriate safe body mechanics, including proper lifting techniques and ergonomics
1.B.06a Locate emergency equipment in your lab, shop, and classroom, including (where appropriate) eyewash stations, shower facilities, sinks, fire extinguishers, fire blankets, telephone, master power switches, and emergency exits
1.B.07a Demonstrate the safe use, storage, and maintenance of every piece of equipment in the lab, shop, and classroom
1.B.08a Describe safety practices and procedures to be followed when working with and around electricity
1.B.09a Illustrate proper handling and storage practices, including working with hazardous materials, disposal, and recycling
1.B.10a Demonstrate proper workspace cleaning procedures

1.B.11c Discuss the relationship between health, safety and productivity
1.C.01a Illustrate First Aid procedures for potential injuries and other health concerns in the occupational area
1.C.02a Describe the importance of emergency preparedness and an emergency action plan
1.C.03a Illustrate procedures used to handle emergency situations and accidents, including identification, reporting, response, evacuation plans, and follow-up procedures
1.C.04a Identify practices used to avoid accidents
1.C.05a Identify and describe fire protection, precautions and response procedures

Skill PDP Program

The following Massachusetts Standards are associated with Skills PDP Program:
4.B.01a Apply strategies to enhance effectiveness of all types of communications in the workplace
4.B.02a Apply reading skills and strategies to work-related documents
4.B.04a Apply basic writing skills to work-related communication
4.B.05a Write work-related materials
4.B.08a Apply basic skills for work-related oral communication
4.B.12a Apply active listening skills to obtain and clarify information
4.B.13a Communicate with others in a diverse workforce
4.C.01a Demonstrate skills used to define and analyze a given problem
4.C.02a Explain the importance and dynamics of individual and teamwork approaches of problem solving
4.C.03a Describe methods of researching and validating reliable information relevant to the problem
4.C.04a Explain strategies used to formulate ideas, proposals and solutions to problems
4.C.05a Select potential solutions based on reasoned criteria
4.C.06a Implement and evaluate solution(s)

The following Massachusetts Standards are associated with Embedded Academics in theory and shop projects:
Read technical manuals, guides, resource books and technical literature to gain information and solve problems.
Use a ruler, protractor, and compass to draw polygons and circles.
Given the formulas, convert from one system of measurement to another. Use technology as appropriate.
Compare, order, estimate, and translate among integers, fractions and mixed numbers (i.e., rational numbers), decimals, and percents.
Apply properties of angles, parallel lines, arcs, radii, chords, tangents, and secants to solve problems.
Demonstrate knowledge of pictorial and multi-view drawings (e.g., orthographic projection, isometric, oblique, perspective) using proper techniques.
Differentiate the selection of tools and procedures used in the safe production of products in the manufacturing process, e.g., hand tools, power tools, computer-aided manufacturing, three-dimensional modeling.
Explain how mechanical systems such as gears, pulleys, levers, and presses work.

Competency Reporting System

The Machine Technology Department at McCann Tech tracks and documents the student competencies annually. Students receive a progress report and a report card per quarter. All student grades are kept on software and reports are generated.

Instructional Activities

The Machine Technology course was designed to provide students with project-based learning opportunities and laboratory-based experiences in the development of content knowledge. There are seven culminating projects that utilize standards-based content during development and completion: Vise stop, Parallel Clamp, Brass End Mallet, and Spring Loaded Center. Skills USA Competition encompasses current projects students are completing in the manual machining program.

Brass End Mallet

The brass end mallet is a multiple component project that uses the milling and lathe knowledge previously learned. This project introduces students to drilling and tapping round stock in a milling machine. With this knowledge learned and demonstrated students build and assemble the project.

Massachusetts State Competencies associated with Brass End Mallet:

Lathe

2.U.02 Set up and use a 4-jaw chuck
2.U.03 Face work piece to length specified on blue print within a tolerance of +/- 1/64
2.U.04 Straight turn and shoulder turn the work piece diameters to a tolerance of +/- .002 and length of +/- 1/64
2.U.05 Turn external and internal tapers to blue print specifications or industrial standard for the part
2.U.08 Cut external threads using die
2.U.09 Cut external and internal groves
2.U.11 Center drill to proper depth
2.U.16 Knurl a piece to design specifications on blue print
2.U.17 File and polish a work piece

Mill

2.V.11 Drill, ream, and tap holes to specifications

Mill Vise Stop

This project introduces the student to the vertical milling machine. Students will learn and demonstrate how to drill and mill. Students learn about speeds, feeds, and machine set-up. Spring creation and inspection tools such as Micrometers 0-1" and 1-2 are introduced. Knowledge learned and demonstrated is then used to complete the project.

Massachusetts State Competencies associated with Mill Vise Stop:

Mill

2.V.03 Locate a daturn feature using indicator and edge finder
2.V.08 Mill workpiece using climb and conventional methods
2.V.10 Mill slots and pockets to size and location specifications within a tolerance of +/- .005
2.V.11 Drill, ream, and tap holes to specifications
2.V.13 Spot face, counterbore, and countersink to specifications

Parallel Clamps

This project introduces students to assembly of components that they build on the lathe and milling machine. The parallel clamp uses both the knowledge of operations for the

lathe and milling machines. When all components are completed then students must assemble their work so that it is fully functional.

Massachusetts State Competencies associated with Parallel Clamp

Lathe

2.U.03 Face work piece to length specified on blue print within a tolerance of +/- 1/64
2.U.04 Straight turn and shoulder turn the work piece diameters to a tolerance of +/- .002 and length of +/- 1/64
2.U.05 Turn external and internal tapers to blue print specifications or industrial standard for the part
2.U.07 Cut external and internal threads with single point tool
2.U.08 Cut external threads using die
2.U.09 Cut external and internal groves
2.U.11 Center drill to proper depth
2.U.16 Knurl a piece to design specifications on blue print
2.U.17 File and polish a work piece

Mill

2.V.03 Locate a daturn feature using indicator and edge finder
2.V.06 Mill a variety of angles within a tolerance of +/- ½ degree
2.V.08 Mill workpiece using climb and conventional methods
2.V.11 Drill, ream, and tap holes to specifications
2.V.13 Spot face, counterbore, and countersink to specifications

Spring Loaded Center

This Project helps the student to learn about the Compound Rest of a lathe. Students will learn and demonstrate how to cut an angle on a lathe. Set up of the machines speeds and controls. Students practice with hand and eye coordination in order to turn a smooth finish on their part and to work with in a1/64th of an inch with a metal scale. Students also learn about heat treating of steel with a torch. Mathematics is used when the student has to change from included angles to cutting angles.

Massachusetts State Competencies associated with

Lathe

2.U.03 Face work piece to length specified on blue print within a tolerance of +/- 1/64
2.U.04 Straight turn and shoulder turn the work piece diameters to a tolerance of +/- .002 and length of +/- 1/64
2.U.05 Turn external and internal tapers to blue print specifications or industrial standard for the part
2.U.11 Center drill to proper depth
2.U.12 Drill hole to specified depth and diameter
2.U.13 Tap a hole to appropriate thread size and depth
2.U.14 Ream a hole in the work piece to specified diameter and depth
2.U.17 File and polish a work piece

Scriber

The scriber project uses all prior knowledge learned on the lathe for speeds, feeds, form turning. With this knowledge learned and demonstrated, students build and assemble the project.

