Maryland
STATE DEPARTMENT OF EDUCATION

Program of Study Guide: Machining Technology - DRAFT

Comprehensive guidelines and course standards for the Engineering pathway

Office of College and Career Readiness

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MARYLAND STATE DEPARTMENT OF EDUCATION

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1.0	October 2024	Initial Document
1.1	January 2025	Standards Reviewed by OCCP Leadership. Course descriptions reviewed and shortened. LMI data verified and updated. IRC selections reviewed and confirmed.

Purpose

The purpose of this document is to communicate the required Career and Technical Education (CTE) academic standards for the Machining Technology Program of Study. The academic standards in this document are theoretical and performance based. The standards contain content from multiple state departments of education, the College Board, and the NIMS Machining Standards and have been reviewed and vetted by members of the Maryland business and industry community.

In addition to academic standards, the Maryland State Department of Education (MSDE) has incorporated into this document Labor Market Information (LMI) definitions and explanations for the Program of Study; program aligned Industry Recognized Credentials; and Work-Based Learning resources and requirements by course level. This document is intended for use by educational administrators and practitioners. A similar document is available for each state-approved CTE Program of Study.

Standards Sources

These sources collectively guide the standards for Machining Technology I-IV Course Standards, ensuring alignment with national education frameworks, industry-recognized certifications, and security standards essential for developing a skilled cybersecurity workforce.

1. **NIMS Standards for Machining and General Manufacturing**
   A. **Source:** NIMS
   B. **Purpose:** The NIMS Standards for Machining and General Manufacturing provide a framework to provide students with the necessary skills for creating precision components by removing material using a Computer Numerical Control (CNC) and manual machine tools to perform processes such as milling, turning, grinding, sawing, and Electrical Discharge Machining (EDM). This framework also includes information on skills needed for performing value-added processes on parts, components, or materials using equipment and/or hand tools.
   C. **Relevance:** The NIMS Standards for Machining and General Manufacturing provide a comprehensive examination of skills needed for students to graduate high school and successfully transition into an industry role in the machining and manufacturing sector. The skills range from basic precision measurement to fabrication and quality control.
   D. **Access:** NIM Standards for Machining and General Manufacturing: NIMS Standards

2. **NIMS Credentialing**
   A. **Source:** NIMS
   B. **Purpose:** NIMS credentialing programs provides certifications in a variety of areas within the metalworking industry, ensuring that students possess the required skills and knowledge for specific task or machinery. Some of the main certification areas include: CNC Machining, Manual Machining, Welding, Metrology, Toolmaking, Production Management, and Quality Control. The NIMS Standards outline specific skill sets that workers must demonstrate to meet certification requirements. These skills are organized by areas such as: Machine Setup and Operation, Blueprint Reading and Interpretation, Measurement and Inspection, Tooling and Equipment Maintenance, Manufacturing Processes (e.g., milling, turning, grinding), and Material Science.
   C. **Relevance:** NIMS credentials are earned by students, trainees, apprentices, employees, and military personnel nationwide and worldwide. By earning NIMS credentials, these individuals secure a competitive edge when applying for jobs because they have demonstrated that their skills meet industry-established standards.
   D. **Access:** NIMS Credentialing: NIMS Credentialing

3. **National Career Cluster Framework – Advanced Manufacturing Cluster**
   A. **Source:** Advance CTE
   B. **Purpose:** The National Career Cluster Framework provides a structure for organizing career and technical education (CTE) around 14 clusters, including Advanced Manufacturing, to promote skill development for specific industry sectors.
   C. **Relevance:** The Advanced Manufacturing Career Cluster blends innovative technologies and practices to enhance design and production. It covers areas such as engineering, research and development, automation and artificial intelligence, equipment maintenance, safety protocols, and quality control. This Cluster aims to increase efficiency, reduce waste, ensure safety, and produce high-quality goods, driving the industry's growth and adapting to modern demands.
   D. **Access:** Advance CTE Career Clusters: https://careertech.org/career-clusters

Course Descriptions

Cybersecurity is the art of protecting networks, devices, and data from unauthorized access or criminal use and the practice of ensuring confidentiality, integrity, and availability of information. Information security analysts plan and carry out security measures to protect an organization's computer networks and systems.

