Engineering Course List

Three foundation courses are required for all engineering students. Typically, students take one per year for the 9th through 11th grade years. A fourth course, chosen from the specialty courses, is required to complete the PLTW program, as well as to satisfy the DPS requirement for a 4-course "concentration". With faculty approval, and as scheduling allows, students may choose to take as many additional engineering courses as are offered.

Transcript credit from Rochester Institute of Technology (NY) can be earned by passing the course with an 85% or higher and earning a passing score on the college portion of the final exam. The transcript must be paid for by November of the following academic year and the proper paper work sent to RIT. AE and the computer science classes have a slightly different process than the rest of the courses to pay for transcript credit. If your son or daughter has earned this credit, Mr. Velegol will inform you and your student by email as the scores are processed during the exam weeks.

PLTW ENGINEERING COURSES

Foundation Courses:

Introduction to Engineering Design (IED - 5 GPA points)

The major focus of this course is to expose students to the design process, research and analysis, teamwork, communication methods, global and human impacts, engineering standards, and technical documentation. The course assumes no previous knowledge, but students should be concurrently enrolled in college preparatory mathematics and science. Students dig deep into the engineering design process, applying math, science, and engineering standards to hands-on projects. They work both individually and in teams to design solutions to a variety of problems using 3-D modeling software and use an engineering notebook to document their work. This course is generally taken in the 9th grade.

The course of study includes: Design Process, Modeling, Sketching, Measurement, Statistics, and Applied Geometry, Presentation Design and Delivery, Engineering Drawing Standards, CAD Solid Modeling, Reverse Engineering, Consumer Product Design, Innovation, Marketing, Graphic Design, Engineering Ethics, Virtual Design Teams

Principles of Engineering (POE - 5 GPA points) POE is a rigorous survey course of engineering. Through problems that engage and challenge, students explore a broad range of engineering topics, including mechanisms, the strength of structures and materials, and automation. Students develop skills in problem solving, research, and design while learning strategies for design process documentation, collaboration, and presentation. To be successful in POE, students should be concurrently enrolled in college preparatory mathematics and science. This course is generally taken in the 10th grade.

The course of study includes: Mechanisms, Energy Sources, Energy Applications, Machine Control, Fluid Power, Statics, Material Properties, Material Testing, Statistics, Kinematics

Digital Electronics™ (DE - 5 GPA points) From smartphones to appliances, digital circuits, which are used to process and control digital signals, are all around us. This course provides a foundation for students who are interested in electrical engineering, electronics, or circuit design. Students study topics such as combinational and sequential logic and are exposed to circuit design tools used in industry, including

logic gates, integrated circuits, and programmable logic devices. This course is appropriate for 10th or 11th grade students. Other than their concurrent enrollment in college preparatory mathematics and science courses, this course assumes no previous knowledge.

The course of study includes: **Foundations of Digital Electronics:** Scientific and Engineering Notations, Electronic Component Identification, Basic Soldering and PCB Construction, Electron Theory & Circuit Theory Laws, Circuit Simulation, Breadboard Prototyping, Component Datasheets & Troubleshooting; **Combinational Logic Analysis and Design:** Binary, Octal and Hexadecimal Number Systems, Boolean Algebra and DeMorgan's Theorems, AND-OR-INVERTER, NAND Only, and NOR Only Logic Design. Binary Adders, and Two's Complement Arithmetic, Combinational Logic Design with Field Programmable Gate Arrays **Sequential Logic Analysis and Design** Flip-Flops, Latches and Their Applications. Asynchronous Counter Design with Small and Medium Scale Integrated Circuits. Synchronous Counter Design with Small and Medium Scale Integrated Circuits. Sequential Logic Design with Field Programmable Gate Arrays Introduction to State Machines. **Introduction to Microcontrollers:** Software Development for an Introductory Microcontroller, Real-World Interface: Introduction to Hardware Controls Process Control with a Microcontroller

Specialty Courses:

Aerospace Engineering (AE- 5 GPA points): This course propels students' learning in the fundamentals of atmospheric and space flight. As they explore the physics of flight, students bring the concepts to life by designing an airfoil, propulsion system, and rockets. They learn basic orbital mechanics using industry-standard software. They also explore robot systems through projects such as remotely operated vehicles. The course is appropriate for 11th and 12th grade students interested in Aerospace. It is recommended that students are concurrently enrolled in college preparatory mathematics and science courses and have successfully completed of POE.

