Department of Education | College, Career and Technical Education

May 2024

Manufacturing Practicum

Primary Career Cluster:	Advanced Manufacturing
Course Contact:	CTE.Standards@tn.gov
Course Code(s):	C13H08
Prerequisite(s):	Minimum of two credits in an Advanced Manufacturing program of study.
Credit:	1
Grade Level:	11-12
Elective Focus - Graduation Requirement:	This course satisfies one of three credits required for an elective focus when taken in conjunction with other Advanced Manufacturing courses.
POS Concentrator:	This course satisfies one out of two required courses that meet the Perkins V concentrator definition, when taken in sequence in the approved program of study.
Programs of Study and Sequence:	This is the fourth course in the *Machining Technology, Industrial Maintenance Technology, Mechatronics,* and *Welding* programs of study.
Aligned Student Organization(s):	Skills USA: http://www.skillsusatn.org/ Technology Student Association (TSA): http://www.tntsa.org
Coordinating Work-Based Learning:	Teachers who hold an active WBL certificate may offer placement for credit when the requirements of the state board's WBL Framework and the Department's WBL Policy Guide are met. For information, visit https://www.tn.gov/education/educators/career-and-technical-education/work-based-learning.html.
Promoted Tennessee Student Industry Credentials:	Credentials are aligned with postsecondary and employment opportunities and with the competencies and skills that students acquire through their selected program of study. For a listing of promoted student industry credentials, visit https://www.tn.gov/education/educators/career-and-technical-education/student-industry-certification.html.
Teacher Endorsement(s):	070, 157, 230, 231, 232, 233, (042 and 043), (042 and 044), (042 and 045), (042 and 046), (042 and 047), (042 and 077), (042 and 078), (042 and 079), (043 and 044), (043 and 045), (043 and 046), (043 and 047), (043 and 077), (043 and 078), (043 and 079), (044 and 045), (044 and 046),(044and 047), (044 and 077), (044 and 078), (044 and 079), (045 and 046), (045 and 047), (045 and 077), (045 and 078), (045 and 079), (046 and 047), (046 and 077), (046 and 078), (046 and 079), (047 and 077), (047 and 078), (047 and 079), (077 and 078), (077 and 079), (078 and 079), 470, 477, 501, 502, 522, 523, 531, 537, 551, 552, 553, 554, 555, 556, 557, 575, 580, 582, 584, 585, 596, 598, 700, 701, 705, 706, 707, 760, 982
Required Teacher Certifications/Training:	Some endorsements require NIMS industry certification to teach this course. Please refer Occupational Endorsement License Guide for a full list.

Course at a Glance

CTE courses provide students with an opportunity to develop specific academic, technical, and 21st century skills necessary to be successful in career and in life. In pursuit of ensuring every student in Tennessee achieves this level of success, we begin with rigorous course standards which feed into intentionally designed programs of study.

Students engage in industry relevant content through general education integration and experiences such as career and technical student organizations (CTSO) and work-based learning (WBL). Through these experiences, students are immersed with industry standard content and technology, solve industry-based problems, meaningfully interact with industry professionals and use/produce industry specific, informational texts.

Using a Career and Technical Student Organization (CTSO) in Your Classroom

CTSOs are a great resource to put classroom learning into real-life experiences for your students through classroom, regional, state, and national competitions, and leadership opportunities. Below are CTSO connections for this course, note this is not an exhaustive list.

- Participate in CTSO Fall Leadership Conference to engage with peers by demonstrating logical thought processes and developing industry specific skills that involve teamwork and project management.
- Participate in contests that highlight job skill demonstration. These include Career Pathways Showcase, Job Interview, Automated Manufacturing Technology, and Electronics Technology.

Using Work-Based Learning (WBL) in Your Classroom

Practicum activities may take the form of work-based learning (WBL) opportunities (such as internships, cooperative education, service learning, and job shadowing) or industry-driven project-based learning. These experiences must comply with the Work-Based Learning Framework guidelines established in SBE High School Policy 2.103. As such, this course must be taught by a teacher with an active WBL Certificate issued by the Tennessee Department of Education and follow policies outlined in the Work-Based Learning Policy Guide available online at https://www.tn.gov/education/educators/career-and-technical-education/work-based-learning.html.