Cybersecurity & Infrastructure Security Agency

Course Level	Course Information	Description
Required Core: Course 1	**Machining Technology I** SCED: <XX> Grades: 9-12 Prerequisite: None Credit: 1	Machining Technology I prepares students for the NIMS certification in Measurement, Materials, and Safety. The course covers machining industry fundamentals, including safety, precision measurement, milling, and grinding. Students participate in lectures and hands-on lab projects, applying knowledge to real-world scenarios to develop technical skills and industry understanding.
Required Core: Course 2	**Machining Technology II** SCED: <XX> Grades: 10-12 Prerequisite: Machining Technology I Credit: 1	Machining Technology II builds on Machining Technology I, preparing students for the NIMS certification in Job Planning, Benchwork, and Layout. The course combines lectures, discussions, and lab activities, where students apply knowledge to hands-on projects using industrial tools. Team-based, real-world scenarios enhance technical skills and understanding of machining industry standards.
Optional Flex: Course 1	**Machining Technology III** SCED: <XX> Grades: 11-12 Prerequisite: Machining Technology I & II Credit: 1	Machining Technology III prepares students for two NIMS Machining Level I credentials, selected by schools from options such as Manual Milling, Turning, Grinding, and Drilling. Building on prior courses, students develop skills in process planning, machine setup, and operation. They collaborate on projects, apply quality assurance practices, follow safety protocols, and interpret orthographic prints and job process sheets. When available, ToolingU is used to supplement instruction.

Course Level	Course Information	Description
Optional Flex: Course 2	**Career Connected Learning I** SCED: <XX> Grades: 11-12 Prerequisite: Machining Technology I and II Credit: 1	This flexible, work-based learning course introduces students to real-world applications of classroom knowledge and technical skills through on-the-job experiences and reflective practice. Students engage in career exploration, skill development, and professional networking by participating in youth apprenticeships, registered apprenticeships, pre-apprenticeships, internships, capstone projects, or other approved career-connected opportunities. Variable credit (1–3) accommodates the required on-the-job training hours and related instruction. By integrating industry standards, employability skills, and personalized learning goals, Career Connected Learning I equips students to make informed career decisions, develop a professional portfolio, and build a strong foundation for success in postsecondary education, training, or the workforce.
Optional Flex: Course 3	**Career Connected Learning II** SCED: <XX> Grades: 11-12 Prerequisite: Career Connected Learning I Credit: 1	Building on the foundational experiences of Career Connected Learning I, this advanced work-based learning course provides students with deeper on-the-job practice, leadership opportunities, and refined career exploration. Students continue to enhance their technical and professional skills, expanding their industry networks and aligning personal goals with evolving career interests. Variable credit (1–3) remains aligned with the required training hours and related instruction. Through elevated responsibilities and skill application, Career Connected Learning II prepares students to confidently transition into higher-level postsecondary programs, apprenticeships, or the workforce.

Dual Enrollment and Career Connected Learning Experiences Must be Aligned to the CTE Core.

Industry-Recognized Credentials and Work-Based Learning

Industry-Recognized Credentials
By the end of Machining Technology I: NIMS Measurement, Materials and Safety **By the end of Machining Technology II:** NIMS Job Planning, Benchwork and Layout **By the end of Machining Technology III:** NIMS Machining Level I (select two) NIMS Machining Level I - Manual Milling NIMS Machining Level I - Turning Operations Between Centers NIMS Machining Level I - Turning with Chucking NIMS Machining Level I - Grinding NIMS Machining Level I - Drill Press Operation

