Regional Occupational Program

Manufacturing Technology 2025-2026

COURSE DESCRIPTION

This course provides students with entry to advanced levels of knowledge and skills needed for success in today's manufacturing industry. Students learn machining and manufacturing procedures for conventional lathes and mills as well as learn how to set up and use (CNC) Computerized Numerical Control Machining/Centers. Course content includes instruction in basic layout, use of precision instruments, blueprint reading and green manufacturing, layout, tool path creation, inspection, and use of CAD/CAM software applications. Students are also exposed to 3 and 5 axis machining techniques. Successful completion of course modules prepare student for testing and credentialing through (NIMS) National Institute for Metalworking Skills in Job Planning, Bench-work and Layout, and an additional credential of their choice.

Course Information

Course Length:	630 Hours
Prerequisite:	18 yrs. and 9th grade math
Course Level:	Capstone
UC:	No
Articulated:	Pending
Industry Cert.:	NIMS CNC Operator, Benchwork and Layout
Industry Sector:	Manufacturing and Product Development
Pathway:	Machining and Forming Technologies
CALPADS:	8221

O*Net SOC Codes

51-9162	Computer Numerically Controlled Tool Programmers
17-2112.03	Manufacturing Engineers
51-4041	Machinists

Legend

CTE - PS	CTE Pathway Standards
CRP	Career Ready Practices
CTE - AS	CTE Anchor Standards
CCSS	Common Core State Standards
ISTE	International Society for Technology in Education

Includes updates from 24/25 Manufacturing Advisory

Advisory Minutes

Big Six: Career Ready Essentials					
The Big Six: Career Ready Essentials units and competencies are embedded throughout the entire length of the program.					
1. Effective Communication	**CTE-PS**	**CRP**	**CTE-AS**	**CCSS**	**ISTE**
a. Demonstrate effective verbal communication and conflict resolution skills. **b. Use the writing process to develop written communication with the appropriate tone, organization, and format for the identified audience.** c. Explain the effect of interpersonal skills on one's ability to communicate effectively and develop relationships. d. Describe the impact of ineffective communication on business relationships. e. Analyze the impact of vocabulary, body language, and tone on verbal communication. f. Demonstrate active listening skills. g. Accurately interpret industry-specific written communication. h. Model responsible and effective use of various communication technologies. i. Identify valid and reliable digital reference and resource materials. j. Gather information from multiple digital sources to compare and contrast, synthesize, and summarize. k. Identify and use appropriate communication and collaboration technologies. l. Utilize technology to problem solve, accomplish tasks, and to produce or publish products.		1 2 11	2 3 4 5 7 8 9 10 11	**LS** 9-10 11-12.6 **SLS** 11-12.2 9-10 11-12.1 11-12.1d **WS** 11-12.7 11-12.6	1b,c 2c 3b,c 5c 6b,c,d
2. Collaboration, Creativity, and Critical Thinking	**CTE-PS**	**CRP**	**CTE-AS**	**CCSS**	**ISTE**
a. Demonstrate critical thinking skills for a variety of purposes and in different settings. **b. Collaborate to reach consensus on an identical objective through the sharing of knowledge, tasks, and learning.** c. Discuss the importance of the critical thinking process to real-world applications. d. Evaluate the impact of creative thinking on problem solving and innovation in real-world applications. e. Compile work that demonstrates the process used to (elaborate, refine, analyze) evaluate original ideas and maximize creative efforts. f. Apply divergent and convergent thinking to the development of an original idea or solution. g. Examine real-world limits to adopting ideas. h. Demonstrate creative thinking (preparation, insight, evaluation, elaboration, and communication) to create a new idea or concept. i. Assume shared responsibility for collaborative work, and value the individual contributions made by each team member.		2 4 5 7 9 10 11	2 3 4 5 7 8 9 11	**LS** 9-10 11- 12.6 **SLS** 9-10 11-12.1 11-12.1d 11-12.2 **WS** 11-12.7 11-12.6	1c 3c,d 4a-d 5c,d 6c 7b,c,d