Massachusetts State Competencies associated with

Lathe

2.U.03 Face work piece to length specified on blue print within a tolerance of +/- 1/64
2.U.04 Straight turn and shoulder turn the work piece diameters to a tolerance of +/- .002 and length of +/- 1/64
2.U.05 Turn external and internal tapers to blue print specifications or industrial standard for the part

2.U.08 Cut external threads using die
2.U.11 Center drill to proper depth
2.U.12 Drill hole to specified depth and diameter
2.U.13 Tap a hole to appropriate thread size and depth
2.U.16 Knurl a piece to design specifications on blue print
2.U.17 File and polish a work piece

C-Clamp

The C-Clamp has 4 assembled parts. Students must work accurately in order to complete this job. All prior knowledge on lathe and milling machines are used. With this knowledge learned and demonstrated, students build and assemble the project.

Massachusetts State Competencies associated with

Lathe

2.U.03 Face work piece to length specified on blue print within a tolerance of +/- 1/64
2.U.04 Straight turn and shoulder turn the work piece diameters to a tolerance of +/- .002 and length of +/- 1/64
2.U.08 Cut external threads using die
2.U.11 Center drill to proper depth
2.U.12 Drill hole to specified depth and diameter
2.U.13 Tap a hole to appropriate thread size and depth
2.U.16 Knurl a piece to design specifications on blue print
2.U.17 File and polish a work piece

Mill

2.V.03 Locate a daturn feature using indicator and edge finder
2.V.05 Mill a flat surface
2.V.06 Mill a variety of angles within a tolerance of +/- ½ degree
2.V.07 Square up a work piece within a tolerance of +/- 1 degree
2.V.08 Mill workpiece using climb and conventional methods
2.V.10 Mill slots and pockets to size and location specifications within a tolerance of +/- .005
2.V.11 Drill, ream, and tap holes to specifications

Skills USA Competition

Students are only in the Machine Shop program for a month which is not enough time to properly test them with the current Skills USA projects. Students are evaluated on the work they accomplish independently for that shop week. By not overwhelming students with this competition the students work at their own safe pace. Students that score the highest on the projects are awarded at the closing ceremonies

National Institute of Machining Skills (NIMS)

Students are introduced to the National Institute of Machining Skills (NIMS) when they have reached certain competencies. NIMS projects are used when teaching drill press operations, layout and bench work.

Resources

Standards and textbook resources:
Textbook: *Technology of Machine Tools* Fifth edition
Steve F. Krar and Albert F. Check (Copyright1997)
Text Book: Mathematics for Machine Technology Third edition
Robert D. Smith (Copyright 1990)
Text Book: Blueprint Reading Basics Third edition
Warren Hammer (Copyright 2001)

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Course Philosophy

The availability of skilled workers in the machinist trade is a national crisis. To be competitive in the global economy, the United States of America must train workers for the ever-changing world. Machine Technology students in the tenth grade at the McCann Technical School are immersed in the basics of the machine technology trade. Students continue to learn about manufacturing processes through the use of common manual machining tools. Students will learn about machining and manufacturing through a project-based curriculum that is aligned with the Massachusetts VTE Curriculum Frameworks. While this course meets the standards identified in the Massachusetts VTE Curriculum Frameworks, the 10th grade course is a continuation and expansion of what students did and learned in the 9th grade. These skills include: the ability to work safely and thoughtfully on a variety of machine tools and to create functional products from various materials. There is an emphasis on planning, organizing and utilizing the available equipment to create the products in the defined curriculum. Students continue their exploration of how technology defines the modern world.

- Students will attain level 1 certification in Lathe and Milling from the National Institute of Metalworking Skills (NIMS)
- Students will achieve OSHA 10 hour certification card

Course Description

The Machine Technology 10th grade course is based on tasks to teach specific skills on the lathe and milling machine. These skills are necessary to complete the NIMS level 1 national standard. Students quickly learn that tolerances must be maintained if the completed project is to function properly. These projects will include the following concepts:

1. Special attachments and machine setups for lathes and milling machines
2. Manufacturing products using blueprints on the Lathe.
3. Manufacturing products using blueprints on a Milling Machine.
4. Measuring tools for inspection of finished products.
5. Indicators and indicating for precision locating.

Safety on the standard shop equipment and the proper use of all tools and materials is emphasized. School procedures for emergencies such as fire safety are revisited.

Students learn intermediate and advanced lathe and milling concepts. These include taper attachments boring, and carriage stops on lathes, rotary tables, indexing devices and locating techniques on milling machines. Students complete tasks to become familiar with how these attachments and processes work. With this knowledge, students build projects that have shop competencies and VTE framework standards embedded in them. Students learn how to properly use a variety of measurement tools specific to the machining industry. With this knowledge students select the proper tool to create and inspect their projects.

Course Syllabus

The Machine Technology curriculum was developed by the machine shop instructors at McCann Technical School. This curriculum is task-based and is aligned with the Massachusetts VTE Curriculum Frameworks. The shop is also certified by the National Institutes of Machining Skills (NIMS). The curriculum was approved by an advisory committee representing local industry, parents and machine technology instructors. Using state standards, the instructors developed task-based learning experiences that:

- Actively engage students in solving manufacturing problems using traditional machining tools, general mathematics and problem-solving techniques.
- Provide opportunities to work individually or in teams where communication, both verbal and written, is an intrinsic part of the learning process.
- Allow students to individualize the learning experience to meet their needs and abilities. Working at their own pace allows students to adapt to the working environment in a non-stressful method.

Each task was developed based on the following important concepts:

- Safety is the top priority.
- There is prior knowledge of machining and machine tools.
- Machining techniques taught through tasks are repetitive in order to reinforce learning and complete NIMS certification.

Upon completion of the NIMS Certification projects, students select from a list of projects that will continue to enhance their skill set. Which include these projects: T Tap Wrench, Drill Press Vise, Table Stop, Bar Tap Wrench and an Arbor Press.

Course Assessment Plan

For the Machine Technology students at McCann Technical High School the following assessment plan will be followed:

Grading System:

"Report cards are issued quarterly and serve as a guideline for students and their parents to measure achievement. Progress reports are issued once a quarter so students can have adequate time for remediation. Parents are encouraged to contact teachers and counselors to ensure a continuing participation in student progress. Courses are graded alphabetically in accordance with the following values." (2010-2011 McCann Student Handbook)

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84-86 B	
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74-76 C	

Machine Technology Grading Policy:

Theory (30%)
Performance (70%)

Final Examinations:

"Final examinations must be taken when scheduled. A grade of "F" will be given for any examination missed unless previously approved by the Principal. Final examinations will be by course title for all students. No exemptions will be given."(2010-2011 McCann Student Handbook)

Timeline For Program Activities

Machine Technology: Grade 10

Time line is self paced, quarters represent minimal required work

First Quarter

- Instructor assigned milling task,(Milltest0, Milltest7, Indicate vice and tram the head of a milling machine)
- Instructor assigned lathe task,(Studtask, LO1, Acme Thread, LBore)
- Indicators for inspecting tasks and for setting machine tools.
- Measurement Tools (Telescope gage, Gage Blocks, Micrometers, Depth Micrometers, Indicators and height gages)
- OSHA 10 hour course (intro to OSHA, Safety and Health program
- Math topic thread calculations
- Blueprint Reading Intermediate

Second Quarter

- Instructor assigned milling task (tbstp-3, NIMS 2.7, Ream)
- Instructor assigned lathe NIMS Lathe and Mill project
- Indicators for inspecting tasks and for setting machine tools.
- Blueprint reading Intermediate
- OSHA 10 hour course (PPE, Means of egress and fire protection)

Third Quarter

- Shop Projects, Instructor Assigned (Collet Stop, Drill Press Vise, Tablestop, T-Tap Bar Tap Wrench)
- Job specific and skill specific tasks
- Instructor assigned NIMS Lathe and Mill Project
- Special Projects
- Related theory including blueprint reading and shop trigonometry.

