

## FY 2023 Manufacturing Technologies Career Field Pathways and Course Structure

Manufacturing Operations R7 Pathway Courses	Metallurgy R8 Pathway Courses
Pre-Engineering Technologies <sup>1</sup>	Pre-Engineering Technologies <sup>1</sup>
Manufacturing Operations <sup>2,4</sup>	Manufacturing Operations <sup>2,4</sup>
Robotics	Welding Technologies <sup>2</sup>
Computer Integrated Manufacturing	Welding Fabrication
Digital Electronics	Gas Metal Arc Welding
Gas Metal Arc Welding	Shielded Metal Arc Welding
Shielded Metal Arc Welding	Flux Cored Arc Welding
Flux Cored Arc Welding	Gas Tungsten Arc Welding
Gas Tungsten Arc Welding	Plan Reading <sup>4</sup>
Machine Tools	Manufacturing Capstone
Machining with Industrial Lathes	
Machining with Industrial Milling Machines	
Computer Numerical Control Technology with Industrial Mills and Lathes	
Manufacturing Capstone	
Welding Technologies <sup>2</sup>	
Principles of Manufacturing	
Welding Fabrication	
Industrial Maintenance	
Industrial Robotics	
Hydraulics and Pneumatics	
Principles of Advanced Manufacturing <sup>4</sup>	
Introduction to Semiconductors <sup>4</sup>	
Vacuum Systems <sup>4</sup>	

<sup>1</sup>First course in the Career Field; <sup>2</sup>First course in the Pathway; <sup>3</sup>Does not count as one of the required four courses; <sup>4</sup>CTAG Available; <sup>5</sup>For Use by SREB Approved Programs Only.

## **Manufacturing Operations**

Subject Code: 175003

Students will learn the production processes applied across manufacturing operations. Students will be able to demonstrate a broad array of technical skills with an emphasis given to quality practices, measurement, maintenance and safety.

## **Robotics**

Subject Code: 175004

Students will apply the knowledge and skills necessary to program and operate robots, using the teach pendant as the main interface point. Students will learn robotic operations and system configurations. Students will code, compile and debug programs using the robotic programming language.

## **Computer Integrated Manufacturing**

Subject Code: 175006

In this course, students will be introduced to all aspects of computer-integrated manufacturing. They will learn about robotics and automation, manufacturing processes, computer modeling, manufacturing equipment, and flexible manufacturing systems.

## **Digital Electronics**

Subject Code: 175007

Students are introduced to the process of combinational and sequential logic design. The system uses a precise sequence of discrete voltages, representing numbers, non-numeric symbols or commands for input, processing, transmission, storage or display. Engineering standards and methods for technical documentation will also be learned.

## **Pre-Engineering Technologies**

Subject Code: 175015

Students will acquire knowledge and skills in problem solving, teamwork and innovation. Students explore STEM careers as they participate in a project-based learning process, designed to challenge and engage the natural curiosity and imagination of middle school students. Teams design and test their ideas using modeling, automation, robotics, mechanical and computer control systems, while exploring energy and the environment.

## **Gas Metal Arc Welding**

Subject Code: 176000

Students will use the Gas Metal Arc Welding process (GMAW) to safely join various types of metal. They will cut metals using oxy-fuel processes and perform multiple types of welds and joints in all positions, up to and including overhead. They will select the appropriate type of electrode wire and shielding gas, and they will adjust welding equipment based on the physical characteristics and metal properties. Students will apply quality control factors to evaluate weld quality.

## **Shielded Metal Arc Welding**

Subject Code: 176001

Students will be able to use the Shielded Metal Arc Welding process (SMAW) to safely join various types of metal. They will perform multiple types of welds and joints in all positions, up to and including overhead. They will select the appropriate type of electrode and adjust welding equipment based on the physical characteristics and properties of the metal. Students will apply quality control factors to evaluate the quality of welds.

## **Flux Cored Arc Welding**

Subject Code: 176002

Students will be able to use the Flux Cored Arc Welding process (FCAW) to safely join various types of metal. They will perform multiple types of welds and joints in all positions up to and including overhead. They will select the appropriate type of cored electrode wire and adjust welding equipment based on the physical characteristics and properties of the metal. Students will apply quality control factors to evaluate the quality of welds.

## **Gas Tungsten Arc Welding**

Subject Code: 176003

Students will use the Gas Tungsten Arc Welding process (GTAW) to safely join various types of metal. They will perform multiple types of welds and joints in all positions, up to and including overhead. They will select the appropriate type of electrode, filler metal and shielding gas. They will be able to adjust welding equipment based on the physical characteristics and properties of the metal. Students will apply quality control factors to evaluate weld quality.

## **Machine Tools**

Subject Code: 176004

This course introduces students to all aspects of machining applications in manufacturing. They will be able to perform routine calculations, interpret basic drawings, begin the process of performing accurate measurements and be able to plan simple machining processes. Students will learn the fundamental principles and practices of cutting, drilling and grinding using modern machine tools, hand tools and precision measuring instruments.