j. Evaluate evidence, arguments, claims, and beliefs to identify connections. k. Identify bias, prejudice, propaganda, self-deception, distortion, and misinformation. l. Produce intellectual, informational, or material products that serve an authentic purpose. m. Work effectively and respectfully with those from diverse backgrounds or cultures. n. Demonstrate respect, trust, commitment, and the ability to compromise in collaborative projects.					
3. Leaders and Teams: Roles and Responsibilities	**CTE-PS**	**CRP**	**CTE-AS**	**CCSS**	**ISTE**
a. Determine the individual and team members' roles and responsibilities. **b. Demonstrate leadership skills and qualities (i.e., reliability, negotiation skills, initiative, positive reinforcement, recognition of others' efforts, problem-solving skills, conflict resolution, and delegation).** c. Explain the importance of technical, social, and communication skills to team success. d. Compare and contrast leadership styles and their effectiveness in various situations. e. Organize and delegate responsibilities in a team setting to encourage ideas, perspectives, and contributions from all team members. f. Develop a strong sense of team identity by brainstorming solutions, volunteering, assisting others, practicing respect and courtesy, and taking initiative. g. Examine situations in which a follower becomes the leader. h. Describe twenty-first-century skills required across all occupations. i. Identify and discuss the characteristics of a successful team (i.e., leadership, cooperation, and effective decision-making). j. Leverage social and cultural differences to increase innovation and quality of work.		7 8 9	3 7 8 9 11	**SLS** 11-12.2 9-10 11-12.1 11-12.1d **WS** 11-12.6	7a,c
4. Legal, Ethical, and Environmental Considerations	**CTE-PS**	**CRP**	**CTE-AS**	**CCSS**	**ISTE**
a. Demonstrate industry specific ethical and legal practices. **b. Identify eco-friendly industry specific practices and resources.** c. Identify local, state, and federal regulatory agencies, entities, laws, and regulations. d. Identify discrimination based on race, nationality, religion, gender, age, disability, or sexual orientation. e. Summarize the ethical and legal implications of workplace discrimination and harassment. f. Explain the concept of corporate citizenship. g. Examine an employer's role in protecting the health and welfare of employees, the community, and the environment.		5 7 8 12	3 5 7 8 9 11	**WS** 11-12.6 11-12.7 **SLS** 9-10 11-12.1 11-12.1d 11-12.2	2a,b 3a,b 5c 6c

h. Analyze current environmental laws and regulations and their impact on industry. i. Compare and contrast both society's and industry's impact on the environment.					
5. Personal Growth and Career Planning	**CTE-PS**	**CRP**	**CTE-AS**	**CCSS**	**ISTE**
a. Demonstrate continued personal development and growth. **b. Develop and manage a personal growth and career plan.** c. Explain the relationship between sound financial habits and financial security. d. Create and manage a personal financial plan. e. Demonstrate initiative in achieving personal and professional goals. f. Apply time management strategies to meet deadlines. g. Demonstrate a growth mindset through flexibility and a positive attitude. h. Select and demonstrate appropriate job-search and retention techniques. i. Demonstrate strategies to prepare for employment. j. Demonstrate interpersonal skills appropriate for the workplace. k. Elaborate on the importance of perseverance to personal and professional success. l. Discover personal career interests, aptitudes, and skills.		1 2 3 4 6	2 3 4 7 8 11	**LS** 9-10 11-12.6 **SLS** 9-10 11-12.1 11-12.1d 11-12.2 **WS** 11-12.6	1a 3a,c 4d 6a,d 7b
6. Workplace Safety and Personal Wellness	**CTE-PS**	**CRP**	**CTE-AS**	**CCSS**	**ISTE**
a. Demonstrate proper industry specific safe work practices to prevent injury or illness. **b. Assess the potential impact of goal setting on personal and professional success.** c. Describe the role of security and emergency procedures in workplace safety. d. Describe the effect of preventative measures on emergencies in the workplace. e. Identify and describe the causes, prevention, and treatment of common accidents. f. Identify local, state, and federal agencies that regulate workplace safety. g. Explain the role of the California Occupational Safety and Health Administration (Cal-OSHA) and the Environmental Protection Agency (EPA). h. Discuss the basics of system operations. i. Demonstrate the proper use of personal protective equipment (PPE). j. Explain the purpose of and accurately interpret a Safety Data Sheet (SDS). k. Identify hazardous materials and chemicals. l. Demonstrate proper procedures to respond to work-related accidents and injuries. m. Describe how ergonomics, housekeeping, and maintenance are related to accidents and injuries. n. Demonstrate cyber ethics, cyber safety, and cybersecurity. o. Assess the potential impact of preventative physical and mental health measures on workplace safety.		2 5 6 8 12	2 5 6 7 8 10 11	**LS** 9-10 11-12.6 **WS** 11-12.7 11-12.6 **SLS** 9-10 11-12.1 11-12.1d	1a,d 2a,d 5b

TRAINING BLOCK 1: Introduction to Manufacturing and Machining (315 Hours)

1.A Orientation and Career Opportunities

a. Discuss objectives for this course, including competencies, teacher expectations, classroom policies, and procedures.
b. Identify and discuss the acquisition of transferable skills (communication, collaboration, creativity, and critical thinking) and their importance to being college and career ready and for future personal and professional success.
c. Discuss student and teacher expectations, including behavior, class rules, appropriate dress, pre-course knowledge, and grading policies, including enrollment and attendance requirements and procedures, and classroom/school safety and disaster procedures.
d. Discuss next steps in course sequence related to the career pathway, the need for reinforcement of basic skills, transferrable skills, and postsecondary and career options.
e. Review the purpose of the Big Six: Career Ready Essentials and the Standards for Career Ready Practice and how they are embedded throughout each unit of the program.

