

Course Title:	Advanced Manufacturing
Grade(s):	11-12

Course Description
This Advanced Manufacturing course introduces students to modern manufacturing processes through the use of computer-aided design (CAD), computer-aided manufacturing (CAM), and CNC machining. Students will use SolidWorks to design mechanical parts and assemblies, create machining toolpaths, and manufacture projects using a Haas Desktop Mill.
Approved Curricular Materials/Textbook(s)

Unit Title	Unit Description (Include Unit Objectives)	Unit Pacing
Unit 1: CAD Modeling Fundamentals	Students will develop foundational skills in Computer-Aided Design (CAD) by creating accurate three-dimensional models used in modern manufacturing. Emphasis is placed on sketching, parametric modeling, design intent, and creating parts suitable for CNC machining and production. Students will be able to: • Navigate CAD software and utilize common design tools. • Create and constrain two-dimensional sketches. • Develop three-dimensional solid models using extrude, revolve, sweep, and loft features. • Apply dimensions and geometric relationships accurately. • Modify designs using parametric modeling techniques. • Create assemblies and evaluate component fit. • Generate engineering drawings from 3-D models. • Design parts that can be efficiently manufactured using CNC	2-4 weeks

	equipment.	
Unit 2: CNC Safety	Students will learn the safety procedures and responsibilities required when operating CNC machinery and working in a manufacturing environment. Topics include machine hazards, personal protective equipment (PPE), emergency procedures, and safe operating practices. Students will be able to: • Identify hazards associated with CNC machining operations. • Demonstrate proper use of personal protective equipment (PPE). • Follow shop safety rules and machine operating procedures. • Explain emergency stop procedures and machine safety systems. • Practice safe material handling techniques. • Maintain a clean and organized work area. • Perform pre-operation safety inspections. • Demonstrate safe behavior during all manufacturing activities.	2 weeks
Unit 3: Machine Setup	Students will learn the procedures required to prepare CNC equipment for manufacturing operations. Topics include machine homing, tool setup, work coordinate systems, material preparation, and program verification. Students will be able to: • Identify major components of CNC machines. • Perform machine startup and homing procedures. • Install and verify cutting tools. • Set work offsets and coordinate systems. • Secure materials for machining operations. • Verify machine setup using simulations and dry runs. • Identify common setup errors and corrective actions. • Prepare machines for safe and efficient production.	1 week

Unit 4: Toolpath Generation	Students will use CAM software to create toolpaths that control CNC machine operations. Students will learn how machining strategies affect part quality, machining time, and tool performance. Students will be able to: • Explain the relationship between CAD, CAM, and CNC machining. • Create machining operations using CAM software. • Select appropriate machining strategies for various features. • Generate roughing, finishing, drilling, and contour toolpaths. • Simulate machining operations to identify errors. • Modify toolpaths to improve efficiency and quality. • Post-process programs into machine-ready code. • Verify toolpaths prior to machining.	1 week
Unit 5: Feeds and Speeds	Students will investigate how spindle speed, feed rate, depth of cut, and material properties affect machining performance. Students will apply calculations and manufacturer recommendations to optimize machining operations. Students will be able to: • Define spindle speed, feed rate, chip load, and cutting depth. • Explain how material properties influence machining parameters. • Calculate basic spindle speeds and feed rates. • Select machining parameters for common manufacturing materials. • Evaluate tool performance during machining operations. • Recognize signs of improper feeds and speeds. • Adjust machining parameters to improve surface finish and tool life. • Use reference charts and tooling data effectively.	2 weeks
Unit 6: Precision Measurement	Students will develop the skills necessary to accurately measure manufactured components using precision inspection tools. Emphasis is placed on tolerance verification, measurement techniques, and interpreting	2 weeks

	engineering drawings. Students will be able to: • Read and interpret engineering dimensions and tolerances. • Use rulers, calipers, and micrometers accurately. • Measure internal, external, and depth dimensions. • Record and communicate measurement results effectively. • Verify part dimensions against design specifications. • Identify measurement errors and sources of inaccuracy. • Apply proper inspection techniques during manufacturing. • Evaluate whether a part meets design requirements.	
Unit 7: Workholding	Students will explore methods of securing materials during machining operations. Students will learn how proper workholding improves safety, accuracy, efficiency, and part quality. Students will be able to: • Explain the purpose of workholding systems. • Identify common workholding devices and applications. • Select appropriate workholding methods for various parts. • Properly secure stock materials for machining operations. • Evaluate workholding setups for safety and accessibility. • Minimize vibration and movement during machining. • Design simple fixtures for specialized applications. • Troubleshoot common workholding challenges.	2 weeks
Unit 8: Inspection and Quality Control	Students will examine quality assurance practices used in modern manufacturing environments. Topics include inspection procedures, process control, defect identification, documentation, and continuous improvement.	Ongoing

	Students will be able to: ● Explain the importance of quality control in manufacturing. ● Perform dimensional inspections using precision measuring tools. ● Identify manufacturing defects and their causes. ● Document inspection results accurately. ● Compare finished parts to engineering specifications. ● Apply basic statistical concepts to quality evaluation. ● Recommend corrective actions for quality issues. ● Demonstrate attention to detail during inspection processes.	
Unit 9: Manufacturing Workflow	Students will integrate CAD, CAM, CNC machining, inspection, and quality control into a complete manufacturing workflow. Students will plan, manufacture, inspect, and document a finished product while applying industry-standard practices. Students will be able to: ● Describe the complete manufacturing process from design to finished product. ● Develop a manufacturing plan for a production project. ● Organize materials, tooling, and machine resources efficiently. ● Execute machining operations according to established procedures. ● Inspect and verify completed components. ● Document manufacturing processes and production data. ● Identify opportunities for process improvement. ● Collaborate effectively within a manufacturing team. ● Demonstrate professional workplace practices and communication skills. ● Produce a finished product that meets established quality standards.	Ongoing