

Precision Machine Technology Program Elements
 January 2023

Career Cluster: Advanced Manufacturing - Pathway: Precision Machining							
Principles		CTE Concentrator A		CTE Concentrator B		Pathway Capstone	
7109	Principles of Precision Machining	7105	Precision Machining Fundamentals	7107	Advanced Precision Machining	7219	Precision Machining Capstone

7109 Principles of Precision Machining	
Course Description	<i>Principles of Precision Machining will provide students with a basic understanding of the processes used to produce industrial goods. Classroom instruction and labs will focus on shop safety, measurement, layout, blueprint reading, shop math, metallurgy, basic hand tools, milling, turning, grinding, and sawing operations. This course prepares the student for the optional National Institute for Metalworking Skills (NIMS) Measurement, Materials, & Safety certification that may be required for college dual credit.</i>
Pre/Co Req	None
Credits	Credits: 2 semester course, 2 semesters required, 1 credit per semester, 2 credits maximum
Counts Toward	Counts as a directed elective or elective for all diplomas
ITCC Courses	MTTC 101: Introduction to Machining; MTTC 106: Print Interpretation
Promoted Certifications	NIMS Measurement, Materials & Safety

CONTENT STANDARDS AND COMPETENCIES	
Competency #	Competency
Domain	<i>Introduction to Machining</i>
7109.D1.1	Demonstrate applications of machining speeds and feeds.
7109.D1.2	Interpret detail and assembly drawings of tooling and related components.
7109.D1.3	Interpret engineering data presented in graphs or charts, algebraic expressions and proportional relationships.
7109.D1.4	Demonstrate the correct use of basic hand tools, special accessories, and required testing equipment.
7109.D1.5	Identify the basic parts and applications of measuring and layout tools.

7109.D1.6	Identify the basic parts and functions of the 5 common machine tools
7109.D1.7	Identify and explain the application of all common cutting tools.
7109.D1.8	Identify and explain Metallurgy and heat treatment of steels
7109.D1.9	Perform routine preventative maintenance procedures.
7109.D1.10	Develop and utilize mathematical formulas to compute coordinates and solve machining related problems.
7109.D1.11	Solve problems and make decisions using formal process methods.
7109.D1.12	Solve mathematical problems related to machining operations.
Domain	Print Interpretation
7109.D2.1	Indicate dimensions and tolerances related to fasteners and joining requirements.
7109.D2.2	Understand detail and assembly drawings of gears and cams.
7109.D2.3	Demonstrate skills in multi-view drawings required for manufacture and repair of machinery.
7109.D2.4	Discuss detail drawings involving multi-view projections, sectional views, auxiliary views,
7109.D2.5	dimensioning subassemblies, and isometric illustrations.
7109.D2.6	Interpret welding symbols and codes.
7109.D2.7	Develop and use mathematical formulas to compute coordinates and solve gearing-related problems.
7109.D2.8	Apply basic knowledge of physics-mechanics to industrial related problems.
7109.D2.9	Apply tolerances, limits, and fits to meet manufacturing requirements.
7109.D2.10	Read prints, interpret drawings, and understand engineering specifications.
7109.D2.11	Think critically and independently, analyze, synthesize, and evaluate technical problems and information.
7109.D2.12	Solve problems and make decisions using formal process methods.
7109.D2.13	Solve mathematical problems related to engineering formulas.
7109.D2.14	Verbally describe and interpret data obtained from prints.

SAMPLE ACTIVITIES			
Domain	Technical Skills	Activity	Assessment / Evaluation
Introduction to Machining	<ul style="list-style-type: none"> ● Students can perform mathematical calculations. ● Students can process workflows. ● Students can lay out dimensions. ● Students can properly de-bur finished parts . 	<ul style="list-style-type: none"> ● Calculate Machine Speeds and Feeds daily for student projects. ● Utilize Blueprints to manufacture student projects. ● T-slot project. ● Tooling “U” assignments. 	<ul style="list-style-type: none"> ● Project assessment rubric. ● Tests and project rubrics. ● NIMS evaluations ● Tooling “U” tests.
Print Interpretation	<ul style="list-style-type: none"> ● Students can interpret multi-view and isometric blueprints. ● Students can sketch a part in 3 views. ● Students will perform mathematical calculations. 	<ul style="list-style-type: none"> ● Utilize Blueprints to manufacture student projects. ● Utilize Machinist HanBook to gather variables for threading calculations. ● Tooling “U” assignments. 	<ul style="list-style-type: none"> ● Student project rubric. ● Speeds and feeds worksheet. ● Thread formula worksheet. ● NIMS certifications. ● Tooling “U” tests.