Work-based Learning Resources		
Engineering I: **Career Awareness**	**Engineering II:** **Career Preparation**	**Flex Courses:** **Career Preparation**
• Industry Visits • Guest Speakers • Participation in Career and Technical Student Organizations • Postsecondary Visits – Program Specific Site Tours • Mock Interviews	• All of Career Awareness plus the following: • Job Shadow • Paid and Unpaid Internships	• Paid and Unpaid Internships • Apprenticeships

Labor Market Information: Definitions and Data

Labor market information (LMI) plays a crucial role in shaping Career and Technical Education (CTE) programs by providing insights into industry demands, employment trends, and skills gaps. This data helps education leaders assess the viability of existing programs and identify opportunities for new offerings. By aligning CTE programs with real-time labor market needs, schools can better prepare students for in-demand careers and ensure that resources are effectively utilized to support pathways that lead to high-quality, sustainable employment.

Standard Occupational Code (SOC) and Aligned Industry:

Indicator	Definition	Pathway Labor Market Data
High Wage[1]	Those occupations that have a 25th percentile wage equal to or greater than the most recent MIT Living Wage Index for one adult in the state of Maryland, and/or leads to a position that pays at least the median hourly or annual wage for the DC-VA-MD-WV Metropolitan Statistical Area (MSA). *Note: A 25th percentile hourly wage of $24.74 or greater is required to meet this definition.*	**Standard Occupational Classification (SOC) Code** 51-4041: Machinists **Hourly Wage/Annual Salary:** 25th Percentile: $22.81 / $47,444.80 50th Percentile: $27.40 / $56,995.00 75th Percentile: $34.13 / $70,982.00
High Skill	Those occupations located within the DC-VA-MD-WV MSA with the following education or training requirements: completion of an apprenticeship program; completion of an industry-recognized certification or credential; associate's degree, or higher.	**Typical Entry-Level Education:** High School Diploma with Postsecondary Credential
In-Demand	These are jobs projected to have increased employment opportunities over time, typically measured through labor market data.	**Annual Openings:** 217

[1] Living Wage Calculator: https://livingwage.mit.edu/states/24

Course Standards: Machining Technology I

1. **General requirements.** This course is recommended for students in Grades 9-12. Students shall be awarded one credit for successfully completing this course.

2. **Introduction.**
   A. Career and technical education instruction provides content aligned with challenging academic standards and relevant technical knowledge and skills for students to further their education and succeed in current or emerging professions.
   B. The Advanced Manufacturing Career Cluster focuses on preparing students for entry-level, technical, and professional careers in various engineering and manufacturing fields.
   C. The Machining Technology Career and Technical Education (CTE) Program of Study prepares students for a beginning career in manufacturing and machine technologies and aligns to the National Institute of Metalworking Skills (NIMS) Machining Level I Credentials. Students will progress through a program that includes hands-on education in precision machining while developing competency in process control, manual operations, process adjustment, part inspection as well as demonstrate usage of machine safety.
   D. Machining Technology I prepares students for the NIMS certification in Measurement, Materials, and Safety. The course covers machining industry fundamentals, including safety, precision measurement, milling, and grinding. Students participate in lectures and hands-on lab projects, applying knowledge to real-world scenarios to develop technical skills and industry understanding.
   E. Students will participate in at least two Career-Connected Education and Work-Based Learning experiences in this course, which might include informational interviews or job shadowing relevant to the program of study.
   F. Students are encouraged to participate in extended learning experiences through aligned Career and Technical Student Organizations (CTSOs). CTSOs are a cocurricular requirement in the Carl D. Perkins Act, and alignment to CTSO activities is an expectation for CTE programs in the state of Maryland.

3. **Knowledge and Skills.**
   A. **The student demonstrates the necessary skills for career development, maintenance of employability, and successful completion of course outcomes. The student is expected to:**
      1. Identify and demonstrate positive work behaviors that enhance employability and job advancement, such as regular attendance, promptness, proper attire, maintenance of a clean and safe work environment, and pride in work.
      2. Demonstrate positive personal qualities such as flexibility, open-mindedness, initiative, active listening, and a willingness to learn.
      3. Employ effective reading, writing, and technical documentation skills in the context of machining processes and procedures.
      4. Solve machining-related problems using critical thinking techniques and structured troubleshooting methodologies.
      5. Demonstrate leadership skills and collaborate effectively as a team member during lab activities and projects.
      6. Implement safety procedures in all aspects of machining, including the proper handling of machinery, tools, and materials, while adhering to industry safety guidelines.
      7. Exhibit an understanding of legal and ethical responsibilities in the machining industry, following relevant laws, standards, and best practices.