Fourth Quarter

- Shop Projects, Instructor Assigned (Collet Stop, Drill Press Vise, Tablestop, T-Tap Bar Tap Wrench)
- Job specific and skill specific tasks
- NIMS Written Exam

- Special Projects
- Related theory including blueprint reading and shop trigonometry.
- Final Exam Preparation
- End of year clean-up

Validated Competency Listing

The competencies for Machine Technology at McCann Technical School have been approved by the Machine Technology Advisory board. The curriculum has employability skills built into every day working environment and Skills USA PDP. The following competencies are integrated through theory and shop projects. Individual competencies that are associated with particular projects are listed with that project under Instructional Activities.

2.B.02c Use the design process to identify, problem solve and evaluate a solution

2.B.03c Read and interpret detail blue prints or technical processes

2.D.01c Identify appropriate person(s) for maintenance and repair of equipment

2.D.02c Monitor equipment indicators to insure that equipment is operating correctly

2.F.01c Define attributes, units, and systems of measurement used in MET fields

2.F.02c Apply a variety of techniques, tools, and formulas for determining measurements

2.F.05c Use measurement systems to solve problems

2.A.02c Identify and apply the concepts of total quality management appropriate to the field

2.G.03 Measure work piece with an inside micrometer within a tolerance of +/- .001

2.G.04 Measure the depth of a work piece using a depth micrometer within a tolerance of +/- .001

2.G.05 Measure work piece with a vernier caliper within a tolerance of at least +/- .005

2.G.06 Measure radius on a work piece using a radius gage within a tolerance of at least +/- 1/32

2.G.08 Use a protractor to measure the angle(s)

2.H.01 Use gage pins to measure location and diameter to a tolerance of at least +/- .001

2.H.02 Measure outside and pitch diameter of a thread to a tolerance of at least +/- .002

2.H.03 Compare surface finish quality of a part using surface finish comparator/gage to print specification

2.H.04 Follow inspection procedures to accurately measure a finished part

2.H.05 Follow procedures to measure inside diameter using a telescope gage and micrometer to a tolerance of at least +/- .005

2.H.06 Use a height gage and indicator on a surface plate to measure dimension and/or location on a work piece

2.H.07 Select, wring, and use gage blocks to determine if finished part meets specifications

2.H.08 Check piece for flatness, parallelism, (within +/- .002) and squareness (within +/- ½ of degree)

2.H.09 Check concentricity of finished part to a tolerance of at least +/- .001

2.H.10 Check straightness of a part to appropriate tolerance

2.I.01 Layout flat and/or round stock

2.I.02 Cut material using hacksaw to appropriate length and size

2.J.01 Draw file flat surface

2.J.02 File and blend angles and radii on work piece

2.J.03 Mark work piece with identification information

2.J.04 Deburr work piece

2.J.05 Finish workpiece as required

2.J.06 Disassemble and assemble mechanical/machine parts

2.K.01 Drill a hole to proper size, depth and location

2.K.02 Hand tap a hole to proper thread size and depth

2.K.03 Hand ream a hole to proper diameter of +/- .001 and depth of +/- 1/16

2.K.04 Thread shaft using a die to proper size and length

2.K.05 Broach a keyway to desired depth and size

2.L.01 Identify types of metals and related materials

2.L.02 List properties that affect machine ability

2.L.04 Perform heat treatment processes: harden, temper, anneal, normalize, and case harden

2.L.07 Identify how heat treatment of materials effects the machining process

2.M.01 Read and interpret detail drawings

2.M.02 Read and interpret assembly drawings

2.M.03 Make a sketch of an existing work piece including detailed measurements to be machined

2.M.04 Design and sketch a basic work piece based on ‘customer’ needs

2.N.01 Select proper materials

2.N.02 Determine size and amount of material needed to complete product(s)

2.N.03 Develop an order of operations

2.N.04 List tools to be used

2.N.05 List fixturing or work holding device(s) to be used

2.N.06 Select appropriate machine tools

2.P.01 Drill a hole to proper size and location to a tolerance +/- 1/64 and diameter of +/- .005

2.P.02 Counter sink a hole to depth and diameter specified by blueprint to a tolerance of +/- 1/64

2.P.03 Ream a hole to size specified by blue print to a tolerance of +/- .001

2.P.04 Tap a hole to proper depth and thread size

2.P.05 Counter bore a hole to proper diameter and depth according to blue print

2.Q.01 Select the appropriate blade for task

2.Q.02 Cut material using horizontal saw to length

2.Q.03 Use a vertical band saw to layout lines

2.T.01 Select, change, mount, and balance grinding wheel

2.T.02 Dress, true, ring grinding wheel

2.T.03 Grind a flat surface to a tolerance of +/- .001

2.T.04 Grind work piece square to within ½ a degree

OSHA 10 hour certification

The following standards are associated with OSHA training:

1.A.01a Identify and apply OSHA and other health and safety regulations that apply to specific tasks and jobs in the occupational area

1.A.03a Identify and apply Right-To-Know (Hazard Communication Policy) and other communicative regulations that apply to specific tasks and jobs in the occupational area

1.A.04a Explain procedures for documenting and reporting hazards to appropriate authorities

1.B.01a Identify, describe and demonstrate the effective use of Material Safety Data Sheets (MSDS)

1.B.02a Read chemical, product, and equipment labels to determine appropriate health and safety considerations

1.B.03a Identify, describe and demonstrate personal, shop and job site safety practices and procedures

1.B.04a Demonstrate safe dress and use of relevant safety gear and personal protective equipment (PPE), including wrist rests, adjustable workspaces and equipment, gloves, boots, earplugs, eye protection, and breathing apparatus

1.B.05a Illustrate appropriate safe body mechanics, including proper lifting techniques and ergonomics

1.B.06a Locate emergency equipment in your lab, shop, and classroom, including (where appropriate) eyewash stations, shower facilities, sinks, fire extinguishers, fire blankets, telephone, master power switches, and emergency exits

1.B.07a Demonstrate the safe use, storage, and maintenance of every piece of equipment in the lab, shop, and classroom

1.B.08a Describe safety practices and procedures to be followed when working with and around electricity

1.B.09a Illustrate proper handling and storage practices, including working with hazardous materials, disposal, and recycling

1.B.10a Demonstrate proper workspace cleaning procedures

1.B.11c Discuss the relationship between health, safety and productivity

1.C.01a Illustrate First Aid procedures for potential injuries and other health concerns in the occupational area

1.C.02a Describe the importance of emergency preparedness and an emergency action plan

1.C.03a Illustrate procedures used to handle emergency situations and accidents, including identification, reporting, response, evacuation plans, and follow-up procedures

1.C.04a Identify practices used to avoid accidents

1.C.05a Identify and describe fire protection, precautions and response procedures

Skill PDP Program

The following Massachusetts Standards are associated with Skills PDP Program:

4.B.01a Apply strategies to enhance effectiveness of all types of communications in the workplace

4.B.02a Apply reading skills and strategies to work-related documents

4.B.03a Locate information from books, journals, magazines, and the Internet

4.B.04a Apply basic writing skills to work-related communication

4.B.05a Write work-related materials

4.B.08a Apply basic skills for work-related oral communication

4.B.12a Apply active listening skills to obtain and clarify information

4.B.13a Communicate with others in a diverse workforce

4.C.01a Demonstrate skills used to define and analyze a given problem

4.C.02a Explain the importance and dynamics of individual and teamwork approaches of problem solving

4.C.03a Describe methods of researching and validating reliable information relevant to the problem

4.C.04a Explain strategies used to formulate ideas, proposals and solutions to problems

4.C.05a Select potential solutions based on reasoned criteria

4.C.06a Implement and evaluate solution(s)

The following Massachusetts Standards are associated with Embedded Academics in theory and shop projects:

Read technical manuals, guides, resource books and technical literature to gain information and solve problems.