7105 Precision Machining Fundamentals	
Course Description	<i>Precision Machining Fundamentals will build a foundation in conventional milling and turning. Students will be instructed in the classroom on topics of shop safety, theory, industrial terminology, and calculations. Lab work will consist of the setup and operation of vertical and/or horizontal milling machines and engine lathes. This course prepares the student for the optional National Institute for Metalworking Skills (NIMS) Milling I certification that may be required for college dual credit.</i>
Pre/Co Req	Principles of Precision Machining
Credits	Credits: 2 semester course, 2 semesters required, 1 credit per semester, 2 credits maximum
Counts Toward	Counts as a directed elective or elective for all diplomas Qualifies as a quantitative reasoning course
ITCC Courses	MTTC 102: Turning Processes I; MTTC 103: Milling Processes I
Promoted Certifications	NIMS Milling I

CONTENT STANDARDS AND COMPETENCIES	
Competency #	Competency
Domain	<i>Manual Milling and Turning</i>
7105.D1.1	Identify, understand and practice general and machine specific safety rules and practices.
7105.D1.2	Interpret engineering data presented in graphs or charts, algebraic expressions and proportional relationships.
7105.D1.3	Demonstrate the correct use of basic hand tools, special accessories, and required testing equipment.
7105.D1.4	Perform routine preventative maintenance procedures.
7105.D1.5	Perform linear and angular measurements using a six inch scale, micrometers, calipers, combination set, and sine bar.
7105.D1.6	Perform layout operations using a combination set, Vernier height gage, and surface plate.
7105.D1.7	Demonstrate the understanding of the theory and function of measuring and layout tools, basic operations performed on conventional machine tools, related shop theory, shop mathematics and calculations.
Domain	<i>Turning Process</i>
7105.D2.1	Identify and demonstrate correct setup and operation of tooling applications for the conventional engine lathe.

7105.D2.2	Utilize mathematical formulas to compute coordinates and solve lathe machining related problems.
7105.D2.3	Apply feeds and speeds calculations for given material and tooling combinations.
7105.D2.4	Think critically and independently analyze, synthesize, and evaluate technical problems and information.
Domain	Milling Process
7105.D3.1	Demonstrate applications of machining speeds and feeds.
7105.D3.2	Interpret detail and assembly drawings of tooling and related components.
7105.D3.3	Develop and utilize mathematical formulas to compute coordinates and solve milling machine related problems.
7105.D3.4	Perform routine preventative maintenance procedures.
7105.D3.5	Identify and demonstrate correct setup and operation of tooling applications for milling machines.
7105.D3.6	Think critically and independently analyze, synthesize, and evaluate technical problems and information.

SAMPLE ACTIVITIES			
Domain	Technical Skills	Activity	Assessment / Evaluation
Manual Milling and Turning	<ul style="list-style-type: none"> ● Students can process workflow. ● Students can create process sheets. ● Students can identify key parts of the engine lathe and milling machine. 	<ul style="list-style-type: none"> ● Machine projects utilizing project sheets. ● Demonstrate operation of the lathe and milling machine. ● Tooling “U” Assignments. 	<ul style="list-style-type: none"> ● Project rubric. ● Tooling “U” Tests. ● NIMS certifications. ● Hands on evaluations.
Turning Process	<ul style="list-style-type: none"> ● Students can turn, bore, face and thread on the engine lathe. ● Students can tram a lathe 4 jaw chuck. ● Students can perform maintenance on the engine lathe. 	<ul style="list-style-type: none"> ● Lathe turning projects. ● Jack screw project. ● Tooling “U” Assignments. 	<ul style="list-style-type: none"> ● Project rubrics. ● Tests. ● Hands on Evaluations. ● EOC final.