8. Demonstrate time-management skills and the ability to prioritize tasks in a technical manufacturing environment.

B. **The student identifies various career pathways in the machining and manufacturing field. The student is expected to:**
   1. Develop a career plan that includes the necessary education, certifications, job skills, and experience for specific roles in machining and manufacturing.
   2. Create a professional resume and portfolio that reflects machining skills, projects, certifications (e.g., NIMS certification), and recommendations.
   3. Demonstrate effective interview skills for roles in machining and manufacturing.

C. **The student develops technology and digital literacy skills. The student is expected to:**
   1. Use technology as a tool for research, organization, communication, and problem-solving within the machining industry.
   2. Use digital tools, including computers, mobile devices, and collaboration platforms, to access, manage, and create information related to machining projects.
   3. Demonstrate proficiency in using industry-standard technologies, including Computer-Aided Design (CAD), Computer-Aided Manufacturing (CAM), and other relevant machining software.
   4. Understand ethical and legal considerations for technology use, including principles of data protection and responsible technology use within the machining field.

D. **The student integrates core academic skills into machining practices. The student is expected to:**
   1. Demonstrate clear communication techniques, both written and verbal, consistent with industry standards, when reporting on machining tasks and outcomes.
   2. Apply mathematical concepts such as measurements, geometric dimensioning and tolerancing (GD&T), conversions, and calculations in machining processes.
   3. Use scientific principles such as material properties, thermodynamics, and machine dynamics to understand and troubleshoot machining tasks.

E. **The student demonstrates the necessary skills to understand and operate machining equipment in a safe and efficient manner. The student is expected to:**
   1. Identify and describe the functions of different machining equipment, including lathes, milling machines, grinders, and CNC machines.
   2. Perform basic machine setup, tool installation, and equipment calibration in line with industry standards.
   3. Demonstrate the ability to operate machine tools safely and efficiently, following manufacturer's guidelines and standard operating procedures.
   4. Perform regular maintenance and adjustments on machines, including cleaning, lubricating, and replacing worn parts.

F. **The student demonstrates the necessary skills to measure and inspect parts accurately. The student is expected to:**
   1. Understand and apply measurement techniques using precision instruments such as micrometers, calipers, height gauges, and coordinate measuring machines (CMM).
   2. Demonstrate proficiency in interpreting engineering drawings and blueprints to ensure part dimensions meet required specifications.

3. Apply standards of accuracy and precision in all measurement tasks, ensuring parts meet tolerances within industry standards.
4. Understand and implement quality control procedures for ensuring finished products meet the necessary specifications.

G. **The student demonstrates the necessary skills for material handling and preparation in machining. The student is expected to:**
   1. Identify and describe various types of materials used in machining, including metals, plastics, and composites.
   2. Demonstrate the ability to select appropriate materials for specific machining tasks based on material properties and project requirements.
   3. Properly prepare materials for machining, including cutting, shaping, and cleaning processes.
   4. Demonstrate knowledge of material safety data sheets (MSDS) and handling procedures to ensure safe usage and disposal of materials.

H. **The student demonstrates the necessary skills to complete projects and troubleshoot issues in a professional environment. The student is expected to:**
   1. Identify and troubleshoot common machining issues, including tool wear, misalignment, and dimensional inaccuracy, using systematic diagnostic methods.
   2. Document technical issues, troubleshooting steps, and solutions in line with industry documentation practices.
   3. Apply teamwork and collaboration skills in group exercises and projects, adhering to professional work practices.
   4. Apply customer service skills in machining-related scenarios, practicing professional communication and problem-solving techniques.