Read, comprehend, and follow written technical directions for repairs, procedures and processes.

Use a ruler, protractor, and compass to draw polygons and circles.

Given the formulas, convert from one system of measurement to another. Use technology as appropriate.

Solve linear equations using tables, graphs, models, and algebraic methods.

Given the formulas, convert from one system of measurement to another. Use technology as appropriate.

Compare, order, estimate, and translate among integers, fractions and mixed numbers (i.e., rational numbers), decimals, and percents.

Recognize and solve problems involving angles formed by transversals of coplanar lines. Identify and determine the measure of central and inscribed angles and their associated minor and major arcs. Recognize and solve problems associated with radii, chords, and arcs within or on the same circle.

Apply properties of angles, parallel lines, arcs, radii, chords, tangents, and secants to solve problems.

Calculate perimeter, circumference, and area of common geometric figures such as parallelograms, trapezoids, circles, and triangles.

Demonstrate knowledge of pictorial and multi-view drawings (e.g., orthographic projection, isometric, oblique, perspective) using proper techniques.

Interpret plans, diagrams, and working drawings in the construction of a prototype.

Differentiate the selection of tools and procedures used in the safe production of products in the manufacturing process, e.g., hand tools, power tools, computer-aided manufacturing, three-dimensional modeling.

Explain how mechanical systems such as gears, pulleys, levers, and presses work.

Competency Reporting System

The Machine Technology Department at McCann Tech tracks and documents the student competencies annually. Students receive a progress report and a report card per quarter. All student grades are kept on software and reports are generated.

INSTRUCTIONAL ACTIVITIES

The Machine Technology course was designed to provide students with task/project-based learning opportunities and laboratory-based experiences. All tasks are targeted toward the successful completion of the NIMS certifications. Related theory is also part of the curriculum and is done 1 or 2 periods a day. This class time is coordinated with the shop activities whenever possible. Theory includes shop science, blueprint reading, related math, OSHA training. Upon completion of the NIMS certifications students will create any of the following projects: Collet Stop, T Tap Wrench, Drill Press Vise, Table Stop, Bar Tap Wrench and an Arbor Press. The 10^{th} grade projects are more complicated than 9^{th} grade projects because all projects have multiple parts that must fit together. Also, many more machine attachments are needed to complete these projects including taper attachments, indexing heads, rotary tables and the dividing head.

Collet Stop

The collet stop project introduces student to checking threads with thread wires. Students use formulas to determine an appropriate thread wire size and also the calculated measurement over the wires. Students must understand thread terminology to be able to use the formulas. Students also use an indexing device to create the hexagon on the part. Another requirement is that the part has concentric diameters and holes and that faces are perpendicular to the axis of the part. Tolerances on lengths are 1/64 and diameters and milled features =/-.003

Massachusetts State Competencies associated with Collet Stop:

Lathe

2.U.01 Set up and use lathe accessories

2.U.03 Face work piece to length specified on blue print within a tolerance of +/- 1/64

2.U.04 Straight turn and shoulder turn the work piece diameters to a tolerance of +/- .002 and length of +/- 1/64

2.U.07 Cut external and internal threads with single point tool

2.U.08 Cut external threads using die

2.U.09 Cut external and internal groves

2.U.10 Cut off work piece with parting tool to specified length for finishing

2.U.11 Center drill to proper depth

2.U.12 Drill hole to specified depth and diameter

2.U.13 Tap a hole to appropriate thread size and depth

2.U.16 Knurl a piece to design specifications on blue print

2.U.17 File and polish a work piece

Mill

2.V.16 Describe the use of a rotary table

2.V.08 Mill workpiece using climb and conventional methods

2.V.09 Mill a shoulder to size and location specifications

T-Tap Wrench

The T-Tap wrench consists of several parts, the main parts being the body and nose cap. The job is mostly completed on a lathe. The difficulty of the job is making good decisions about what steps to do. Making poor decisions about the order of operations can lead to real problems holding the parts in the machines for subsequent operations. New operations performed on some of the pieces are boring internal tapers and employing fixtures to complete some parts.

Massachusetts State Competencies associated with T-Tap Wrench:

Lathe

All Lathe and Mill Competencies are the same as the Collet Stop including the following-

2.U.14 Ream a hole in the work piece to specified diameter and depth

2.U.06 Bore hole to depth (or through) piece

Mill

2.V.03 Locate a datum feature using indicator and edge finder

2.V.10 Mill slots and pockets to size and location specifications within a tolerance of +/- .005

Drill Press Vise

The drill press vise consists of many parts that must be very accurate to work properly. Students bore the holes in a Bridgeport with print tolerances that are +.001/-.000. Students use telescope gages to measure the holes. The position of these main holes and the many other holes in each part must be very accurate. Another part involves the use of a rotary table and fixture that must be mounted on the rotary table. Students must indicate the fixture on the rotary table using an indicator and also align the front edge of the fixture in relation to degree graduations on the rotary table. When positioning the cutting tool students must calculate where to position the cutter in relation to the part zero which is at the center of the rotary table.

Massachusetts State Competencies associated with Drill Press Vise

Lathe

2.U.01 Set up and use lathe accessories

2.U.03 Face work piece to length specified on blue print within a tolerance of +/- 1/64

2.U.04 Straight turn and shoulder turn the work piece diameters to a tolerance of +/- .002 and length of +/- 1/64

2.U.07 Cut external and internal threads with single point tool

2.U.08 Cut external threads using die

2.U.09 Cut external and internal groves

2.U.11 Center drill to proper depth

2.U.16 Knurl a piece to design specifications on blue print

Mill

2.V.01 Indicate vise within a tolerance of .002 over a 6" span

2.V.02 Tram miller head within a tolerance of .001 over a 6" diameter sweep

2.V.03 Locate a datum feature using indicator and edge finder

2.V.05 Mill a flat surface

2.V.06 Mill a variety of angles within a tolerance of +/- ½ degree

2.V.07 Square up a work piece within a tolerance of +/- 1 degree

2.V.08 Mill workpiece using climb and conventional methods

2.V.09 Mill a shoulder to size and location specifications

2.V.11 Drill, ream, and tap holes to specifications

2.V.12 Bore a hole to size and location within a tolerance of +/- .005

2.V.13 Spot face, counterbore, and countersink to specifications

Table Stop

The table stop also involves boring holes on the Bridgeport. Students must first drill holes that are 1/16 smaller than the finish bore size. Then they finish bore the holes again using telescope gages to measure these holes. The students then use an arbor with a large slitting saw to cut the required slots in the main part. Students must calculate proper cutting speeds and make good setups with the large slitting saw to operate this tool safely.