Sustained and coordinated activities that relate to the course content are the key to successful work-based learning. Possible activities for this course include the following. This is not an exhaustive list.

- **Standards 2.1-2.2** | Participate in safety activities at their workplace (practicum site).
- **Standard 3.2-3.3** | Have a local manager from industry discuss job searches and hiring.
- **Standard 4.1-4.2** | Have an industry person discuss how laws and patents impact their company.
- **Standard 5.4** | Have a local manager discuss their production plans.
- **Standard 6.1** | Participate in troubleshooting at their workplace (practicum site).
- **Standard 6.2** | Participate in quality control at their workplace (practicum site).
- **Standard 6.3** | Participate in measurements at their workplace (practicum site).
- **Standards 8.2** | Have a local industry representative critique the presentation.

Course Description

Manufacturing Practicum is a capstone course intended to provide students with the opportunity to apply the skills and knowledge learned in previous Advanced Manufacturing courses within a professional, working environment. While continuing to add to their technical skillsets, students in this course assume increasing responsibility for overseeing manufacturing processes and managing complex projects. Specifically, proficient students will be able to work in teams to plan the production of a sophisticated product; develop troubleshooting and problem-solving mechanisms to ensure that projects run smoothly; analyze output and compile professional reports; and connect practicum activities to career and postsecondary opportunities. For all projects undertaken in this course, students are expected to follow the focus area in their chosen program of study (*Machining Technology, Industrial Maintenance Technology, Mechatronics,* or *Welding*), while also refining skills previously acquired to achieve deeper levels of mastery. Upon completion of the practicum, proficient students will be prepared for postsecondary study and career advancement in their chosen focus area.

Course Requirements

This capstone course aligns with the requirements of the Work-Based Learning Framework (established in Tennessee State Board High School Policy), with the Tennessee Department of Education's Work-Based Learning Policy Guide, and with state and federal Child Labor Law. As such, the following components are course requirements:

Course Standards

1. Personalized Learning Plan

1.1 Personalized Learning Plan: A student will have a **personalized learning plan** that identifies their long-term goals, demonstrates how the Work-Based Learning (WBL) experience aligns with their elective focus and/or high school plan of study, addresses how the student plans to meet and demonstrate the course standards, and addresses employability skill attainment in the following areas:

a. application of academic and technical knowledge and skills (embedded in course standards),
b. career knowledge and navigation skills,
c. 21st century learning and innovation skills, and
d. personal and social skills.

2. Safety

2.1 Safety Rules: Accurately read, interpret, and **demonstrate adherence to safety rules**, including rules published by the (1) National Science Teachers Association (NSTA); (2) rules pertaining to electrical safety; (3) Occupational Safety and Health Administration (OSHA) guidelines; (4) American Society for Testing Materials, ANSI Z49.1: Safety and Welding, Cutting, and Allied Processes; and (5) state and national code requirements. Be able to distinguish between rules and explain why certain rules apply.

2.2 Safety Equipment: Identify and explain the intended use of **safety equipment** available in the classroom. Demonstrate how to properly inspect, use, store, and maintain safe operating procedures with tools and equipment.

3. Advanced Manufacturing Careers

3.1 Advanced Manufacturing Companies: Identify local, regional, and national **companies operating in advanced manufacturing industries**. Summarize the companies and the production environments in which they operate, including the specific products they manufacture, the industries in which they are used, the long-term and short-term employment projections, and their overall contributions to society. For example, report on three manufacturers within the aerospace industry and describe how the products they make support the transportation sector.

3.2 Job Search: Conduct a **job search within an advanced manufacturing focus area of choice**, including but not limited to machining technology, industrial maintenance technology, mechatronics, and welding. Compare and contrast job opportunities across sample companies and determine areas of growth.

3.3 Resume and Application: Analyze the requirements and qualifications for various advanced manufacturing job postings identified in the previous standard. Summarize information from multiple sources, such as sample resumes, interviews with advanced manufacturing professionals, and job boards, to determine effective strategies for realizing career goals. **Create a personal resume** modeled after elements based on the findings above, then **complete an authentic job application** as part of a career search or work-based learning experience.

4. Professional Ethics and Legal Responsibilities

4.1 Legal Responsibilities: Identify **laws impacting jobs in the student's program**. Investigate national and international labor laws governing advanced manufacturing-related industries. Summarize the legal and professional consequences for breaking these laws, citing news media, company policies, and text from relevant legislation.