I. **The student demonstrates proficiency in preparing for the NIMS certification in Measurement, Materials, and Safety. The student is expected to:**
   1. Demonstrate knowledge of safety standards and protocols required for obtaining NIMS certification, including the safe use of machinery, tools, and equipment.
   2. Display competency in using precision measuring tools and understanding material properties as part of NIMS certification preparation.
   3. Understand and apply the principles of machining to prepare for the NIMS certification examination in measurement, materials, and safety.

Course Standards: Machining Technology II

1. **General requirements.** This course is recommended for students in Grades 10-12. Students shall be awarded one credit for successfully completing this course.

2. **Introduction.**
   A. Career and technical education instruction provides content aligned with challenging academic standards and relevant technical knowledge and skills for students to further their education and succeed in current or emerging professions.
   B. The Advanced Manufacturing Career Cluster focuses on preparing students for entry-level, technical, and professional careers in various engineering and manufacturing fields.
   C. The Machining Technology Career and Technical Education (CTE) Program of Study prepares students for a beginning career in manufacturing and machine technologies and aligns to the National Institute of Metalworking Skills (NIMS) Machining Level I Credentials. Students will progress through a program that includes hands-on education in precision machining while developing competency in process control, manual operations, process adjustment, part inspection as well as demonstrate usage of machine safety.
   D. Machining Technology II builds on Machining Technology I, preparing students for the NIMS certification in Job Planning, Benchwork, and Layout. The course combines lectures, discussions, and lab activities, where students apply knowledge to hands-on projects using industrial tools. Team-based, real-world scenarios enhance technical skills and understanding of machining industry standards.
   E. Students will participate in at least two Career-Connected Education and Work-Based Learning experiences in this course, which might include informational interviews or job shadowing relevant to the program of study.
   F. Students are encouraged to participate in extended learning experiences through aligned Career and Technical Student Organizations (CTSOs). CTSOs are a cocurricular requirement in the Carl D. Perkins Act, and alignment to CTSO activities is an expectation for CTE programs in the state of Maryland.

3. **Knowledge and Skills.**
   A. The student demonstrates the necessary skills for career development, maintenance of employability, and successful completion of course outcomes. The student is expected to:
      1. Identify positive work behaviors that enhance employability and job advancement, such as regular attendance, promptness, proper attire, maintenance of a clean and safe work environment, and pride in work.
      2. Demonstrate positive personal qualities such as flexibility, open-mindedness, initiative, active listening, and a willingness to learn, particularly in advanced machining tasks.
      3. Employ effective reading, writing, and technical documentation skills in creating job plans and layout drawings.
      4. Solve advanced machining-related problems using critical thinking techniques and structured troubleshooting methodologies, including planning for complex machining tasks.
      5. Demonstrate leadership skills and collaborate effectively as a team member during advanced lab activities and projects, taking on greater responsibility in team tasks.
      6. Implement advanced safety procedures in all aspects of machining, including the use of specialized tools, equipment, and materials in line with industry safety guidelines.
      7. Exhibit an understanding of legal and ethical responsibilities in the machining industry by following relevant laws, standards, and best practices for machining and design.
      8. Demonstrate time-management skills and the ability to prioritize tasks in a high-paced technical environment, especially in complex machining projects.

B. The student identifies various career pathways in the machining and manufacturing fields. The student is expected to:

1. Develop a career plan that includes the necessary education, certifications, job skills, and experience for specific roles in advanced machining and manufacturing.
2. Create a professional resume and portfolio that reflects advanced machining skills, projects, certifications (e.g., NIMS Job Planning, Benchwork and Layout), and recommendations.
3. Demonstrate effective interview skills for advanced roles in machining, manufacturing, and production planning.