1.B Introduction to Manufacturing	CTE-PS	CRP	CTE-AS	CCSS
a. Explain and apply philosophies of lean manufacturing. **b. Demonstrate understanding of "cell planning".** c. Use 5s and Visual systems tools to assist in conducting projects. d. Demonstrate and understand Kanban pull systems. e. Use poka-yoke (mistake proofing) to assist in projects. f. Explain the use of Tak time in production. g. Summarize how Spaghetti diagrams are used to assist in conducting projects. h. Prepare a Cellular layout to aid production flow.		1 2 5 10	1 2 5 11	**LS** 9-10, 11-12.6 **WS** 11-12.7

1.C Introduction to Applied Mathematics and Machinery's Handbook	CTE-PS	CRP	CTE-AS	CCSS
a. Demonstrate understanding of applied Mathematics. b. Calculate cutting velocities (CCS/SFM (RPM formulas)) for different metallic materials. c. Determine cutting velocities for different metals (according to NIMS standards). d. Use Trigonometry to solve right angle triangles. e. Apply entry Level Mathematics to obtain dimension from a metal part. f. Demonstrate concepts related to coordinate systems. g. Use trigonometric identities to solve geometry problems. h. Compare and contrast cutting velocities with diameter relationships. i. Compute calculations to feed, RPM, and chip load an end mill. j. Explain the "Taper per Foot" application. k. Demonstrate understanding of mathematical operations with decimal numbers. l. Describe the Cartesian coordinate systems, the absolute and incremental positioning systems, and the polar coordinate system. m. Correctly reference charts in the Machinery's Handbook. n. List the 5s, 5s+1 and describe its application in lean manufacturing.	B3.3 B7.4	1 2 4 5 11	1 2 4 5 11	**LS** 9-10, 11-12.6 **WS** 11-12.6-7 **Algebra** A-SSE 1.0-3.0 A-CDE 4.0 A-REI 1.0, 2.0, 4.0 **Geometry** G-CO 1.0, 5.0, 10.0 , 11.0 12.0, 13.0 G-SRT 6.0 -9.0 G-GMD 3.0, 6.0 F-TF 1.0

1.D Measurement	CTE-PS	CRP	CTE-AS	CCSS
a. Demonstrate the use and care of common semi-precision measuring tools. **b. Explain the uses of semi-precision calipers, squares, combination sets, common fixed gages, and protractors.** c. Read an English ruler to within 1/64 of an inch. d. Read an English decimal ruler within 1/100 of an inch. e. Read a metric ruler within 0.5mm. f. Read protractors within 1 degree. g. Describe the care of precision measuring instruments. h. Identify the micrometer's parts and explain their functions. i. Read English and metric micrometers. j. Identify and describe the uses of Vernier measuring instruments. k. Read English and metric Vernier scales. l. Describe the features and use of dial indicators. m. Discuss the methods for measuring surface finishes. n. Identify and discuss the use of an optical comparator.	B1.0 B1.2 B1.3 B2.2 B7.6	1 2	1 2 11	**LS** 9-10, 11-12.6

1.E Engineering Print Reading	CTE-PS	CRP	CTE-AS	CCSS
a. Read and interpret various blueprints and blueprint designations. **b. Make a part from raw material and create a process plan demonstrating the planning process to team members.** c. Utilize a blueprint to determine tolerance. d. Interpret an operational blueprint. e. Identify, describe, and define the geometric symbols used in blueprints. f. Identify, describe title blocks, orthographic projections, basic views, and isometric views. g. Compare and contrast unilateral, bilateral, and limit tolerances. h. Recognize and describe basic geometric dimension and tolerance symbols (GD&T). i. Explain allowances and fit classes for cylindrical components. j. Explain how green technology is utilized when manufacturing parts from raw material.	B1.1 B1.4 B5.9 B7.1 B7.2	1 2 4 5 9	1 2 4 5 9 11	**LS** 9-10, 11-12.6 **WS** 11-12.6-7 **SLS** 11-12.1d **Algebra** A-SSE 1.0, 3.0 A-REI 2.0 A-CED 1.0 **Geometry** G-CO 12.0, 13.0 G-SRT 2.0-8.1

1.F Metrology and Inspection	CTE-PS	CRP	CTE-AS	CCSS
a. Demonstrate and explain how different measuring instruments are used to verify machined features of a part. **b. Name and identify different measuring instruments to find dimensions of machined parts (e.g., micrometer, Caliper, Depth micrometer).** c. Describe and demonstrate the use of precision tools for quality control and inspection processes. d. Explain how to use printed inspection references.	B1.0 B1.2 B1.4 B11.5	1 2 4 5 11	1 2 4 5 11	**LS** 9-10, 11-12.6 **WS** 11-12.6-7 **MA Operations & Algebraic Thinking** 5.O. A, 1.0, 5. OA 2.0