Massachusetts State Competencies associated with the Table Stop:

Lathe:

2.U.03 Face work piece to length specified on blue print within a tolerance of +/- 1/64

2.U.04 Straight turn and shoulder turn the work piece diameters to a tolerance of +/- .002 and length of +/- 1/64

2.U.12 Drill hole to specified depth and diameter

2.U.13 Tap a hole to appropriate thread size and depth

All Mill Competencies are the same as the Drill Press Vise including the following:

Mill

2.V.10 Mill slots and pockets to size and location specifications within a tolerance of +/- .005

Bar Tap Wrench

The bar tap wrench is a very good lathe project that requires a lot of machining to create the finish part. Because of the amount of material removed from the initial stock size, students must first rough both ends of the part. Students must also leave extra material during the roughing process to accommodate the radiuses in the corners of the part. An emphasis is placed on concentricity of the different diameters. A taper attachment is used to cut the .750/tpf. Next, students use an indexing device to hold the part to machine the flat surfaces and the pocket. They must locate the center of the part using an indicator. Students use an adjustable parallel to measure the width of the pocket. Students must setup and use a boring bar to cut the 1.156 radiuses.

Massachusetts State Competencies associated with the Bar Tap Wrench:

2.U.01 Set up and use lathe accessories

2.U.03 Face work piece to length specified on blue print within a tolerance of +/- 1/64

2.U.04 Straight turn and shoulder turn the work piece diameters to a tolerance of +/- .002 and length of +/- 1/64

2.U.07 Cut external and internal threads with single point tool

2.U.08 Cut external threads using die

2.U.09 Cut external and internal groves

2.U.11 Center drill to proper depth

2.U.12 Drill hole to specified depth and diameter

2.U.13 Tap a hole to appropriate thread size and depth

2.U.15 Machine a form into the work piece

Mill

2.V.03 Locate a daturn feature using indicator and edge finder

2.V.05 Mill a flat surface

2.V.08 Mill workpiece using climb and conventional methods

2.V.10 Mill slots and pockets to size and location specifications within a tolerance of +/- .005

2.V.11 Drill, ream, and tap holes to specifications

2.V.16 Describe the use of a rotary table

2.V.17 Explain the uses of a dividing head for part positioning

Arbor Press

The arbor press introduces several new concepts. The student must make two types of gears, a rack and a spur gear. They use the horizontal milling machine to cut the gears. An indexing head is used to hold and index the part while cutting the spur gear. Students must use gear formulas to calculate linear pitch and tooth depth. Students also must determine the hole circle to use and the number of turns that the dividing head must be moved for each tooth. The main body of the part is machined on a fixture mounted to a rotary table. Again, students must calculate the moves required to cut the part features the proper size and position and move to the proper location using the dials and handling backlash.

Massachusetts State Competencies associated with the Arbor Press:

The Arbor Press project is an acumination of all previous competencies completed.

SKILLS USA COMPETITION

Students are given two projects to complete in a designated amount of time. The lathe project consists of the following machining competencies: turning, threading, undercutting, boring, cutting angles and inspection. The milling project consists of the following machining competencies: side and end-milling, drilling, counter-boring, reaming, pocket milling, grinding and inspection. Students then take a written exam. The cumulate total of the parts and exam determines which students advance to the district competition.

Massachusetts State Competencies associated with Skills USA:
Project Competencies are based on prior knowledge learned to date.

NATIONAL INSTITUTE OF METALWORKING SKILLS

Students are required to complete milling and turning between centers certifications of the NIMS projects. Students will be tested when they achieved a predetermined skill level on either the lathe or milling machine. Students must successfully make a part which is inspected by instructors first and then sent out to a local shop for accuracy verification. Once it is determined that the part meets all physical requirements students take an online test to complete the certification process. Certificates are then mailed to students. The NIMS projects provide a national certification process for students in the Machine Technology program.
Massachusetts State Competencies associated with NIMS:
All Competencies completed in shop projects are taught previously through the use of tasks associated with NIMS projects. See NIMS curriculum.

RESOURCES

Standards and textbook resources:

Textbook: *Technology of Machine Tools* Fifth edition
Steve F. Krar and Albert F. Check (Copyright1997)

Text Book: Mathematics for Machine Technology Third edition
Robert D. Smith (Copyright 1990)

Text Book: Blueprint Reading Basics Third edition
Warren Hammer (Copyright 2001)

Machine Technology/Computer Aided Design
CIP Code 480501
Plastics Technology
Grade 11
Northern Berkshire Vocational Regional School District
McCann Technical School
70 Hodges Cross Road
North Adams, MA 01247

Gary Wood
Instructor

Tom Matuszak
Instructor

Scott Botto
Instructor

Thomas Tinney
CAD Instructor

Course Philosophy

The World has become one small business environment with the advancement of technology, and over seas competitors are aggressively targeting the United States of America. The plastics industry is just one of many areas that foreign imports have had a devastating impact on the work force and economy in this country. America now has companies that have invested in equipment and man-power and are competitive once again. The plastics industry is looking for an increase in skilled workers, but the availability of these talented men and women is at an all time low and is part of a national technology crisis. To be competitive in the global economy the United States of America must train workers for the ever changing and highly technical plastics trade. Students in the eleventh grade at McCann Technical School are immersed in the basics of the plastics technology trade. Students are introduced to manufacturing processes through the use of common and untraditional tool making machinery. Students operate untraditional machines such as Computer Numerical Control (CNC), Electrical Discharge Machine (EDM), Computer Assisted Design and Machine CAD/CAM software and Injection Molding press. Students will learn about the manufacturing of Injection molding through a team orientated standard based curriculum that is aligned to National Institute of Metalworking Skills (NIMS) standards and the Massachusetts Curriculum Frameworks. While this course meets the standards identified in the Massachusetts Curriculum

Frameworks, the main goal of the Plastics Technology course is to introduce students to a team philosophy used in the industry. Machine Technology students and CAD department students are teamed to safely create a mold that they will process in the molding lab

Course Description

The Plastic Technology course is developed based on a team philosophy where student work cooperatively in the creation of a mold. From brainstorming to design then manufacturing students process their concepts into real products. Molds are created on traditional and untraditional machinery.

This course includes the following concepts:

1. Safe usage of machine tools.
2. Collaboration of shops in conceptual development of a product.
3. Designing a product on CAD.
4. Program CNC machines using a CAM process.
5. Creation of electrodes for EDM
6. Assemble and processing of the molds in an injection molding machine

Safety is among the student's first priority in Plastics Technology. All students are safety tested on the molding machines. Students apply the rules of safety in the shop and school as written in the student's handbook.

Students learn basic CNC machining concepts and capabilities. Based on this knowledge and understanding, students build fully functional molds.

Students learn to operate industrial grade molding machines. Based on this knowledge students assemble, set-up and process their molds.

Students are introduced to the mold building and processing in theory classes to eliminate errors and costly mistakes.

Course Syllabus

The Plastic Technology curriculum was developed by the Machine Technology Shop and CAD instructors at McCann Technical School for the eleventh grade class. The curriculum was approved by an advisory committee representing local industry, parents, cad and machine technology instructors. Using Massachusetts VTE standards, the instructors developed team-based learning experiences that:

- Actively engages students in creating an innovative project using traditional and untraditional machining tools, general mathematics and problem solving techniques.
- Provide opportunities to work individually and in teams where communication, both verbal and written, is an intrinsic part of the learning process.
- Allows students to realize each person's abilities in expediting a project. Working at their own pace allows students to adapt to the working environment in a non-stressful method.

