# Scope & Sequence

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| Course Name: Precision Metal Manufacturing I**TSDS PEIMS Code:** 13032500 | **Course Credit:** 2.0**Course Requirements:** This course is recommended for students in grades 10-12. **Prerequisites:** None.**Recommended Prerequisites:** Principles of Manufacturing and completion of, or concurrent enrollment, in Algebra I or Geometry. |
| **Course Description:** Precision Metal Manufacturing I will provide the knowledge, skills, and technologies required for employment in precision machining. While the course is designed to provide necessary skills in machining, it also provides a real-world foundation for any engineering discipline. This course may address a variety of materials such as plastics, ceramics, and wood in addition to metal. Students will develop knowledge of the concepts and skills related to precision metal manufacturing to apply them to personal and career development. This course supports integration of academic and technical knowledge and skills. Students will have opportunities to reinforce, apply, and transfer knowledge and skills to a variety of settings and problems. Knowledge about career opportunities, requirements, and expectations and the development of workplace skills prepare students for success. This course is designed to provide entry-level employment for the student or articulated credit integration into a community college and dual credit with a community college with completion of the advanced course. |
| **NOTE:** This is a suggested scope and sequence for the course content. This content will work with any textbook or instructional materials. If locally adapted, make sure all TEKS are covered. |
| **Total Number of Periods****Total Number of Minutes****Total Number of Hours** | 350 Periods15,750 Minutes262.5 Hours\* | \*Schedule calculations based on 175/180 calendar days. For 0.5 credit courses, schedule is calculated out of 88/90 days. Scope and sequence allows additional time for guest speakers, student presentations, field trips, remediation, extended learning activities, etc. |
| **Unit Number, Title, and Brief Description** | **# of Class Periods\***(assumes 45-minute periods)Total minutes per unit | **TEKS Covered****130.359 Knowledge and skills** |
| **Unit 1: Academic Knowledge and Technical Skills for Precision Metal Manufacturing**This unit will include lessons on terminology and skills that are associated with technical reading and writing, mathematics, and science knowledge specifically pertaining to metal fabrication and machining. Students will focus on understanding, interpreting, analyzing and knowing how to correctly understand engineering drawings, use units of measure, and apply mathematics and science concepts in order to complete projects and solve problems.  | 30 Periods1,350 Minutes | 3. The student applies advanced academic skills to the requirements of precision metal manufacturing. The student is expected to:(A) demonstrate technical writing skills related to writing requirements found in manufacturing;(B) demonstrate mathematical skills such as algebra, geometry, trigonometry, statics, and conversion as applied to machining;(C) interpret engineering drawings, including drawings using geometric dimensioning and tolerancing;(D) describe orthographic and isometric views of three-dimensional figures;(E) evaluate mathematics as it applies to precision machining operations; and(F) discuss basic concepts of physics as applied to machining4. The student recognizes the concepts and skills that form the technical knowledge required in precision machining. The student is expected to:(A) examine the resources found in recognized manufacturing reference materials such as *The Machinery's Handbook*; and(B) demonstrate knowledge of the uses of reference charts such as tap drill charts, drill size charts, and feed-speed charts |
| **Unit 2: Workplace Regulations, Safety & Compliance**This unit will expose students to the important regulations and safety standards that are implemented within this industry. Students will learn that such practices are in place to manage resources to minimize losses and liabilities to businesses in the industry. During this unit students will acquire and apply basic knowledge regarding safe use of professional precision metal manufacturing equipment. Students will demonstrate the proper use and care of Personal Protection Equipment (PPE) used in precision metal manufacturing. | 30 Periods1,350 Minutes | 2. The student explores the employability characteristics of a successful worker in the global economy. The student is expected to:(F) demonstrate skills related to health and safety in the workplace as specified by appropriate governmental regulations5. The student evaluates the function and application of the tools, equipment, technologies, and materials used in precision machining. The student is expected to:(A) practice safety while running equipment commonly employed in machine shops;(B) identify and properly dispose of environmentally hazardous materials used in machine shops6. The student employs skills necessary to perform bench work and layout. The student is expected to:(A) use equipment commonly employed in bench work and layout in a safe manner8. The student employs skills necessary to perform manual lathe work. The student is expected to:(A) use equipment such as accessories commonly implemented on and around a lathe in a safe manner9. The student employs skills necessary to perform manual milling work. The student is expected to:(A) use equipment commonly used with a milling machine in a safe manner10. The student employs skills necessary to perform work on various support equipment commonly found in a machine shop. The student is expected to:(A) use various support equipment commonly found in a machine shop in a safe manner |
| **Unit 3: Metallurgy**Students will learn that metallurgy is the study of the properties and characteristics of metals. In this unit students will explore the cause and effects of oxidation on metal, what types of metal are best used for products based on functionality and quality. Students will demonstrate the ability to identify and measure different types of metals used in sheet metal. Students will identify and demonstrate using various metals in sheet metal, including alloys and pure metals and their properties. | 25 Periods1,125 Minutes | 5. The student evaluates the function and application of the tools, equipment, technologies, and materials used in precision machining. The student is expected to(E) demonstrate knowledge of heating metals such as hardening, tempering, annealing, normalizing, and case hardening steel; and (G) identify basic metallic and non-metallic materials |