e. Recall and describe several different types of inspection processes.				**Measure & Data** 5.MD-1.0-5.0 **Geometry** G-CO 1.0, 2.0, 12.0, 13.0 GCO 5.0, 8.0-11.0 G-SRT 6.0-9.0
1.G Conventional Machines and Hand Tools	**CTE-PS**	**CRP**	**CTE-AS**	**CCSS**
a. Demonstrate the use of semi-precision and precision measurement instruments. **b. Demonstrate the usage of common machine shop hand tools.** c. Discuss the differences between ferrous and nonferrous metals and their alloys. d. Describe how lubricants and cutting fluids are utilized in manufacturing. e. Define the processes of drilling, threading, tapping, boring, countersinking, counter-boring, and reaming. f. Summarize the types and uses of grinders. g. Describe and name the structural components of the conventional lathe. h. Identify components of a vertical mill that utilize basic hand tools to operate the machine.	B1.0 B1.2 B3.1 B6.1 B7.0 B7.1 B7.3 B7.5	1 2 5	1 2 5 11	**LS** 9-10, 11-12.6 **WS** 11-12.7
1.H NIMS Benchwork and Layout Certification	**CTE-PS**	**CRP**	**CTE-AS**	**CCSS**
a. Obtain the NIMS certification for Benchwork and Layout. b. Define layout and explain its purpose. c. Define benchwork and explain its purpose. d. Describe the importance of layout effectiveness in the production of machined parts. e. Summarize the process of planning and laying out a taper on a given part. f. Describe how Vertical and Horizontal saws cut material. g. Identify and describe the use of common semi-precision layout tools. h. Identify and describe the use of common precision layout instruments. i. Perform typical mathematical calculations required to perform layout. j. Perform basic layout procedures.	B5.9	1 2 5	1 2 5 11	**LS** 9-10, 11-12.6 **WS** 11-12.7 **Algebra** A-SSE 1.0. 3.0 A-REI 2.0 A-CED 1.0 **Geometry** G-CO 12.0, 13.0 G-SRT 2.0-8.1. **Invest. /Expir.** 1a,1g
TRAINING BLOCK 2: Basic Machine Operations (315 Hours)				
2.A Machine Operation on the Engine Lathe	**CTE-PS**	**CRP**	**CTE-AS**	**CCSS**
a. Demonstrate the basic operations of cutting an alloy material on the manual lathe. **b. Explain the fundamental functions of the parts of an engine lathe.** c. Plan and layout a process to machine a metal part on the manual lathe machine. d. Explain how geometric shapes are generated on a lathe. e. Describe the lathe components used to create angled features, both internal and external, on metal parts.	B1.1 B2.0 B2.1 B2.5 B8.0 B8.1	1 2 5	1 2 5 11	**LS** 9-10, 11-12.6 **WS** 11-12.7 **Algebra** A-SSE 1.0-3.0 A-CDE 4.0 A-REI 1.0, 4.0

f. Summarize basic turning operations involved in working between centers. g. Demonstrate the proper grinding a lathe-cutting tool. h. Show workpiece- and tool-holding devices used in manual lathe machining. i. Compare and contrast the depth of cut and diameter of the part. j. Demonstrate lathe operations such as: facing, threading, turning outside/inside, grooving, tapping, and knurling. k. Recognize and identify structural components of the manual lathe. l. Explain centering a part in a four-jaw chuck, and boring with a 3-jaw chuck. m. Describe various tap styles used to create a thread. n. Demonstrate and explain the tap removal process.	B8.2			AREI 2.0 **Geometry** G-CO 1.0, 12.0, 13.0 G-SRT 6.0 -9.0 G-GMD 3.0, 6.0 F-TF 1.0
2.B Machine Operation on the Vertical Mills	**CTE-PS**	**CRP**	**CTE-AS**	**CCSS**
a. Demonstrate and explain the basic concepts for cutting metal using HSS cutting tools and a manual milling machine. b. Explain and practice the safety procedures specific to the manual vertical mill. c. Demonstrate and understand basic hole-making operations such as: spot drilling, countersinking, drilling, tapping, counterboring, and removing broken taps. d. Demonstrate the application of feeds for drilling and milling. e. Compare and contrast the main differences of various milling machines. f. Demonstrate the calculations needed for feed rate, RPM, and chip load. g. Compare and contrast conventional and climbing cutting on the mill. h. Explain standardized thread systems and their designations. i. Demonstrate various tap styles and explain their uses. j. Discuss and describe the broken tap removal process. k. Explain what tramming is and how it is done. l. Describe what and how indicating a mill vise occurs using a dial indicator. m. Demonstrate and explain the process of finding the centers of circular shapes. n. Explain and describe end mills, spot drills, and drills to create features on a metal piece.	B7.1 B7.2 B7.4 B7.5 B7.6 B9.1 B9.2	1 2 5	1 2 5 11	**LS** 9-10, 11-12.6 **WS** 11-12.7 **Algebra** A-SSE 1.0, 2.0, 3.0 A-CDE 4.0 A-REI 1.0, 4.0 AREI 2.0 **Geometry** G-CO 1.0, 12.0-13.0 G-SRT 6.0 -9.0 G-GMD 3.0, 6.0 F-TF 1.0
2.C CNC Turning Operations	**CTE-PS**	**CRP**	**CTE-AS**	**CCSS**
a. Demonstrate workflow and work holding procedures for turning machines. **b. Demonstrate post processing and verification of work programs for turning centers.** **c. Demonstrate toolpath creation for turning operation in Mastercam.** d. Identify parts of a CNC turning machine. e. Describe the machine axis used for turning. f. Identify and describe tool-holding and tool-mounting devices and their application for CNC turning. g. Identify and describe work-holding devices and their application for CNC turning. h. Identify the basic G- and M-codes used for CNC turning.	B10.0 B10.1 B10.2 B10.4	1 2 4 5 11	1 2 4 5 11	**LS** 9-10, 11-12.6 **WS** 11-12.6-7 **Algebra** A-SSE 1.0-3.0 A-CDE 4.0 A-REI 1.0, 4.0 AREI 2.0 **Geometry** G-CO 1.0, 12.0-