The Plastic Technology Curriculum was developed based on the following important concepts:

- Safety is the top priority.
- There is no prior knowledge of mold making.
- Traditional tools are used to create a product that a team of students create using their own ingenuity.

The main goal of this program is to develop the ability to work as a team members to create one product.

COURSE ASSESSMENT PLAN

The Plastic Technology students at McCann Technical School are graded by the rules of the two shops integrated for the curriculum. Plastics grades are included to the theory grade for their shop. Final exams for Plastic Technology are administered and are averaged into the students main shop grade

GRADING SYSTEM:
"Report cards are issued quarterly and serve as a guideline for students and their parents to measure achievement. Progress reports are issued once a quarter so students can have adequate time for remediation. Parents are encouraged to contact teachers and counselors to ensure a continuing participation in student progress. Courses are graded numerically in accordance with the following values." (2010-2011 McCann Student Handbook)

TIMELINE FOR PROGRAM ACTIVITIES

- Plastic Technology: Grade 11
  - Third Quarter (Theory)
    - Safety- Personal and Shop
    - History of mold making
    - Mold Components
    - 2 plate mold frame identification
    - Ideas are designed in CAD
    - Toolpaths are created in Machine Technology

  - Fourth Quarter (Theory)
    - Machine Shop cuts cavity and core
    - Ejection Pin calculation
    - Molding Machine safety and operation
    - Molding of plastic components

Standards

Massachusetts Manufacturing, Engineering and Technology: Machine Tool Technology Curriculum Framework

Learning Standards for Plastic Technology Course: Grade 11 (2010-2011)

2.B.02c Use the design process to identify, problem solve and evaluate a solution
2.B.03c Read and interpret detail blue prints or technical processes
2.D.01c Identify appropriate person(s) for maintenance and repair of equipment
2.D.02c Monitor equipment indicators to insure that equipment is operating correctly
2.D.02c Monitor equipment indicators to insure that equipment is operating correctly
2.E.01c Identify customer needs
2.E.02c Identify resources needed (supplies, personnel, equipment)
2.E.03c Identify and create/provide needed standard operational procedures (SOPs)
2.E.04c Monitor process using process control data
2.E.05c Explain inventory control and the implications to production and performance
2.E.06c Test or inspect a product to verify that it meets customer specifications and regulations
2.E.07c Demonstrate process used to document and ensure compliance
2.F.01c Define attributes, units, and systems of measurement used in MET fields
2.F.02c Apply a variety of techniques, tools, and formulas for determining measurements
2.F.05c Use measurement systems to solve problems
2.G.03 Measure work piece with an inside micrometer within a tolerance of +/- .001
2.G.04 Measure the depth of a work piece using a depth micrometer within a tolerance of +/- .001
2.G.05 Measure work piece with a vernier caliper within a tolerance of at least +/- .005
2.H.03 Compare surface finish quality of a part using surface finish comparator/gage to print specification
2.H.04 Follow inspection procedures to accurately measure a finished part
2.H.05 Follow procedures to measure inside diameter using a telescope gage and micrometer to a tolerance of at least +/- .005
2.H.06 Use a height gage and indicator on a surface plate to measure dimension and/or location on a work piece
2.H.09 Check concentricity of finished part to a tolerance of at least +/- .001
2.H.10 Check straightness of a part to appropriate tolerance
2.J.04 Deburr work piece
2.J.05 Finish work piece as required
2.J.06 Disassemble and assemble mechanical/machine parts
2.M.01 Read and interpret detail drawings
2.M.02 Read and interpret assembly drawings
2.M.03 Make a sketch of an existing work piece including detailed measurements to be machined
2.M.04 Design and sketch a basic work piece based on ‘customer’ needs
2.N.01 Select proper materials
2.N.02 Determine size and amount of material needed to complete product(s)
2.N.03 Develop an order of operations
2.N.04 List tools to be used
2.N.05 List fixturing or work holding device(s) to be used
2.N.06 Select appropriate machine tools
2.U.03 Face work piece to length specified on blue print within a tolerance of +/- 1/64
2.U.04 Straight turn and shoulder turn the work piece diameters to a tolerance of +/- .002 and length of +/- 1/64
2.V.01 Indicate vise within a tolerance of .002 over a 6” span
2.V.02 Tram miller head within a tolerance of .001 over a 6” diameter sweep
2.V.03 Locate a datum feature using indicator and edge finder
2.V.04 Locate and indicate holes and pins within a tolerance of .0005
2.V.05 Mill a flat surface

1.B.03a Identify, describe and demonstrate personal, shop and job site safety practices and procedures
1.B.04a Demonstrate safe dress and use of relevant safety gear and personal protective equipment (PPE), including wrist rests, adjustable workspaces and equipment, gloves, boots, earplugs, eye protection, and breathing apparatus
1.B.05a Illustrate appropriate safe body mechanics, including proper lifting techniques and ergonomics
1.B.06a Locate emergency equipment in your lab, shop, and classroom, including (where appropriate) eyewash stations, shower facilities, sinks, fire extinguishers, fire blankets, telephone, master power switches, and emergency exits
1.B.07a Demonstrate the safe use, storage, and maintenance of every piece of equipment in the lab, shop, and classroom
1.B.08a Describe safety practices and procedures to be followed when working with and around electricity
1.B.09a Illustrate proper handling and storage practices, including working with hazardous materials, disposal, and recycling
1.B.10a Demonstrate proper workspace cleaning procedures
1.B.11c Discuss the relationship between health, safety and productivity
1.C.04a Identify practices used to avoid accidents
4.B.01a Apply strategies to enhance effectiveness of all types of communications in the workplace
4.B.02a Apply reading skills and strategies to work-related documents
4.B.03a Locate information from books, journals, magazines, and the Internet
4.B.04a Apply basic writing skills to work-related communication
4.B.05a Write work-related materials
4.B.08a Apply basic skills for work-related oral communication
4.B.12a Apply active listening skills to obtain and clarify information
4.B.13a Communicate with others in a diverse workforce
4.C.01a Demonstrate skills used to define and analyze a given problem
4.C.02a Explain the importance and dynamics of individual and teamwork approaches of problem solving
4.C.03a Describe methods of researching and validating reliable information relevant to the problem
4.C.04a Explain strategies used to formulate ideas, proposals and solutions to problems
4.C.05a Select potential solutions based on reasoned criteria
4.C.06a Implement and evaluate solution(s)
4.A.08a Demonstrate employability skills needed to get and keep a job
4.D.01a Identify time management and task prioritization skills
4.D.02a Explain the importance of following workplace etiquette/protocol
4.D.03a Demonstrate willingness to learn and further develop skills

Strand 3 A,B,C: Embedded Academics

Read technical manuals, guides, resource books and technical literature to gain information and solve problems.
Read, comprehend, and follow written technical directions for repairs, procedures and processes.
Use a ruler, protractor, and compass to draw polygons and circles.
Given the formulas, convert from one system of measurement to another. Use technology as appropriate.
Solve linear equations using tables, graphs, models, and algebraic methods.
Given the formulas, convert from one system of measurement to another. Use technology as appropriate.
Compare, order, estimate, and translate among integers, fractions and mixed numbers (i.e., rational numbers), decimals, and percents.
Recognize and solve problems involving angles formed by transversals of coplanar lines. Identify and determine the measure of central and inscribed angles and their associated minor and major arcs. Recognize and solve problems associated with radii, chords, and arcs within or on the same circle.
Apply properties of angles, parallel lines, arcs, radii, chords, tangents, and secants to solve problems.
Calculate perimeter, circumference, and area of common geometric figures such as parallelograms, trapezoids, circles, and triangles.
Demonstrate knowledge of pictorial and multi-view drawings (e.g., orthographic projection, isometric, oblique, perspective) using proper techniques.
Interpret plans, diagrams, and working drawings in the construction of a prototype.
Differentiate the selection of tools and procedures used in the safe production of products in the manufacturing process, e.g., hand tools, power tools, computer-aided manufacturing, three-dimensional modeling.
Explain how mechanical systems such as gears, pulleys, levers, and presses work

Instructional Activities

The Plastic Technology course was designed to provide students a real world learning opportunities and laboratory-based experiences in the development of content knowledge. This program allows the student the opportunity to explore their creative side while working with other students. Students will learn to brainstorm and use effective strategies to get their ideas across to other students. The team approach as used in industry will be the platform for all product creation. Students will first be instructed to team up and create a product to build. They will use all prior knowledge of their shops to build these products. Reverse engineering of existing tools will and the use of Untraditional tools will need to be mastered.

