TN Department of Education | College, Career and Technical Education

Manufacturing Practicum

Primary Career Cluster:	Advanced Manufacturing
Consultant:	Deborah Knoll, (615) 532-2844, Deborah.Knoll@tn.gov
Course Code:	5926
Prerequisite(s):	Minimum of two credits in an Advanced Manufacturing program of study.
Credit:	1
Grade Level:	11-12
Graduation Requirement:	This course satisfies one of three credits required for an elective focus when taken in conjunction with other Advanced Manufacturing courses.
Programs of Study and Sequence:	This is the fourth course in the *Machining Technology, Electromechanical Technology, Mechatronics,* and *Welding* programs of study.
Aligned Student Organization(s):	Skills USA: http://www.tnskillsusa.com Tracy Whitehead, (615) 532-2804, Tracy.Whitehead@tn.gov Technology Student Association (TSA): http://www.tntsa.org Tracy Whitehead, (615) 532-2804, Tracy.Whitehead@tn.gov
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://tn.gov/education/topic/work-based-learning.
Available Student Industry Certifications:	CPT Modules if Practicum is taken in the Machining Technology POS: Manufacturing Processes & Production Maintenance Awareness
Dual Credit or Dual Enrollment Opportunities:	There are no known dual credit/dual enrollment opportunities for this course. If interested in developing, reach out to a local postsecondary institution to establish an articulation agreement.
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, 582, 584, 585, 596, 598, 700, 701, 705, 706, 707, 760
Required Teacher Certifications/Training:	Some endorsements require NIMS industry certification to teach this course. Please refer to the correlation of course codes for a full list.
Teacher Resources:	https://tn.gov/education/article/cte-cluster-advanced-manufacturing

Approved January 30, 2015; Amended April 15, 2016

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, Electromechanical 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.

Work-Based Learning Framework

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://tn.gov/education/topic/work-based-learning. The Tennessee Department of Education provides a *Personalized Learning Plan* template to ensure compliance with the Work-Based Learning Framework, state and federal Child Labor Law, and Tennessee Department of Education policies, which must be used for students participating in WBL opportunities.

Program of Study Application

This is the fourth course in the *Machining Technology, Electromechanical Technology, Mechatronics,* and *Welding* programs of study. For more information on the benefits and requirements of implementing these programs in full, please visit the Advanced Manufacturing website at https://tn.gov/education/article/cte-cluster-advanced-manufacturing.

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) 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
d. Personal and social skills

Safety

2) 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, (4) 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.

3) 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.

Advanced Manufacturing Careers

4) Research local, regional, and national companies operating in advanced manufacturing industries. Synthesize findings into a written report or oral presentation profiling several companies and the production environments in which they operate, including the specific products they manufacture, the industries in which they are used, the long- 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.

5) Conduct a job search within an advanced manufacturing focus area of choice, including but not limited to machining technology, electromechanical technology, mechatronics, and welding. Compare and contrast job opportunities across sample companies, and determine areas of growth.

6) Analyze the requirements and qualifications for various advanced manufacturing job postings identified in the previous standard. Gather 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.

Professional Ethics and Legal Responsibilities

7) 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. For example, research Apple's stance on child and migrant labor, then compare the company's policy with

independent reports on their manufacturing practices overseas.

8) 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. Synthesize information from multiple sources, including the text of actual patent documents, in order to communicate the process to others.

9) 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.

Advanced Process Management

10) In teams, research an industry need that can be met with a manufacturing product. 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 work as a team to develop a production plan, delegate responsibilities, and determine deadlines to meet the client's specifications. Present the plan with supporting graphics and data compiled from the research.

11) Simulate the work of a plant operations manager or related position by formulating a detailed production schedule. Use diagrams, schematics, and floor plans to lay out production processes and assign sample shifts. Determine how each team member will contribute to the designated production project.

12) Develop a logical decision tree to guide manufacturing processes for a range of products. 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 employ serial, batch, or continuous manufacturing processes.

13) Demonstrate the ability to apply statistical analysis to the evaluation of process outputs. For a given set of constraints, calculate the ideal production rate for a simulated product, then apply learnings toward original projects undertaken in this course. Using quality control methods learned in previous courses, determine criteria to maximize output and minimize product defects.

14) Work together to 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.

15) 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.

Troubleshooting, Problem Solving, and Quality Control

16) Work in teams to 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.

17) 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.

18) 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.

Portfolio

19) 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
    h. Feedback from instructor and/or supervisor based on observations

Communication of Project Results

20) Produce technical reports highlighting the purpose, content, and use for all advanced manufacturing and production projects undertaken in this course. Cite evidence from multiple authoritative sources in order to justify design and production decisions and maximize client satisfaction (when applicable). Incorporate supporting graphics, sketches, and data as needed to summarize the technical specifications of products generated for each project.

21) Upon completion of the practicum, develop a technology-enhanced presentation showcasing highlights, challenges, and lessons learned from the experience. The presentation should be delivered orally, but supported by relevant graphic illustrations, such as diagrams, flowcharts, and/or summary data generated from simulated operations and quality control analysis. Prepare the presentation 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.