i. Compare and contrast linear and circular interpolation for CNC turning. j. Compare and contrast radial and diametric programming. k. Explain facing operations for CNC turning. l. Differentiate CNC rough turning- from finish-turning operations. m. Compare and contrast threading and tapping operations for CNC turning machines. n. Describe various canned cycles for CNC turning machines. o. Define and explain the principles of tool nose radius compensation (TNRC) for CNC turning. p. Compare and contrast the work coordinate system (WCS) and the machine coordinate system (MCS) for CNC turning centers. q. Explain the turning center's homing procedure and purpose. r. Differentiate between workpiece offsets, geometry offsets, and wear offsets. s. Explain program prove-out procedures. t. Develop workflow processes for several projects. u. Write several programs for turning machines. v. Import and export CAD/CAM files. w. In Mastercam set up a turning CNC in a work coordinate systems environment.				13.0 G-SRT 6.0-9.0 G-GMD 3.0, 6.0 F-TF 1.0
2.D CNC Milling Operations	**CTE-PS**	**CRP**	**CTE-AS**	**CCSS**
a. Differentiate between workpiece offsets, geometry offsets, and wear offsets on CNC machining centers. **b. Describe a Basic CNC program for simple operations (facing, drilling, spot drilling, and taping).** c. Identify and describe CNC milling machine types. d. Describe the machine axis used for milling. e. Describe the two major types of ATCs. f. Identify and describe work-holding tool-holding devices used for CNC milling. g. Compare and contrast the work coordinate system (WCS) and the machine coordinate system (MCS) for CNC turning centers. h. Explain cutter radius compensation (cutter comp) offsets used in CNC milling. i. Define RPM, Depth of cut and F(Feed) I(Inches) M(Minute) in a CNC program. j. Summarize the set-up process of an CNC milling Machine. k. Demonstrate calculations for interpolation.	B7.1 B7.2 B7.4 B7.5 B7.6	1 2 4 5	1 2 4 5 11	**LS** 9-10, 11-12.6 **WS** 11-12.6-7 **Algebra** A-SSE 1.0-3.0 A-CDE 4.0 A-REI 1.0, 4.0 AREI 2.0 **Geometry** G-CO 1.0, 12.0-13.0 G-SRT 6.0-9.0 G-GMD 3.0, 6.0 F-TF 1.0
2.E Basics of CNC Machine Programming	**CTE-PS**	**CRP**	**CTE-AS**	**CCSS**
a. Demonstrate how a program will utilize safety tool movement processes when manufacturing a given part. **b. Describe the main components of a CNC program.** c. Identify and describe basic CNC motion-control hardware. d. Describe the absolute and incremental positioning systems.	B10.1	1 2 4 5 6	1 2 4 5 6	**LS** 9-10, 11-12.6 **WS** 11-12.6-7 **RSTS** 9-10, 11-12.4 **Algebra**

