

## FY 2023 Engineering and Science Technologies Career Field Pathways and Course Structure

Engineering and Science Technologies F6 Pathway Courses	Robotics F7 Pathway Courses
Pre-Engineering Technologies <sup>1</sup>	Pre-Engineering Technologies <sup>1</sup>
Engineering Design <sup>4</sup>	Engineering Design <sup>4</sup>
Engineering Principles <sup>2,4</sup>	Engineering Principles <sup>2,4</sup>
Manufacturing Operations <sup>2,4</sup>	Engineering Principles <sup>2,4</sup>
Robotics	Robotics
Computer Integrated Manufacturing <sup>4</sup>	Digital Electronics <sup>4</sup>
Digital Electronics <sup>4</sup>	Mechanisms and Drives
Mechanisms and Drives	Engineering Capstone <sup>3</sup>
Engineering Capstone <sup>3</sup>	Analog Based Electronic Devices
Analog Based Electronic Devices	Engineering Logic
Engineering Logic	AC Electronic Circuits
AC Electronic Circuits	DC Electronic Circuits <sup>4</sup>
DC Electronic Circuits <sup>4</sup>	Machine Tools
Machine Tools	Computer Numerical Control Technology with Industrial Mills and Lathes <sup>4</sup>
Computer Numerical Control Technology with Industrial Mills and Lathes <sup>4</sup>	Principles of Manufacturing
Welding Technologies <sup>4</sup>	Industrial Robotics
Principles of Manufacturing	Hydraulics and Pneumatics
Industrial Robotics	Computer Hardware
Hydraulics and Pneumatics	Computer Software
Energy Systems Management	Plan Reading and Estimating <sup>4</sup>
Biomedical Engineering	
Computer Hardware	
Computer Software	
Aviation	
Unmanned Aircraft Systems	
Plan Reading and Estimating <sup>4</sup>	
Architecture Design – Structural and Mechanical/Electrical/Plumbing	
Architecture Design – Site and Foundation Plans	
Innovations in Science and Technology (SREB) <sup>5</sup>	
Aerospace Engineering (SREB) <sup>5</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

## **Engineering Design**

Subject Code: 175001

Students will learn the application of the engineering design process. Topics include work-processes, optimization methods, design optimization and risk management tools. Students will use 2D and 3D modeling software to help them design solutions to proposed problems, document their work and communicate solutions. Additionally, students will interpret industry prints and create working drawings from functional models. Emphasis is given to experimental problem solving in real systems.

## **Engineering Principles**

Subject Code: 175002

This course will introduce students to fundamental engineering concepts and scientific principles associated with engineering design applications. Topics include mechanisms, energy statics, materials and kinematics. Additionally, students will learn material properties and electrical, control and fluid power systems. Students will learn to apply problem solving, research and design skills to create solutions to engineering challenges.

## **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.

## **Mechanisms and Drives**

Subject Code: 175008

Students will learn the principles and practices of machine operation and machine applications. They will learn how machine components such as gears, belts, sprockets, bearings, clutches, couplings, springs, etc. contribute to the application for which the machine is designed. They will also examine the basic drives of such mechanisms as electric motors and hydraulic & pneumatic actuators.

## **Engineering Capstone**

Subject Code: 175009

The capstone course provides opportunities for students to apply knowledge, attitudes and skills that were learned in an Engineering 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.

## **Analog Based Electronic Devices**

Subject Code: 175012

Students are introduced to semiconductor diode applications, other two-terminal devices, thyristors, transistors and field effect transistors. Course includes design and analysis of transistor and FET DC bias circuitry. Operational characteristics and applications of FET and diode switching circuitry are studied. Students will examine rectifier circuits, amplifier circuits and Zener voltage regulation. Emphasis is on component testing and troubleshooting.

## **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.

## **Engineering Logic**

Subject Code: 175017

Students will apply the processes of digital circuit theory, combinational and sequential logic as it relates to circuit design and operation. Students will identify numbering systems, arithmetic and Boolean operations and apply simplification methods. Emphasis will be given to the analysis of wiring schematics and diagrams for accuracy and function. In addition, students will use electronic components to construct and troubleshoot digital circuits.

## **AC Electronic Circuits**

Subject Code: 175100

Students will learn the fundamental principles of electricity with emphasis on AC (alternating current) circuits. They will use concepts of Ohm's Law, the Power Formula and Kirchhoff's Law with series, parallel and series-parallel circuit applications. The relationship between electricity and magnetism and motor theory will also be introduced. The student will master electrical safety, breadboard wiring, basic circuit troubleshooting, operation of function generator, digital multimeter (DMM) and oscilloscope.