| **Unit 4: Bench Work and Layout**In this unit students will learn about common bench work operations performed before and after machining a part and describes common layout tools and procedures. Students will use blueprints and process plans to determine project requirements, develop and complete layout patterns, layout, measurement, marking dimensions and referencing lines on materials. Students will safely and properly use bench work equipment and layout tools including, but not limited to, surface plate, gage, combination set, scriber, layout ink, punch, ball peen hammer, reamer, tap, etc.  |  35 Periods 1,575 Minutes | 6. The student employs skills necessary to perform bench work and layout. The student is expected to:(A) use equipment commonly employed in bench work and layout in a safe manner;(B) develop the ability to use a file to cut flats, angles, and radiuses; and(C) employ standard layout tools to transfer a part design to the actual part(D) perform center punching and hand drilling of holes using an electric or air hand drill;(E) perform hand tapping of holes;(F) perform hand reaming of holes using an electric or air hand drill;(G) develop a detailed layout part such as the National Institute for Metalworking Skills (NIMS) Level 1 layout part;(H) develop a detailed bench work part such as the NIMS Level 1 bench work part; and(I) employ basic housekeeping skills as applied to a machine shop |
| **Unit 5: Precision Measurement**Students will learn the responsibility of calibrating equipment through precision measurement to ensuring that every piece of equipment and machinery is in proper, safe, working order. Students will be able to identify the required measuring instruments for inspection and demonstrate their use. Students will utilize exacting attention to detail as they take measurements in increments as small as millionths to ensure machines and equipment are safe for operation. Additionally, students will analyze and interpret data for statistical process control. | 35 Periods1,575 Minutes | 7. The student employs skills necessary to perform precision measurement. The student is expected to:(A) use equipment commonly used during precision measurement in a safe manner;(B) write an inspection plan;(C) identify and select the required measuring instrument(s) to conduct the required inspection procedure(s); and(D) describe statistical process control |
| **Unit 6: Manual Lathe Processes and Procedures**Students will identify and describe the function of lathe components including bed, tool post, Chuck, head stock, tail stock, legs, Gear chain, lead screw, carriage, cross slide, split nut, apron, chip pan, guide ways, etc. Students will learn basic maintenance, and how to safely and properly use lathe equipment. Students will demonstrate standard lathe operations used to perform turning, chamfering, boring, facing, internal threading, shaping, slot cutting etc. on cylindrical work piece.  | 35 Periods1,575 Minutes | 8. The student employs skills necessary to perform manual lathe work. The student is expected to:(A) use equipment such as accessories commonly implemented on and around a lathe in a safe manner;(B) analyze the advantages and disadvantages between a four-jaw independent chuck, a three-jaw universal chuck, and a collet workholding system;(C) indicate a part in a four-jaw independent chuck within.003" total indicated runout (TIR) using a standard indicator;(D) identify and describe the function of the components of a lathe;(E) identify and use most accessories and tooling for turning operations;(F) demonstrate the standard turning operations of boring, chamfering, cutting tapers, drilling, facing, grooving, knurling, polishing, threading, and turning on a manual lathe;(G) write a detailed process plan for turning, including appropriate processes such as feeds, speeds, tool selection, and sequencing;(H) develop a detailed turning part such as the NIMS Level 1 turning, chucking or turning between centers part; and(I) employ basic preventative maintenance on the lathe |
| **Unit 7: Manual Milling Machine Processes and Procedures**Students will identify and describe the function of lathe components including the head, knee, worktable, column, base, saddle, etc. Students will demonstrate milling procedures such as milling flat surfaces, beveling, chamfering, grooving, climb milling, conventional milling, slotting, cutting angles, etc. Students will learn about the hazard of leaving loose items around the table of the mill, flying objects and even chemicals that can be dangerous when working on the mill and will practice safety daily. Students will learn advantages and disadvantages of various work holding methods such as using a vise, clamping to a table, and clamping to an angle plate. Students will employ basic preventative maintenance on the milling machine and keep them clean.  | 35 Periods1,575 Minutes | 9. The student employs skills necessary to perform manual milling work. The student is expected to:(A) use equipment commonly used with a milling machine in a safe manner;(B) analyze the advantages and disadvantages of various work holding methods such as using a vise, clamping to a table, and clamping to an angle plate;(C) contrast the various ancillary tools used on milling machines such as a rotary table, indexing head, and super spacer;(D) identify or describe the function of the components of a milling machine;(E) tram in the head of a vertical milling machine;(F) locate and set a work piece in a milling vise employing a dial indicator;(G) develop a square block in the milling machine to close tolerances;(H) demonstrate various hole-making activities such as spot drilling, drilling, reaming, tapping, countersinking, and boring on the milling machine;(I) demonstrate various milling activities such as climb milling, conventional milling, slotting, grooving, cutting angles, and chamfering;(J) write a detailed process plan, including appropriate feeds, speeds, tool selection, work holding methods, and sequencing for milling;(K) develop a detailed milling part such as the NIMS Level 1 milling part; and(L) employ basic preventative maintenance on the milling machine |