e. Describe the purpose of G- and M-codes. f. Explain word addresses. g. Describe modal codes. h. Define what a "block" is in CNC programming. i. Describe the machine motion types.			11	A-SSE 1.0-3.0 A-CDE 4.0 A-REI 1.0, 4.0 AREI 2.0 **Geometry** G-CO 1.0, 12.0-13.0 G-SRT 6.0-9.0 G-GMD 3.0, 6.0 F-TF 1.0
2.F Introduction to CAD-CAM Software	**CTE-PS**	**CRP**	**CTE-AS**	**CCSS**
a. Describe the basic applications of Computer Aided Design (CAD) software. **b. Describe the basic applications of Computer Aided Manufacturing (CAM) software.** c. Differentiate between wireframe, solid model, and surface drawings. d. Explain the basic principles of toolpath creation. e. Explain the basic principles of post-processing.		1 2 5	1 2 5	**LS** 9-10, 11-12.6 **WS** 11-12.7
2.G Advanced CAD/CAM Software	**CTE-PS**	**CRP**	**CTE-AS**	**CCSS**
a. Demonstrate how to import a given file from CAD to a Mastercam software to create a CNC part program file. **b. Create 2D geometry, basic blueprints, solids, toolpaths, and CNC programs using CAD/CAM software.** c. Select appropriate cutting tools for CNC machine operation using CAD/CAM software. d. Associate common CAD/CAM file types with their features. e. Apply positioning and transformation-rotation operations to set a solid piece of a particular orientation in Mastercam. f. Accurately use geometry from CAD/CAM files to create CNC programming. g. Demonstrate the process of post processing and verification of programs. h. Identify given toolpath utilizing a specific end mill to generate the cut around a given part specification. i. Generate toolpaths from solids and 2D geometry to create word address programs for 3 and 5-axis machining centers. j. Demonstrate understanding of selecting and manipulating work coordinate systems. k. Demonstrate different toolpath patterns application.	B 9.3 B10.2 B10.3 B 10.4 B.11.5	1 2 4 5	1 2 4 5 11	**LS** 9-10, 11-12.6 **WS** 11-12.6-7 **Algebra** A-SSE 1.0-3.0 A-CDE 4.0 A-REI 1.0, 4.0 AREI 2.0 **Geometry** G-CO 1.0,12.0-13.0 G-SRT 6.0-9.0 G-GMD 3.0,6.0 F-TF 1.0
2.H NIMS CNC Operator's Certification	**CTE-PS**	**CRP**	**CTE-AS**	**CCSS**
a. Inspect tool and work holders for damage. b. Inspect machine coolants and lubrications for proper levels. c. Inspect the machine guarding for safe operations. d. Describe machine startup and shutdown procedures.	B10.0 B10.1 B10.2 B10.4	1 2 4 5	1 2 4 5	**LS** 9-10, 11-12.6 **WS** 11-12.6-7 **RSTS** 9-10, 11-12.4

e. Explain fixture offset adjustments. f. Explain how to adjust for geometry offsets. g. Describe the function of each machine control. h. Describe the process of deburring completed parts. i. Explain the process of part loading using a vise or fixture. j. Illustrate tool height offset adjustments.		6	6 11	

Standards Alignment

The curricula have been aligned with the CTE Model Curriculum Standards released in 2013. Each industry sector was updated to meet the increased rigor and relevancy requirements of the Common Core State Standards. The curriculum also includes the new Standards for Career Ready Practices.

Standards for Career Ready Practice

1. *Apply appropriate technical skills and academic knowledge.*
2. *Communicate clearly, effectively, and with reason.*
3. *Develop an education and career plan aligned with personal goals.*
4. *Apply technology to enhance productivity.*
5. *Utilize critical thinking to make sense of problems and persevere in solving them.*
6. *Practice personal health and understand financial literacy.*
7. *Act as a responsible citizen in the workplace and the community.*
8. *Model integrity, ethical leadership, and effective management.*
9. *Work productively in teams while integrating cultural and global competence.*
10. *Demonstrate creativity and innovation.*
11. *Employ valid and reliable research strategies.*
12. *Understand the environmental, social, and economic impacts of decisions.*

CTE Anchor Standards—Common Core English Language Arts Alignment

Anchor Standard 1: Academics

Analyze and apply appropriate academic standards required for successful industry sector pathway completion leading to postsecondary education and employment. Refer to the industry sector alignment matrix for identification of standards. Note: alignment listed within each sector.

Anchor Standard 2: Communications

Language Standard: Acquire and accurately use general academic and domain-specific words and phrases sufficient for reading, writing, speaking, and listening at the (career and college) readiness level; demonstrate independence in gathering vocabulary knowledge when considering a word or phrase important to comprehension or expression. LS 9-10, 11-12.6

Anchor Standard 3: Career Planning and Management

Speaking and Listening Standard: Integrate multiple sources of information presented in diverse formats and media (e.g., visually, quantitatively, orally) in order to make informed decisions and solve problems, evaluating the credibility and accuracy of each source and noting any discrepancies among the data. SLS 11-12.2

Anchor Standard 4: Technology

Writing Standard: Use technology, including the Internet, to produce, publish, and update individual or shared writing products in response to ongoing feedback, including new arguments and information.