Product Concept

Students work together to brainstorm ideas of a project to build. This project must meet constraints set by the instructor. Students create and submit hand drawn sketches of ideas for instructor's approval.

Design Process

Students use their sketches to design a product in CAD on software call Solid Works. Student use the 3 dimensional printing machine and software to create a prototype. Students then transfer the design data to the machine shop via the intranet.

Reverse Engineering

CAD and Machine Technology students disassemble the existing mold to inspect and document relevant information. Students use this information to reverse engineer cores and cavities that will be used in the creation of their molds. CAD students take the information and design the frame, cores and cavities on Solid Works. Machine Technology students create the cores and cavities on traditional and nontraditional machinery according to the cad drawings

Mold Processing

Students from CAD and Machine Technology assemble all molding components and install their molds in the injection molding machine. Students manually cycle their molds till it meets the proper criteria. Then the mold is put into production in fully automatic mode to make a multitude of parts.

Plastics Theory
Students will be introduced to mold components and processes that are common to the plastics industry. Injection, extrusion, blow molding and vacuum forming processes are introduced through theory books and demonstrations. Field trips to G.E. Plastics and Almega Tool or any one of the forty mold shops in the area give our students real life experiences. Plastics science will introduce students to the difference between thermoplastic and thermoset materials. Amorphous and crystalline materials are covered when students learn about recycling materials.

Resources

Standards and textbook resources:

What is a Mold (Tech Mold Inc)

Machine Technology
Grade 12

Northern Berkshire Vocational Regional School District
Charles H. McCann Technical School
70 Hodges Cross Road
North Adams, MA 01247

Scott Botto
Machine Technology Instructor

Thomas Matuszak
Machine Technology Instructor

Gary Wood
Machine Technology Instructor

COURSE PHILOSOPHY

The Machine Technology Department's philosophy at McCann Technical School is to provide and educate students in as many aspects of the machine trade as possible and to provide them the opportunities to become skilled, successful citizens of the global community. The instructors are committed in providing a safe, industry-standard learning environment that promotes commitment, teamwork, communication skills, strong work ethic and responsibility. Students are encouraged to pursue work in a related field, continuous education and industry related training upon successful graduation from the department. During the senior year SkillsUSA competitions and championships reward students for excellence and keep training relevant to employers' needs. The main focus of this year is the Senior Project. It provides a senior experience that actively engages students in reflective exploration of self and to help students to make a smooth transition from high school to their post high school experience. The goal of this program is not only to produce skilled CNC operators, programmers and precision machinists, but to give students the ability to adapt their talents to the ever-changing technologies in the manufacturing world.

Grade 12 Course Syllabus

COURSE DESCRIPTION:

The Senior Project is an activity and assessment for all graduating seniors. It is a culminating exit program which demonstrates a senior's ability to write, speak, apply knowledge, problem solve, and use the skills of time management, organization and risk taking. Seniors use a multitude of resources as they work through the four phases of the program (the proposal, the paper, the project and the presentation).

. The purpose of this senior project is twofold:

- To enable students to demonstrate that they are able to apply, analyze, create and evaluate information

- To provide students a vehicle for communicating knowledge and understanding

The mission of this senior project is twofold:

- To provide a senior experience that actively engages students in reflective exploration of self
- To provide a senior experience that helps students to make a smooth transition from high school to their post high school experience.

COURSE ASSESSMENT PLAN

Students are assessed in a variety of ways. Each student is assessed on attendance and participation on a daily basis. There is also a weekly assessment based on quantity of work, quality of work, effort and problem solving ability. (Please see grading criteria). The Senior Project product is graded for its adherence to the product guidelines as well as for the quality of workmanship. The paper is graded by an English instructor for format and the technical instructor for content The math/science portion of the paper is graded by a member of the Math/Science department. The presentation is evaluated on content, delivery and the demonstration of theory knowledge. The final senior project grade will be added in as a fifth quarter grade and will count for twenty percent of the theory grade for the year. AJI assessments are based on the grading system guidelines as published in the student/parent handbook.

Report cards are issued quarterly and serve as a guideline for students and parents to measure achievement. Parents are encouraged to contact instructors to ensure a continuing participation in student progress. Progress reports are issued three times a year in the middle of each quarter to provide students and parents a timely update on progress and achievement.

For the Machine Technology students at Charles H. McCann Technical School the following assessment plan will be followed:

GRADING SYSTEM:

Report cards are issued quarterly and serve as a guideline for students and their parents to measure achievement Parents are encouraged to contact teachers and counselors to ensure a continuing participation in student progress. Courses are graded numerically in accordance with the following values" (McCann Student Handbook)

	Satisfactory
	Passing
	Failing
	Incomplete (make-up required)
	Excused
	Below standard (no credit)

MACHINE TECHNOGY GRADE 12 GRADING POLICY

Weekly Performance:

75% Competency and Performance
- 25% Quantity of Work
- 25% Quality of Work
- 25% Effort and Perseverance
- 25% Problem Solving Ability

10% Attendance and Participation

15% SkillsUSA project

FINAL SENIOR PROJECT GRADE

The final senior project grade is considered a fifth quarter shop grade and will count for twenty percent of the theory grade for the year. The product, paper and presentation will be equally grade as 33 1/3% of the fifth quarter grade.

TIMELINE FOR PROGRAM ACTIVITIES

Machine Technology Grade 12

- First Quarter
  - Introduction to Senior Project
    - Two or three project topics are researched and chosen
    - Topics are reviewed by shop instructors
    - Product process outline reviewed and approved by instructor
    - Approved project production may begin
      Teaching and mentoring of exploratory students

- Second Quarter
  - Senior project production
  - SkillsUSA Competition
- Third Quarter
  - Senior project production
  - Presentation preparation
  - EDM process, setup and operation (if senior project is completed)
  - NIMS standards testing (if senior project is completed)
- Fourth Quarter
  - Senior project production
  - Presentations reviewed
  - Paper graded for technical quality
  - Presentations
  - 4^{th} and 5^{th} axis Mastercam design and tool path creation (if senior project is completed)
  - NIMS standards testing (if senior project is completed)

Standards

Massachusetts Vocational Technical Education Curriculum Framework
Manufacturing, Engineering and Technology
Machine Tool Technology (Draft – August 2007)
NIMS (National Institute of Metalworking Skills)
McCann Technical School Senior Project Handbook