| **Unit 8: Machining Support Equipment**Students will demonstrate safe and proper use of files, grinders, saws and other hand and power tools in accordance with good shop practices. Students will demonstrate the ability to properly set up and use a pedestal grinder including dressing of grinding wheels. Students will select appropriate speeds and feeds for the workpiece on a drill press and band saw. Students will understand demonstrate the operations of a drill press including, but not limited to, center drilling, creating pilot holes, and drilling of blind holes. Students will learn basic maintenance, and how to safely and properly use lathe equipment. | 35 Periods1,575 Minutes | 10. The student employs skills necessary to perform work on various support equipment commonly found in a machine shop. The student is expected to:(A) use various support equipment commonly found in a machine shop in a safe manner;(B) understand basic pedestal grinder functions such as wheel selection criteria and requirements;(C) understand basic sawing functions such as band type, speed, and feeds for various types of material;(D) understand basic drill press operations, including work holding, appropriate speeds, and feeds; and(E) use proper safety procedures for surface grinding operations5. The student evaluates the function and application of the tools, equipment, technologies, and materials used in precision machining. The student is expected to:(H) compare various abrasives for type, structure, bond, and use |
| **Unit 9: Tools, Equipment, Technology, and Materials**During this unit, students will learn about the types of technology integrated into the metal fabrication and machining industry. Students will understand how computerized systems increase businesses’ effectiveness and completing workplace tasks with accuracy and efficiency. Students will identify and describe trends in the use of emerging technology in the welding industry, including the use of automated welding machines such as numerical control, computer numerical control, and robotics-controlled machines. | 30 Periods1,350 Minutes | 5. The student evaluates the function and application of the tools, equipment, technologies, and materials used in precision machining. The student is expected to:(C) demonstrate knowledge of computer numerical control (CNC) operations; and(D) demonstrate knowledge of emerging technologies that may affect the machine shop |
| **Unit 10: Employability Skills**This unit explores the professional standards and employability skills required by business and industry. Students will grow to understand that responsibility, time management, organization, positive attitude, and good character have a large impact on employability and job retention. Students will understand the professional ethics legal responsibilities pertaining to the manufacturing industry. Students will also be able to identify and describe the work ethic needed for career advancement in the manufacturing industry (e.g., skill sets, work schedules, travel/relocation, teamwork, communication skills, flexibility and adaptability etc.).  | 30 Periods1,350 Minutes | 1. The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:(A) express ideas to others in a clear, concise, and effective manner through written and verbal communication;(B) convey written information that is easily understandable to others;(C) demonstrate acceptable work ethics in reporting for duty and performing assigned tasks as directed;(D) conduct oneself in a manner acceptable for the profession and work site such as suitable dress and polite speech;(E) choose the ethical course of action and comply with all applicable rules, laws, and regulations;(G) evaluate systems and operations; identify causes, problems, patterns, or issues; and explore workable solutions or remedies to improve situations;(H) follow written and oral instructions and adhere to established business practices, policies, and procedures, including health and safety rules; and(I) prioritize tasks, follow schedules, and work toward goal-relevant activities in an effective, efficient manner2. The student explores the employability characteristics of a successful worker in the global economy. The student is expected to:(C) demonstrate the professional standards required in the workplace such as interviewing skills, flexibility, willingness to learn new skills and acquire knowledge, self-discipline, self-worth, positive attitude, and integrity in a work situation; and(E) communicate effectively with others in the workplace to clarify objectives |
| **Unit 11: Professional Development**During this unit, students will learn more about the qualities and characteristics required to be successful in business and industry. While a basic understanding and development of employability skills will help students obtain employment, they will learn that developing leadership skills will aid them in job retention and potential promotion opportunities. This unit will help students better understand the various career opportunities within the manufacturing industry. Students will develop a career plan designed to achieve their career goals within this industry.Students will focus on expanding their knowledge about the education, training, and/or certification required to obtain employment in the industry. Students will develop a career plan designed to achieve their career goals within this industry. | 30 Periods1,350 Minutes | 1. The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:(F) review the fine, detailed aspects of both quantitative and qualitative work processes and end products2. The student explores the employability characteristics of a successful worker in the global economy. The student is expected to:(A) determine academic knowledge and skills required for postsecondary education;(B) identify employers' expectations to foster positive customer satisfaction; (D) evaluate personal career goals; and (F) demonstrate skills related to health and safety in the workplace as specified by appropriate governmental regulations5. The student evaluates the function and application of the tools, equipment, technologies, and materials used in precision machining. The student is expected to:(F) apply technical knowledge and skills in a machine shop to career preparation experiences |