## **Machining with Industrial Lathes**

Subject Code: 176005

This course directs the student in the safe use of different types of manual industrial lathes. Students will use these machine tools to shape, pattern, bore, thread and polish metal and other materials. Students will apply their knowledge of product characteristics, perform necessary calculations, use precision measuring instruments and make all adjustments needed to fabricate products to print dimensions. Students will be able to identify operational problems and provide routine care and maintenance to the lathe.

## **Machining with Industrial Milling Machines**

Subject Code: 176006

In this course, students are directed in the safe use of manual milling machines. Students apply their knowledge of product characteristics, perform necessary calculations, and use precision measuring instruments and layout equipment to mill products to print dimensions. Students will use these machine tools to shape, cut, drill and bore metal and other materials. Students will be able to identify operational problems and provide routine care and maintenance to the manual mill.

## **Computer Numerical Control Technology with Industrial Mills and Lathes**

Subject Code: 176007

In this course, students will use computer numerical control (CNC) programming to mill products comprised of various materials. Students will prepare numerical control programs in positioning systems using standard industrial G and M codes. They will program computerized numerical control mills and lathes.

## **Manufacturing Capstone**

Subject Code: 176008

The capstone course provides opportunities for students to apply knowledge, attitudes and skills that were learned in a Manufacturing program in a more comprehensive and authentic way. Capstones often include project/problem-based learning opportunities that occur both in and away from school. Under supervision of the school and through community partnerships, students may combine classroom learning with work experience. This course can be delivered through a variety of delivery methods including cooperative education or apprenticeship.

## **Welding Technologies**

Subject Code: 176009

Students will use fundamental welding principles involving shielded metal arc, oxyacetylene, gas tungsten and gas metal arc welding in the flat, horizontal and vertical positions. Emphasis is given to electrode selection, equipment setup, operating procedures, welding inspection and testing. Students will learn joint designs and layout and will be introduced to welding codes and standards. Additional topics include employability skills, and an emphasis will be given to personal safety.

## **Principles of Manufacturing**

Subject Code: 176010

Students will apply knowledge and skills required in the application of standard manufacturing practices including planning, design and visualization. Students will learn and apply skills related to interpreting drawings, creating documentation and performing measurements. Additionally, students will use principles and techniques of Computer Numerical Control (CNC), employ scheduling, and practice project evaluation.

## **Welding Fabrication**

Subject Code: 176015

Students will apply the knowledge and skills necessary to safely fabricate parts by cutting, drilling, bending, shaping, forming, edging and assembling stock to drawing dimensions. Students will identify weld types, fasteners and adhesives to join materials.

## **Industrial Maintenance**

Subject Code: 176020

Students will apply the knowledge and skills necessary for installing, maintaining and safely troubleshooting modern industrial machinery. Students will learn about pneumatic, hydraulic, mechanical and electrical systems. They will learn to solve practical maintenance problems, read and interpret drawings and maintenance manuals and understand manufacturing process quality practices. Students will troubleshoot electrical controls, sensors and actuators for automated machinery and manufacturing processes.

## **Industrial Robotics**

Subject Code: 176025

Students will apply the knowledge and skills necessary to program, safely operate, and troubleshoot industrial robots. Students will learn industrial robotic operations and system configurations. Students will code, compile and debug programs using industrial robotic programming language.

## **Hydraulics and Pneumatics**

Subject Code: 010225

Students will learn to diagnose, repair and rebuild hydraulic systems and their components. Students will learn the physical and mechanical principles of both hydraulic and hydrostatic operating units. Topics include testing system components and properly maintaining hydraulic and hydrostatic circuits. Students will demonstrate contamination control and system cleanliness in both hydraulic and hydrostatic operating systems. Throughout the course, site and personal safety procedures and business practices are reinforced.

## **Principles of Advanced Manufacturing**

Subject Code: 176035

This course introduces students to modern manufacturing organizations, technology, business systems, and problem solving. Provides the fundamentals of Lean Manufacturing, Quality Systems and Statistical Process Control, documentation and standard operating procedures, concepts in measurement, geometric dimensioning and tolerancing, visualization and graphics.

## **Introduction to Semiconductors**

Subject Code: 176030

This course is a broad introduction to semiconductor and integrated circuit manufacturing from a technician and maintenance perspective. In lecture, students will learn about what a cleanroom is, why it's important to gown up, and have a broad non-quantitative introduction to semiconductor processing. In the lab students will use hand-tools to perform inspection, maintenance and repair of mechanical fasteners and fixtures associated with semiconductor equipment, and gown up to simulate working in a bunny suit.

## **Vacuum Systems**

Subject Code: 176040

This class focuses on the mechanical maintenance, processing, and data collection of vacuum systems typically used in semiconductor processes such as thin film deposition, ion implantation, and reactive ion etching. The lectures consist of a broad introduction to the use of vacuum pumps in semiconductor manufacturing and how to measure vacuum pressure within a multi-pump system. In Lab, students will gown up in a bunny suit and simulate working in a cleanroom environment.