C. The student develops technology and digital literacy skills. The student is expected to:

1. Demonstrate technology as a tool for research, organization, communication, and problem-solving in machining job planning and layout.
2. Demonstrate digital tools, including computers, mobile devices, and collaboration platforms, to access, manage, and create information related to advanced machining projects.
3. Demonstrate proficiency in using industry-standard technologies, including Computer-Aided Design (CAD), Computer-Aided Manufacturing (CAM), and specialized software for job planning and layout.
4. Understand ethical and legal considerations for technology use, including principles of data protection and responsible technology use in the machining field.

D. The student integrates core academic skills into machining practices. The student is expected to:

1. Demonstrate clear communication techniques, both written and verbal, consistent with industry standards, in reporting on advanced machining tasks and job plans.
2. Apply mathematical concepts such as trigonometry, geometry, and advanced measurement techniques in job planning, layout, and machining processes.
3. Describe scientific principles such as material properties, tool dynamics, and forces involved in machining to understand and troubleshoot advanced machining tasks.

E. The student demonstrates the necessary skills to understand and operate advanced machining equipment in a safe and efficient manner. The student is expected to:

1. Identify and describe the functions of advanced machining equipment, including CNC machines, surface grinders, and advanced milling and turning machines.
2. Perform advanced machine setup, tool installation, and equipment calibration in line with industry standards, including preparing machines for specific job plans and layouts.
3. Demonstrate the ability to operate advanced machine tools safely and efficiently by following manufacturer's guidelines and standard operating procedures for complex tasks.
4. Perform regular maintenance and adjustments on machines, including cleaning, lubricating, and replacing worn parts, with attention to precision and accuracy in setup.

F. The student demonstrates the necessary skills to measure, lay out, and inspect parts accurately. The student is expected to:

1. Understand and apply advanced measurement techniques using precision instruments such as micrometers, calipers, height gauges, and CMMs, especially in the context of job planning and layout.
2. Demonstrate proficiency in interpreting engineering drawings, blueprints, and technical specifications to ensure part dimensions meet required tolerances and specifications.
3. Apply principles of geometric dimensioning and tolerancing (GD&T) to ensure machining accuracy and consistency.

4. Understand and implement advanced quality control procedures for verifying parts meet necessary specifications and tolerances, including preparation for NIMS certification.

G. The student demonstrates the necessary skills for material handling and preparation in advanced machining. The student is expected to:

1. Identify and describe different types of materials used in advanced machining processes, including alloys, composites, and heat-treated materials.
2. Demonstrate the ability to select appropriate materials based on material properties, job planning needs, and machining processes.
3. Prepare materials for machining by carrying out tasks such as cutting, shaping, and cleaning, ensuring readiness for precise operations.
4. Demonstrate knowledge of material safety data sheets (MSDS) and material handling procedures, including safe usage, storage, and disposal of materials.

H. The student demonstrates the necessary skills to complete job planning, benchwork, and layout tasks. The student is expected to:

1. Develop and execute detailed job plans, outlining the steps, tools, and equipment required for machining tasks.
2. Perform benchwork tasks such as filing, sawing, drilling, and tapping with precision and accuracy, in preparation for machining operations.
3. Organize machining tasks on materials by accurately marking dimensions, locations, and angles to ensure processes proceed according to the job plan.
4. Apply appropriate machining strategies based on job requirements, machine capabilities, and available materials.

I. The student demonstrates proficiency in preparing for the NIMS certification in Job Planning, Benchwork, and Layout. The student is expected to:

1. Demonstrate knowledge of the job planning process, including preparation of specifications, material selection, tool requirements, and detailed operation instructions.
2. Demonstrate competency in performing precise benchwork tasks, such as accurate measurement, layout, and assembly, in preparation for NIMS certification.
3. Apply principles of job layout, including marking, drilling, and milling operations required to meet job specifications in the certification context.

Course Standards: Machining Technology III

1. **General requirements.** This course is recommended for students in Grades 11-12. Students shall be awarded one credit for successfully completing this course.