4.2 Patents: Research the significance of **patents in advanced manufacturing**. Describe the process for securing a patent, and explain why patent protection is important for maintaining the integrity and quality of manufactured goods. Summarize the patent process.

4.3 Ethics: Research a case study involving an **ethical issue related to consumer safety** in the context of advanced manufacturing. Examine a variety of perspectives surrounding the issue, then develop an original analysis explaining the impact of the issue on those involved, using persuasive language, and citing evidence from the research. For example, discuss the legal and financial fallout resulting from the recall of a defective automobile part; draw on news media and related coverage to describe the implications of withholding knowledge of such a defect from the public.

5. Advanced Process Management

5.1 Manufacturing Process: Use a selected **manufacturing process to be used with a project**. If possible, meet with a potential client who could use such a product, and discuss the client's wants and needs. Research what materials, labor, equipment, and other inputs are necessary to complete production, then develop a production plan, delegate responsibilities, and determine deadlines to meet the client's specifications.

5.2 Decisions in Manufacturing Process: Develop a logical **decision tree to guide the manufacturing process** for the selected project. Given a set of defined criteria and constraints, conduct if/then analyses to answer a variety of process-oriented questions. For example, follow a logical decision tree to determine when to conduct each step of the process.

5.3 Activities in Manufacturing Process: Assemble adequate documentation of **production activities** in the form of a team log, manual, or executive summary of production processes. Be able to explain to both lay and technical audiences how various aspects of the process work, including how the end product is created. Document constraints and criteria using domain-specific vocabulary and industry terminology.

5.4 Implement Manufacturing Process: **Execute all production plans** undertaken in this course in line with resource constraints, deadlines, and all other specifications in order to meet the vision of a client or the expectations of a classroom-based project. Critique the quality of final products for their compliance with client or classroom specifications. Document product evaluations in a written format that can be easily interpreted by others.

6. Troubleshooting, Problem Solving, and Quality Control

6.1 Troubleshooting: Identify, diagnose, and **troubleshoot malfunctions in advanced manufacturing equipment.** Apply problem solving skills learned in previous courses to determine the source of the problem(s), assess the maintenance that will be required, and develop a multistep procedure for making corrections. Conduct the required maintenance according to outlined procedures and critique the effectiveness of the corrective action.

6.2 Quality Control: Apply **quality control methods** learned in previous courses to regularly test and evaluate the quality of manufactured products created in this course. Drawing on associated industry standards, develop quality benchmarks for measuring the acceptability of the end product. Formulate criteria for identifying defects and make recommendations for reducing the number of defects based on observations.

6.3 Measurement Adjustments: Record accurate and repeatable measurements to specified degrees of precision, attending to appropriate units as directed. **When measurements misalign, make the necessary adjustments in order to eliminate the problem**. For example, if a machining part is specified to be sized within an acceptable range of nanometers, adjust the CNC code to cut the part within a more accurate margin of error.

7. Portfolio

7.1 Portfolio: Create a **portfolio**, or similar collection of work, that illustrates mastery of skills and knowledge outlined in the previous courses and applied in the practicum. The portfolio should reflect thoughtful assessment and evaluation of the progression of work involving the application of steps of the design process, as outlined by the instructor. The following documents will reside in the student's portfolio:

a. personal code of ethics;
b. career and professional development plan;
c. resume;
d. list of responsibilities undertaken through the course;
e. examples of visual materials developed and used during the course (such as drawings, models, presentation slides, videos, and demonstrations);
f. description of technology used, with examples if appropriate;
g. periodic journal entries reflecting on tasks and activities; and
h. feedback from instructor and/or supervisor based on observations.

8. Project

8.1 Project: Complete a **project in the assigned program** (Industrial Maintenance Technology, Machining Technology, Mechatronics, or Welding).

8.2 Reports: **Report on projects** completed as a student. Summarize the purpose, content, and use for all advanced manufacturing and production projects undertaken in this program. Include the technical specifications of products generated for each project. Prepare the report in a format that could be presented to both a technical and a non-technical audience, as well as for a career and technical student organization (CTSO) competitive event.

Standards Alignment Notes

*References to other standards include:

- P21: Partnership for 21st Century Skills Framework for 21st Century Learning
    - Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.