Course Curriculum Topic
Senior Project
Standard
The standards will vary depending on the project chosen by the student. They are based on Strand 2 of the Massachusetts Vocational Technical Education Curriculum Framework Manufacturing, Engineering and Technology
Machine Tool Technology (Draft - August 2007)

EDM (Electrical Discharge Machining)	3.A.02c Apply steps for obtaining information from a variety of sources, organizing information, documenting sources, and presenting research in individual projects: 3 .A.06c For informational/expository writing: Write well-organized research papers that prove a thesis statement using logical organization, effective supporting evidence, and variety in sentence structure. 3.A.08c Deliver formal presentations for particular audiences using clear enunciation and appropriate organization, gestures, tone, and vocabulary. 4.B.03a Locate information from books, journals, magazines, and the Internet 4.B. 06a Explain information presented graphically

	4.B.07a Use writing, publishing, presentation applications 6. C 0 1 a Locate, evaluate, collect, and process information from a variety of electronic sources

Mastercam 4th and 5th axis	2.0.01 Describe the uses and operations of electrical discharge machines (wire and electrode) Nllv1S Level 11 Job 2.19 2.W.II Design a part using computer aided design (CAD) software 2.W.12 Use computer aided manufacturing *(CAM)* software to apply machining processes to design (ex. Speeds, feeds, cutter compensation, etc) 2.W.13 Post and transfer files to CNC machine 2.W.14 Receive transferred files at CNC machine
Teaching and Mentoring	4.B.08a Apply basic skills for work-related oral communication 4.D.10a Value the importance of professionalism, including reliability, honesty, responsibility, and ethics

Strand 1: Health and Safety

1.8 Demonstrate health and safety practices:

1.8.01a Identify, describe and demonstrate the effective use of Material Safety Data Sheets (MSDS)

1.B.02a Read chemical, product, and equipment labels to determine appropriate health and safety considerations

1.8.03a Identify, describe and demonstrate personal, shop and job site safety practices and procedures

1. B.04a Demonstrate safe dress and use of relevant safety gear and personal protective equipment (PPE), including wrist rests, adjustable workspaces and equipment, *gloves,* boots, earplugs, eye protection, and breathing apparatus

1. B.05a Illustrate appropriate safe body mechanics, including proper lifting techniques and ergonomics

1.B.06a Locate emergency equipment in your lab, shop, and classroom, including (where appropriate) eyewash stations, shower facilities, sinks, fire extinguishers, fire blankets, telephone, master power switches, and emergency exits

1.B.07a Demonstrate the safe use, storage, and maintenance of every piece of equipment in the lab, shop, and classroom

1.B.09a Illustrate proper handling and storage practices, including working with hazardous materials, disposal, and recyciing

1. B.1 Oa Demonstrate proper workspace cleaning procedures

1.C Demonstrate responses to situations that threaten health and safety

'1.C.04a Identify practices used to avoid accidents

1.C.05a Identify and describe fire protection, precautions and response procedures

1.C.06a Discuss the role of the individual and tile company/organization in ensuring workplace safety

Strand 2: Technical

2.A Apply principles of 'world class' operations (industry quality standard operation)
2.A.01c Explain lean techniques as applied to manufacturing/engineering and technical processes
2.A.02c Identify and apply the concepts of total quality management appropriate to the field
2.A.03c Develop, implement and assess plan for continuous improvement

2.8 Demonstrate and apply the design process
2.B.01c List the attributes of design in a variety of technical fields (biotechnology, manufacturing, environmental, power and energy, transportation, etc)
2.B.02c Use the design process to identify, problem solve and evaluate a solution
2.B.03c Read and interpret detail blue prints or technical processes

2.C Problem solving/Diagnostic skills/Troubleshooting
2.C.0'lc Identify the components and process of the system(equipment)
2.C.02c Identify the problem or source of the problem
2.C.03c Develop solutions using a structured problem solving process
2.C.04c Use appropriate testing equipment and tools for diagnosing the problem
2.C.05c Implement tile correct strategies to remedy the problem

2.0 Maintain equipment and machinery
2. D.01 c Identify appropriate person(s) for maintenance and repair of equipment
2.D.02c Monitor equipment indicators to insure that equipment is operating correctly
2.D.03c Demonstrate ability to maintain equipment

2.E Demonstrate and apply the manufacturing process
2.E.02c Identify resources needed (supplies, personnel, equipment)
2.E.03c Identify and create/provide needed standard operational procedures (SOPs)
2.E.06c Test or inspect a product to verify that it meets customer specifications and regulations
2.E.07c Demonstrate process used to document and ensure compliance

2.F Use of measurement devices
2.F.0'lc Define attributes, units, and systems of measurement used in MET fields
2.F.02c Apply a variety of techniques, tools, and formulas for determining measurements
2.F.03c Identify appropriate electronic device/gauge for the task at hand
2.F.04c Calibrate and use electronic devices and/or gauges accurately
2.F.05c Use measurement systems to solve problems

2.G Use a precision instrument to accurately measure a finished part
2.G.01 Measure work piece with a scale within a tolerance of +/- 1/64
2.G.02 Measure work piece with an outside micrometer within a tolerance of +/- .001
2.G.03 Measure work piece with an inside micrometer within a tolerance of +/- .001
2.G.04 Measure the depth of a work piece using a depth micrometer within a tolerance of *+i- .001*
2.G.05 Measure work piece with a veneer caliper within a tolerance of at least +/- .005
2.G.06 Measure radius on a work piece using a radius gage within a tolerance of at least +/- 1/32

2.G.07 Use a hardness tester to determine the surface hardness of a finished part to a standard hardness scale

2.G.08 Use a protractor to measure the angle(s)

2.G.09 Describe applications of current inspection technology (e.g. CMM and shadow graphs)

Instructional Activities

The grade 12 Senior Project was designed to provide students with a project-based learning opportunity and a laboratory-based experience that reflects the background, history, development, explanation and application of technical content knowledge. The three areas of focus are the product, paper and final presentation. The product is an authentic and original project that is chosen by the student that substantially reflects the tasks and skills that make up the Machine Technology curriculum. The research paper, which is a minimum of eight pages in length, uses the lVILA style format. The presentation will be developed with instructors as an informative, well organized 10-25 minute PowerPoint production that covers the highlights of the project and the research paper. Students are encouraged to use as many types of presentation media as possible.

Students may also cam national certification through NIMS standards and testing.

Mastercam 4th and 5th axis design and toolpaths

Students design a three dimensional wireframe drawing of a cylinder and unwrapped geometry of four holes and numbers. Once complete, a rotary 4th axis milling and drilling toolpath will be created. The student will verify the program using Mastercarn Verify. These projects will be given after the completion of the Senior Project

1\TTI-AS EDM Certification

Students who pass the timed l'ilMS EDM performance exam may take the online theory assessment Successful students will earn NllvlS Level Two National EDM certification This assessment may be taken after the completion of the Senior Project.

SkillsUSA Competition

Students may compete in three occupational related competitions during term two.

CNC Milling and Programming is an individual contest which involves manual programming and CNC mill setup and operation. The problem is based on National SkillsUSA standards.

Automated Manufacturing Technology is a team competition. Teams are comprised of one CAD student and two Machine Technology students. The competition is based on National SkillsUSA and NlMS standards. Teams produce a prototype part design, solid part model, CNC toolpath and actual part creation with the use of computer software and bench top CNC machines. A design change is given to the teams once the initial prototype has been completed to test their problem solving skills.

Precision Machiningis an individual contest which involves manual machining with the use of lathes and milling machines. The contest is based on NIMS and SkillsUSA standards.