Anchor Standard 5: Problem Solving and Critical Thinking

Writing Standard: Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem, narrow, or broaden the inquiry when appropriate, and synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation. WS 11-12.7

Anchor Standard 6: Health and Safety

Reading Standards for Science and Technical Subjects: Determine the meaning of symbols, keywords, and other domain-specific words and phrases as they are used in a specific scientific or technical context. RSTS 9-10, 11-12.4

Anchor Standard 7: Responsibility and Flexibility

Speaking and Listening Standard: Initiate and participate effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners, building on others' ideas and expressing their own clearly and persuasively. SLS 9-10, 11-12.1

Anchor Standard 8: Ethics and Legal Responsibilities

Speaking and Listening Standard: Respond thoughtfully to diverse perspectives; synthesize comments, claims, and evidence made on all sides of an issue; resolve contradictions when possible; and determine what additional information or research is required to deepen the investigation or complete the work. SLS 11-2.1d

Anchor Standard 9: Leadership and Teamwork

Speaking and Listening Standard: Work with peers to promote civil, democratic discussions and decision making; set clear goals and deadlines; and establish individual roles as needed. SLS 11-12.1b

Anchor Standard 10: Technical Knowledge and Skills

Writing Standard: Use technology, including the Internet, to produce, publish, and update individual or shared writing products in response to ongoing feedback, including new arguments or information. WS 11-12.6

Anchor Standard 11: Demonstration and Application

Demonstrate and apply the knowledge and skills contained in the industry-sector anchor standards, pathway standards, and performance indicators in the classroom, laboratory, and workplace settings, and the career technical student organization. Note: no alignment evident for this standard. WS 11-12.6

Manufacturing and Product Development

B. Machining and Forming Technologies Pathway

B1.0 Validate that a provided part meets specifications from its engineering drawing by comparing specifications (geometric dimensioning and tolerancing) and by demonstrating proper technique using appropriate precision measuring tools.

B1.1 Identify and describe how the isometric and the orthographic views and the tolerance, scale, and material from an engineering drawing are used with an actual part.

B1.2 Demonstrate the correct use of precision measuring tools such as vernier and dial calipers, height gages, and micrometers utilizing both English and Metric systems.

B1.3 Demonstrate the correct use of a gage block (set) to check a part or to calibrate the accuracy of other precision measuring tools.

B1.4 Explain calibration, tolerancing, and conditions that cause parts to fall out of tolerance.

B2.0 Describe and layout a project according to specifications or engineering drawings. Demonstrate proper technique with layout tools and work-holding devices such as three- and four-jaw chucks, collet chucks, angle plates, sine bars, parallels, and v-blocks to machine a real part.

B2.1 Describe and then contrast when to use work-holding fixtures, such as v-block, angle plate, toe clamp, vises, chucks, or custom fixtures.

B2.2 Describe and demonstrate how to indicate a vice on a milling machine to "square up" a block on a mill using a micrometer and a precision square measure to confirm that the block is square.

B2.5 Describe and demonstrate the engine lathe by grinding a high-speed tool bit focusing on the tool cutting geometry and tip radius, speeds and feeds for the materials being cut and using their tool bit and precision measuring tool, machine a part within specifications.

B3.1 Classify the difference between ferrous and nonferrous metals and contrast low-, medium-, and high-carbon steels by their common uses in industry.

B3.3 Demonstrate how to calculate, then revise the calculations, for spindle speed and feed rate, for both alloy examples, for either a vertical mill or a lathe.

B4.2 Cut one steel bar and one aluminum plate determining the correct or optimal blade material (carbon steel, high speed, or bimetal), the proper sawtooth set to use for each and explain why.

B5.9 Complete a layout project using a detailed set of sequential instructions to manufacture the project to plan specifications.

B6.1 Set up and safely operate pedestal and surface grinders.

B7.0 Perform a series of routine boring operations from a set of specifications or a drawing and explain the selection of proper tools (drill, reamer, countersink, spot facer, counter bore, tap, and center drill) for each step of the process.

B7.1 Set up and safely operate a drill press.

B7.2 Square-up and lay out a block according to provided drawing and/or specifications.

B7.3 Drill, tap, or ream holes according to specifications.

B7.4 Research the proper material machinability and tooling recommendations from trade resources such as 'Machinery's Handbook'; choose the correct tool and holder; and calculate the spindle rpm and the feed rate for holes.

B7.5 Perform secondary operations on each hole to specification including reaming, countersinking, counter boring, tapping, and deburring.

B7.6 Use a pin gage or thread gage to validate each hole or that a tapped thread meets specifications.

B8.0 Describe and demonstrate the machining of an external and internal taper, knurled part, and threaded and bored part on an engine lathe to plan specification or drawing to produce a part and measure each end diameter within tolerance.

B8.1 Demonstrate proper cutting tool selection and speeds for an engine lathe.

B8.2 Set up and safely operate an engine lathe taper attachment or turning center.

B9.1 Set up and safely operate a vertical milling machine.

B9.2 Demonstrate proper cutting tool selection and speeds and demonstrate an efficient setup to minimize work-holding setups.

B9.3 Produce a part with keyway to specification demonstrating proper end mill selection, proper toolpath, and proper speeds.

B10.0 Produce parts to specifications or drawings provided on a computer numerical controlled (CNC) mill or lathe. Demonstrate common functions or controls through manual input and through programmed (stored) input. Introduce basic G and M Code Programming focusing on the use of the Cartesian coordinate system and machine axis.