7107 Advanced Precision Machining	
Course Description	<i>Advanced Precision Machining will build upon the Turning and Milling processes learned in Precision Machining Fundamentals and will build a foundation in abrasive process machines. Students will be instructed in the classroom on topics of shop safety, theory, industrial terminology, and calculations associated with abrasives. Lab work will consist of the setup and operation of bench grinders and surface grinders. Additionally students will be introduced to Computerized Numeric Controlled (CNC) setup, operations and programming. This course prepares the student for the optional National Institute for Metalworking Skills (NIMS) Grinding I certification that may be required for college dual credit.</i>
Pre/Co Req	Principles of Precision Machining; Precision Machining Fundamentals
Credits	Credits: 2 semester course, 2 semesters required, 1 credit per semester, 2 credits maximum
Counts Toward	Counts as a directed elective or elective for all diplomas Qualifies as a quantitative reasoning course
ITCC Courses	MTTC 105: Abrasive Processes I; MTTC 110: Turning and Milling Processes
Promoted Certifications	NIMS Grinding I

CONTENT STANDARDS AND COMPETENCIES	
Competency #	Competency
Domain	<i>Advanced Milling and Turning</i>
7107.D1.1	Demonstrate knowledge of basic OSHA requirements, general shop safety, and MSDS information.
7107.D1.2	Create and interpret documentation for safety, set-up, and quality control purposes.
7107.D1.3	Utilize standard shop documents such as Job Routers, Job Process Sheets, Inspection Plans, etc.
7107.D1.4	Effectively interpret part prints or technical drawings, including GD&T, and use the information to select proper gauging and measurement tools.
7107.D1.5	Demonstrate applications of machining speeds and feeds.
7107.D1.6	Interpret detail and assembly drawings of tooling and related components.
7107.D1.7	Interpret engineering data presented in graphs or charts, algebraic expressions, and proportional relationships.
7107.D1.8	Demonstrate the correct use of basic hand tools, special accessories, and required testing equipment.

7107.D1.9	Perform routine preventative maintenance procedures.
7107.D1.10	Develop and utilize mathematical formulas to compute coordinates and solve lathe and milling machine related problems.
7107.D1.11	Apply basic knowledge of physics-mechanics to lathe and mill problems.
7107.D1.12	Apply tolerance limits and fits to meet lathe and mill machine tooling problems.
7107.D1.13	Identify and demonstrate correct setup and operation of tooling applications for the conventional engine lathe and mill.
7107.D1.14	Think critically and independently analyze, synthesize, and evaluate technical problems and information.
Domain	<i>Abrasive Processes</i>
7107.D2.1	Demonstrate the correct use of abrasive tooling, special accessories, and required testing equipment.
7107.D2.2	Apply tolerance limits and fits to meet abrasive processing requirements.
7107.D2.3	Identify and demonstrate correct setup and operation of abrasive operations.
7107.D2.4	Solve mathematical problems related to abrasive processing operations.
Domain	Basic CNC Programming and Operation
7107.D3.1	Develop basic CNC programming and operating skills
7107.D3.2	Utilize CNC programming and machine tools to perform complex machining tasks
7107.D3.3	Use CNC machines to rough in parts that will be used in grinding processes.
7107.D3.4	Compare the material cost, waste, manpower, scheduling of producing a part with manual machines compared to using a CNC production method using G- and M-codes

SAMPLE ACTIVITIES			
Domain	Technical Skills	Activity	Assessment / Evaluation
Advanced Milling and Turning	<ul style="list-style-type: none"> ● Students can tram the Bridgeport Head. ● Students can bore, mill and tap on the Bridgeport mill. ● Students can perform routine maintenance on the Bridgeport mill. 	<ul style="list-style-type: none"> ● Various mill projects. ● Tooling “U” assignments. ● Lecture and hands on demonstrations. 	<ul style="list-style-type: none"> ● Tooling “U” Tests. ● Project rubrics. ● Written tests. ● NIMS Certifications.
Abrasive Processes	<ul style="list-style-type: none"> ● Students can dress the grinding wheel. ● Students can square parts using a grinding vise or angle plate. ● Students can perform routine maintenance on the surface grinder. 	<ul style="list-style-type: none"> ● Student Projects. ● Tooling “U” assignments. 	<ul style="list-style-type: none"> ● Tooling “U” Tests. ● Project rubrics. ● Written tests. ● NIMS Certifications.