2. **Introduction.**
   A. Career and technical education instruction provides content aligned with challenging academic standards and relevant technical knowledge and skills for students to further their education and succeed in current or emerging professions.
   B. The Advanced Manufacturing Career Cluster focuses on preparing students for entry-level, technical, and professional careers in various engineering and manufacturing fields.
   C. The Machining Technology Career and Technical Education (CTE) Program of Study prepares students for a beginning career in manufacturing and machine technologies and aligns to the National Institute of Metalworking Skills (NIMS) Machining Level I Credentials. Students will progress through a program that includes hands-on education in precision machining while developing competency in process control, manual operations, process adjustment, part inspection as well as demonstrate usage of machine safety.
   D. Machining Technology III prepares students for two NIMS Machining Level I credentials, selected by schools from options such as Manual Milling, Turning, Grinding, and Drilling. Building on prior courses, students develop skills in process planning, machine setup, and operation. They collaborate on projects, apply quality assurance practices, follow safety protocols, and interpret orthographic prints and job process sheets. When available, ToolingU is used to supplement instruction. Students will participate in at least two Career-Connected Education and Work-Based Learning experiences in this course, which might include informational interviews or job shadowing relevant to the program of study.
   E. Students are encouraged to participate in extended learning experiences through aligned Career and Technical Student Organizations (CTSOs). CTSOs are a cocurricular requirement in the Carl D. Perkins Act, and alignment to CTSO activities is an expectation for CTE programs in the state of Maryland.

3. **Knowledge and Skills.**
   A. **The student demonstrates the necessary skills for career development, maintenance of employability, and successful completion of course outcomes. The student is expected to:**
      1. Identify and demonstrate positive work behaviors that enhance employability and job advancement, such as regular attendance, promptness, proper attire, and the maintenance of a clean and safe work environment.
      2. Demonstrate positive personal qualities such as flexibility, open-mindedness, initiative, active listening, and a willingness to learn, especially in collaborative environments and technical problem-solving scenarios.
      3. Employ effective reading, writing, and technical documentation skills in the context of process planning, setup sheets, and job instructions for machining operations.
      4. Solve advanced machining-related problems using critical thinking techniques and structured troubleshooting methodologies, particularly during the setup, operation, and finishing of machining tasks.
      5. Demonstrate leadership skills and collaborate effectively as a team member, offering ideas and feedback to improve machining processes and resolve technical issues.
      6. Implement safety procedures in all aspects of machining, including the proper handling of machinery, tools, materials, and waste disposal, while adhering to industry safety guidelines.

7. Exhibit an understanding of legal and ethical responsibilities in the machining industry, following relevant laws, standards, and best practices in the production environment.
8. Demonstrate time-management skills and the ability to prioritize tasks in a busy technical setting, especially during multiple-machine operations and complex projects.

B. **The student identifies various career pathways in the machining and manufacturing fields. The student is expected to:**
   1. Develop a career plan that includes the necessary education, certifications, job skills, and experience for specific roles in machining operations and manufacturing.
   2. Create a professional resume and portfolio that reflects skills in machining operations, process planning, machine setup, and successful project outcomes, including certifications such as NIMS Machining Level I.
   3. Demonstrate effective interview skills for advanced roles in machining, manufacturing, and production planning, including discussing knowledge of industry-specific credentials and competencies.

C. **The student develops technology and digital literacy skills. The student is expected to:**
   1. Use technology as a tool for research, organization, communication, and problem-solving in machining operations, including digital tools for job planning and documentation.
   2. Use digital tools, including computers, mobile devices, and collaboration platforms, to access, manage, and create information related to machining processes and project management.
   3. Demonstrate proficiency in using industry-standard software tools, including Computer-Aided Design (CAD), Computer-Aided Manufacturing (CAM), and online learning management systems like ToolingU for continued learning and certification preparation.
   4. Understand ethical and legal considerations for technology use, including principles of data protection, intellectual property, and responsible technology use in manufacturing environments.