B10.1 Discuss and demonstrate the setup and safe operation of a CNC turning or milling center: the setup of tools in tool holders; referencing the vice or chuck to the machine's control; and referencing the cutting tool to the machine's control.

B10.2 Demonstrate control panel commands to perform basic milling or turning commands for motion of the tool path along the coordinate axis.

B10.3 Convert a provided three-dimensional (3-D) or computer-aided design (CAD) data set to a set of machine instructions (G code) and then run the program producing the part to specifications provided.

B10.4 Demonstrate a tooling change and tool selection to complete a multistep process on a CNC milling or turning center.

B11.0 Understand and defend the purposes and processes of inspection and quality control in machining and forming processes.

B11.6 Evaluate and know how to troubleshoot performance problems of machined and formed parts.

ISTE Standards for Students

1. Empowered Learner- Students leverage technology to take an active role in choosing, achieving, and demonstrating competency in their learning goals, informed by the learning sciences.

a) Students articulate and set personal learning goals, develop strategies leveraging technology to achieve them, and reflect on the learning process itself to improve learning outcomes.

b) Students build networks and customize their learning environments in ways that support the learning process.

c) Students use technology to seek feedback that informs and improves their practice and to demonstrate their learning in a variety of ways

d) Students understand the fundamental concepts of technology operations, demonstrate the ability to choose, use and troubleshoot current technologies and are able to transfer their knowledge to explore emerging technologies.

2. Digital Citizen- Students recognize the rights, responsibilities, and opportunities of living, learning, and working in an interconnected digital world, and they act and model in ways that are safe, legal, and ethical.

a) Students cultivate and manage their digital identity and reputation and are aware of the permanence of their actions in the digital world.

b) Students engage in positive, safe, legal, and ethical behavior when using technology, including social interactions online or when using networked devices.

c) Students demonstrate an understanding of and respect for the rights and obligations of using and sharing intellectual property.

d) Students manage their personal data to maintain digital privacy and security and are aware of data-collection technology used to track their navigation online.

3.Knowledge Constructor- Students critically curate a variety of resources using digital tools to construct knowledge, produce creative artifacts, and make meaningful learning experiences for themselves and others.

a) Students plan and employ effective research strategies to locate information and other resources for their intellectual or creative pursuits.

b) Students evaluate the accuracy, perspective, credibility, and relevance of information, media, data, or other resources.

c) Students curate information from digital resources using a variety of tools and methods to create collections of artifacts that demonstrate meaningful connections or conclusions.

d Students build knowledge by actively exploring real-world issues and problems, developing ideas and theories, and pursuing answers and solutions.

4. Innovative Designer- Students use a variety of technologies within a design process to identify and solve problems creating new, useful, or imaginative solutions.

a) Students know and use a deliberate design process for generating ideas, testing theories, creating innovative artifacts, or solving authentic problems.

b) Students select and use digital tools to plan and manage a design process that considers design constraints and calculated risks.

c) Students develop, test, and refine prototypes as part of a cyclical design process.

d) Students exhibit a tolerance for ambiguity, perseverance, and the capacity to work with open-ended problems.

5. Computational Thinker- Students develop and employ strategies for understanding and solving problems in ways that leverage the power of technological methods to develop and test solutions.

a) Students formulate problem definitions suited for technology-assisted methods such as data analysis, abstract models, and algorithmic thinking in exploring and finding solutions.

b) Students collect data or identify relevant data sets, use digital tools to analyze them, and represent data in various ways to facilitate problem-solving and decision-making.

c) Students break problems into component parts, extract key information, and develop descriptive models to understand complex systems or facilitate problem-solving.

d) Students understand how automation works and use algorithmic thinking to develop a sequence of steps to create and test automated solutions.

6. Creative Communicator- Students communicate clearly and express themselves creatively for a variety of purposes using platforms, tools, styles, formats, and digital media appropriate for their goals.

a) Students choose the appropriate platforms and tools for meeting the desired objectives of their creation or communication.

b) Students create original works or responsibly repurpose or remix digital resources into new creations.

c) Students communicate complex ideas clearly and effectively by creating or using a variety of digital objects such as visualizations, models, or simulations.

d) Students publish or present content that customizes the message and medium for their intended audiences.

7. Global Collaborator- Students use digital tools to broaden their perspectives and enrich their learning by collaborating with others and working effectively in teams locally and globally.

a) Students use digital tools to connect with learners from a variety of backgrounds and cultures, engaging with them in ways that broaden mutual understanding and learning.

b) Students use collaborative technologies to work with others, including peers, experts, or community members, to examine issues and problems from multiple viewpoints.

c) Students contribute constructively to project teams, assuming various roles and responsibilities to work effectively toward a common goal.

d) Students explore local and global issues and use collaborative technologies to work with others to investigate solutions.