7219 Precision Machining Capstone	
Course Description	<i>Precision Machining Capstone is an in-depth study of skills learned in Precision Machining I, with a stronger focus on CNC setup/operation/programming. Students will be introduced to two axis CNC lathe programming and three axis CNC milling machine programming. Develops the theory of programming in the classroom with applications of the program accomplished on industry-type machines. Studies terminology of coordinates, cutter paths, angle cutting, and linear and circular interpolation. Classroom activities will concentrate on precision set-up and inspection work, as well as machine shop calculations. Students will develop skills in advanced machining and measuring parts involving tighter tolerances and more complex geometry. A continued focus on safety will also be presented.</i>
Pre/Co Req	Principles of Precision Machining; Precision Machining Fundamentals; Advanced Precision Machining
Credits	Credits: 2 semester course, 2 semesters required, 1-3 credits per semester, 6 credits maximum
Counts Toward	Counts as a Directed Elective or Elective for all diplomas Qualifies as a quantitative reasoning course
ITCC Courses	MTTC 107: CNC Setup and Operations I; MTTC 208: CNC Mill Programming; MTTC 209: CNC Lathe Programming
Promoted Certifications	NIMS CNC Mill Operations; NIMS CNC Lathe Operations

CONTENT STANDARDS AND COMPETENCIES	
Competency #	Competency
Domain	<i>CNC Setup and Operation</i>
7219.D1.1	Demonstrate a basic knowledge of OSHA requirements, chip handling, and general shop safety
7219.D1.2	Identify the components of a CNC Mill (Machining Center) and Lathe (Turning Center)
7219.D1.3	Identify and understand important documentation including job routers/process plan sheets, setup sheets, and prints.
7219.D1.4	Perform machine inspections and preventative maintenance checks on CNC mills & lathes
7219.D1.5	Understand and navigate the machine control unit (MCU)
7219.D1.6	Perform safe and proper machine startup and shut down procedures
7219.D1.7	Recognize and correct machine malfunctions
7219.D1.8	Use jog controls to move the machine manually

7219.D1.9	Locate, assemble, and install the correct tooling in the tool changer/turret.
7219.D1.10	Properly install and align the appropriate workholding systems in the machine according to part documentation
7219.D1.11	Locate and set work offsets
7219.D1.12	Properly set tool offsets for each tool required in the part documentation
7219.D1.13	Load, verify, and safely execute a CNC program in automatic mode
7219.D1.14	Use manual, manual data input, and automatic operation modes.
7219.D1.15	Interpret the components of a basic CNC program
7219.D1.16	Perform basic edits of a part program
7219.D1.17	Use standard measuring and inspection tools to determine if parts are within tolerances
7219.D1.18	Apply basic Geometric Dimensioning & Tolerancing (GD&T) to part inspection.
7219.D1.19	Make tool wear adjustments to manufacture parts to specifications
Domain	<i>CNC Programming: Mill and Lathe</i>
7219.D2.1	Consistently demonstrate proper programming format and techniques for manual CNC programming to machine parts without error.
7219.D2.2	Complete appropriate documentation for safety, set-up, and quality control purposes.
7219.D2.3	Create process plans and routings for machining operations.
7219.D2.4	Choose appropriate tooling for specified material and machining operation.
7219.D2.5	Calculate proper feeds and speeds for optimal tool life, machining time, and part finish.
7219.D2.6	Understand and use the Cartesian Coordinate System
7219.D2.7	Write mill and lathe G and M code programs manually on the machine control/simulator/PC
7219.D2.8	Verify, troubleshoot, and correct part programs and machining problems
7219.D2.9	Navigate CNC controls to run programmed parts

SAMPLE ACTIVITIES			
Domain	Technical Skills	Activity	Assessment / Evaluation
CNC Setup and Operation	<ul style="list-style-type: none"> • Students can setup CNC Machine. • Students can edit a program. • Students can change offsets. 	<ul style="list-style-type: none"> • CNC projects. • Lecture and demonstrate. • Tooling “U” assignments. 	<ul style="list-style-type: none"> • Tooling “U” Tests. • Project rubrics. • Written tests. • NIMS Certifications.
CNC Programming : Mill and Lathe	<ul style="list-style-type: none"> • Students can create CNC Setup sheets. • Students can create a CNC program. • Students can edit a CNC Program. 	<ul style="list-style-type: none"> • CNC Projects. • Tooling “U” assignments. • Lecture and Demonstrations. 	<ul style="list-style-type: none"> • Tooling “U” Tests. • Project rubrics. • Written tests. • NIMS Certifications.