D. **The student integrates core academic skills into machining practices. The student is expected to:**
   1. Demonstrate clear communication techniques, both written and verbal, consistent with industry standards, when preparing process plans, job instructions, and reports for machining tasks.
   2. Apply mathematical concepts such as trigonometry, geometry, and advanced measurement techniques in process planning, machine setup, and quality control during machining operations.
   3. Use scientific principles such as material properties, cutting tool dynamics, and thermal effects to understand and optimize machining processes like milling, turning, grinding, and drilling.

E. **The student demonstrates the necessary skills to operate and set up advanced machining equipment. The student is expected to:**
   1. Identify and describe the functions of advanced machining equipment, including CNC and manual lathes, mills, surface grinders, and drilling machines.
   2. Perform advanced machine setup for turning, milling, drilling, and grinding operations, ensuring accuracy in alignment, tool selection, and material preparation.

3. Demonstrate the ability to operate machines safely and efficiently, following standard operating procedures, and adjusting machine parameters as needed for specific operations.
4. Perform routine maintenance, tool changes, and adjustments on machines to ensure optimal performance and precision in machining operations.

F. **The student demonstrates the necessary skills in process planning and job setup for machining operations. The student is expected to:**
   1. Develop process plans for machining operations that outline step-by-step instructions, including material selection, tooling requirements, and machining methods for turning, milling, drilling, or grinding.
   2. Read and interpret orthographic prints, job process sheets, and technical specifications to determine the correct approach to machining tasks and ensure dimensional accuracy.
   3. Implement setup procedures for a variety of machining operations, adjusting for specific requirements such as part tolerances, cutting speeds, and tooling configurations.
   4. Demonstrate proficiency in organizing and preparing materials, tools, and machines for specific jobs based on detailed plans and specifications.

G. **The student demonstrates the necessary skills to perform quality assurance in machining operations. The student is expected to:**
   1. Understand and apply basic quality control principles, including statistical process control (SPC), to monitor and adjust machining processes for consistent quality and precision.
   2. Use precision measurement instruments, such as micrometers, calipers, height gauges, and CMMs, to inspect finished parts and ensure compliance with engineering specifications.
   3. Perform inspection and testing of both single and multiple part production, identifying and correcting issues related to part defects, dimensional inaccuracy, and tooling wear.
   4. Follow established procedures for documenting quality control results, process changes, and any corrective actions taken during machining operations.

H. **The student demonstrates the necessary skills for material handling and disposal in machining operations.. The student is expected to:**
   1. Identify and handle a variety of materials used in machining operations, including metals, alloys, and composites, ensuring that material properties are considered during planning and setup.
   2. Implement appropriate material handling techniques to ensure safety and efficiency, including the use of lifting equipment, storage methods, and transportation protocols.
   3. Safely dispose of waste materials, including scrap, coolant, and hazardous materials, in accordance with environmental and safety regulations.

I. **The student demonstrates proficiency in preparing for the NIMS Machining Level I certifications in specific machining operations. The student is expected to:**
   1. Develop the skills and knowledge required to obtain NIMS Machining Level I certification in the selected areas, such as Manual Milling, Turning Operations Between Centers, Turning and Chucking, Grinding, or Drilling Operations.

2. Demonstrate competency in executing specific machining tasks with precision and following industry standards, preparing for certification testing.
3. Participate in simulations, practice tests, and hands-on activities to reinforce understanding of machining operations, safety procedures, and quality control for certification readiness.

Course Standards: Career Connected Learning I and II

Career connected learning is an educational approach that integrates classroom instruction with real-world experiences, enabling high school students to explore potential careers and develop relevant skills before graduation. By participating in work-based learning opportunities—such as apprenticeships, internships, capstone projects, and school-based enterprises—students apply academic concepts in authentic settings, gain practical industry knowledge, and build professional networks. This hands-on engagement helps students connect their studies to future career paths, strengthens their problem-solving and communication skills, and supports a smoother transition into college, vocational programs, or the workforce.

All Career and Technical Education Programs of Study include aspects of work-based learning, and almost all of the programs include two Career Connected Learning (CCL) courses. The CCL standards can be found via this link: