

# Engineering and Science Technologies

## Career Field Pathways and Course Structure

### Courses in Engineering and Design (F6)

PATHWAY COURSES	SUBJECT CODE
Engineering Design	175001
Engineering Principles <sup>2</sup>	175002
Manufacturing Operations <sup>2</sup>	175003
Robotics	175004
DC and AC Electronic Circuits	175011
Analog Based Electronic Devices	175012
Computer Integrated Manufacturing	175006
Digital Electronics	175007
Mechanisms and Drives	175008
Engineering Capstone <sup>3</sup>	175009
Pre-Engineering Technologies <sup>1</sup>	175015
Engineering Logic	175017
Machine Tools	176004
Welding Technologies	176009
Principles of Manufacturing	176010
Plan Reading	178019
Architecture Design- Structural and Mechanical/Electrical/Plumbing	178020
Architecture Design - Site and Foundation Plans	178021
Energy Systems Management	010715
Computer Hardware <sup>2</sup>	145025
Computer Software	145030
Aviation	177013
Biomedical Engineering	072115

<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

#### Pre-Engineering Technologies

Subject Code: 175015

Students in the pre-engineering programs 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 Design

Subject Code: 175001

The focus of Engineering Design is 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 solve 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. The Students will learn robotic operations and system configurations. Students will code, compile, and debug programs using the robotic programming language.

**DC and AC Electronic Circuits**

Subject Code: 175011

Students will learn the fundamental principles of electricity with emphasis on DC (direct current) circuits and an introduction to AC (alternating current) circuits. They will use concepts of Ohm's Law, the Power Formula, and Kirchoff's Laws with series, parallel, and series-parallel circuit applications. The relationship between electricity and magnetism and motor theory will also be introduced. The student will use and maintain digital multimeters and oscilloscopes.

**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.

**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.

**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.

### **Mechanisms and Drives**

Subject Code: 175008

Students will learn the principles and practices of machine operation and machine applications. They will learn 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 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.

### **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.

Note: In the zip file that contains the Course Descriptions, there are two versions of this course. One is the FY2017 (2016-2017) version. The second version is for FY2018 and is marked as such.

### **Machine Tools**

Subject Code: 176004

Description: 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.

### **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 project evaluation.

Note: In the zip file that contains the Course Descriptions, there are two versions of this course. One is the FY2017 (2016-2017) version. The second version is for FY2018 and is marked as such.

### **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.

### **Plan Reading**

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. Using construction plans, students will identify problems or shortcomings related to the layout and installation of materials for the project.

### **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 energy sources including, solar thermal, hydrogen generation, photovoltaic, wind, and biomass use. Future energy systems and energy use scenarios are investigated, with a focus on promoting the use of renewable energy resources and technologies.

### **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.

### **Biomedical Engineering**

Subject Code: 072115

Students learn the use of cell culture techniques for bioscience research and commercial applications. Topics include cultivation of cell lines, bench-top fermenter management, detection of contamination, and an introduction to bioassays. Students will use microbiological techniques to manipulate, evaluate, and study cell growth. Focus will be on media formulation, preparation, autoclaving, and clean up procedures for the vessel and accessories. Further, students will implement quality control methods, maintain records and ensure compliance with regulatory requirements.