## **DC Electronic Circuits**

Subject Code: 175105

Students will learn the fundamental principles of electricity with emphasis on DC (direct current) circuits. They will use concepts of Ohm's Law, the Power Formula and Kirchhoff's Law with series, parallel and series-parallel circuit applications. The student will master electrical safety, breadboard wiring, basic circuit troubleshooting, operation of DC power supply and digital multimeter (DMM).

## **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.

## **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.

## **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. An 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.

## **Industrial Robotics**

Subject Code: 176025

Students will apply the knowledge and skills to program, safely operate, and troubleshoot industrial Robots. The students will learn industrial robotic operations and system configurations. Throughout the course, 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.

## **Energy Systems Management**

Subject Code: 010715

Students will apply basic principles of energy accounting, thermodynamics and heat transfer, energy conversion and efficiency to heating, power generation and transportation. Students will apply the principles and practices needed for managing renewable and non-renewable energy resources. Throughout this course, future energy systems and energy use scenarios are investigated, with a focus on promoting the use of renewable energy resources and technologies.

## **Biomedical Engineering**

Subject Code: 072115

Students learn medical interventions that extend and improve quality of life including gene therapy, use and development of prosthetics, rehabilitation techniques, and supportive care. Students will use 3D imaging, data acquisition software, and current scientific research to design and develop medical intervention products. Students will demonstrate current and emerging strategies and technologies used for collecting, analyzing, recording and sharing information. In addition, students will develop leadership and team-building skills that promote collaboration.

## **Computer Hardware**

Subject Code: 145025

Students will learn to install, repair, and troubleshoot computer hardware systems. They will perform preventative maintenance practices and learn techniques for maintaining computer hardware security. Communication skills and professionalism in troubleshooting situations will be emphasized.

## **Computer Software**

Subject Code: 145030

Students will apply knowledge and skills of commercial and open source operating systems in portable, stand alone, and networked devices. Students will install a variety of operating systems manually and using remote assistance. They will learn to configure, modify, and troubleshoot operating systems. Desktop virtualization, system security, and operating system history will be addressed.

## **Aviation**

Subject Code: 177013

In this first course, students apply knowledge of aviation theory and navigation to flight performance and planning. Students will apply principles of simple machines and fluid mechanics to aircraft operations. Identification of aircraft engines and airframe related systems will be emphasized. Weather theories and concepts are used to interpret weather-briefing documents. Additionally, students will distinguish among airport environments, and understand rules, regulations and orders relevant to the airport industry.

## **Unmanned Aircraft Systems**

Subject Code: 177024

Students will learn the essentials of operating an unmanned aircraft in a variety of environments. Students will learn principles of regulations, operations, air space, and navigation. Additionally, students will acquire and use geospatial information for various applications.

## **Plan Reading and Estimating**

Subject Code: 178019

Students learn blueprint reading as it relates to the architecture and construction. Students will use scaling, orthographic projections, dimensioning practices, symbols, notations, and abbreviations to perform area calculations and to interpret floor plan, section, and elevations and develop an estimate of material, time, personnel, and equipment needs, availability, and cost. Using construction plans, students will identify problems or shortcomings related to the layout and installation of materials for the project.

## **Architecture Design – Structural and Mechanical/Electrical/Plumbing**

Subject Code: 178020

Students will use architecture design principles to organize and arrange structures to create a perspective of a building. Students will use orthographic/pictorial projection, freehand technical sketching and computer-aided drafting (CAD) skills to generate floor and wall plans, elevations, sections, details and schedules. Students will develop sets of structural framing and mechanical working drawings that include plumbing, HVAC and electrical power and lighting plans.

## **Architecture Design – Site and Foundation Plans**

Subject Code: 178021

Students use advanced architectural design concepts to construct design models including perspective drawings for final presentations. Students use orthographic/pictorial projection, freehand technical sketching and computer-aided drafting (CAD) tools to create site foundation and section plans that include topographical details and schedules. Additionally, students perform zoning analysis, develop preliminary plot plans, and construct grading and utilities plans that include legal descriptions and cut and fill volumes.

## **Innovations in Science and Technology (SREB)**

***\*\*This course can only be used by approved SREB programs***

Subject Code: 175995

Students will be introduced to technological literacy and stimulate their interest in pursuing a career in science, technology, engineering and mathematics (STEM). Students will engage in hands-on experiences they need to be successful in the new global workforce. Finally, students will apply critical thinking skills to solving complex real-world problems.

## **Aerospace Engineering (SREB)**

***\*\*This course can only be used by approved SREB programs***

Subject Code: 175999

Students will explore the designing, building, testing and analyzing science behind the forces and physical properties of planes, rockets and unmanned vehicles. They will utilize tools such as spreadsheets and sensing systems to collect and analyze data. Further, students will use technology to effectively solve real-world, challenging problems with business and industry partners. Lastly, students will explore the future of the aerospace industry.