The course of study includes: **Introduction of Aerospace Engineering** Evolution of flight, Physics of flight, Airfoils, Air navigation, Air traffic control, Global positioning system, GPS **Aerospace Design** Aerospace materials, Turbine, rocket and space propulsion, Flight Physiology **Space** Space law, Space junk, Orbital mechanics **Alternative Applications** Alternative applications, Remote systems, Rover design and building, Aerospace careers

Civil Engineering and Architecture (CEA- 5 GPA points): In CEA, students learn important aspects of building and site design and development. They apply math, science, and standard engineering practices to design both residential and commercial projects and document their work using 3-D architectural design software. CEA is appropriate for 11th or 12th grade students, and while completing POE is a pre-requisite, this course assumes no previous knowledge.

The course of study includes: **Overview of Civil Engineering and Architecture:** History of Civil Engineering and Architecture -Past Civil Engineering and Architecture -Principles and Elements of Design -Architectural Styles Careers in Civil Engineering and Architecture; **Residential Design:** Building Design and Construction practices -Building codes -Building components -Green technology -Universal Design -3D architectural software -Design and construction documentation Cost Analysis Energy Efficiency Storm water analysis Water supply Plumbing Electrical Systems Wastewater management Affordable housing design Universal design; **Commercial Applications:** Commercial Buildings -Building codes -Land Use and Development -Commercial building components Structural design -Steel deck -Precast concrete floors -

Steel joints -Structural steel beams -Spread footings Services and Utilities -Energy Codes -Plumbing (Optional) -Electrical systems (Optional) -Heating, Ventilating and Air-Conditioning systems -Wastewater management Site Considerations -Land surveying -Soil analysis -Road design (Optional) -Parking lot design -Storm water management -Site grading (Optional) -Low impact development; **Commercial Building Design:** Commercial Building Design Project -Property description -Site discovery -Commercial project viability -Project management Commercial Building Design Presentation

Computer Integrated Manufacturing (CIM- 5 GPA points): Manufactured items are part of everyday life, yet most students have not been introduced to the high-tech, innovative nature of modern manufacturing. This course illuminates the opportunities related to understanding manufacturing. At the same time, it teaches students about manufacturing processes, product design, robotics, and automation. Students will apply knowledge gained throughout the course in a final open-ended problem to build a factory system. CIM is a high school level course that is appropriate for 10th, 11th, or 12th grade students. It is recommended that students are concurrently enrolled in grade level mathematics and science courses and have successfully completed IED.

The course of study includes: **Principles of Manufacturing**: History of manufacturing, Manufacturing as an enterprise, System process flow, Automated control, Cost of manufacturing; **Manufacturing Processes:** Design considerations for manufacturability, Property analysis, Ethics and safety, Creating a prototype, Manufacturing processes and machines, CNC mill programming and usage; **Elements of Automation:** Robotic simulation and physical testing, Power systems, Pneumatic system design and construction; **Integration of Manufacturing Elements**: Computer Integrated Manufacturing system types, Manufacturing and automation career research, Manufacturing system design and construction

PLTW COMPUTER SCIENCE COURSES

Computer Science Essentials (CSE - 4 GPA points): CSE is an excellent entry point for new high school computer science (CS) learners. All students will experience the major topics, big ideas, and computational thinking practices used by computing professionals to solve problems and create value for others, whether it be through app development, web design, or connecting computing with the physical world. CSE introduces students to coding fundamentals through an approachable, block-based programming language where they will have early success in creating usable apps. As students sharpen their computational thinking skills, they will transition to programming environments that reinforce coding fundamentals by displaying block programming and text-based programming side-by side. Finally, students will learn the power of text-based programming as they are introduced to the Python® programming language

Computer Science Principles (CSP - 5 GPA points): Using Python® as a primary tool, students learn the fundamentals of coding, data processing, data security, and task automation, while learning to contribute to an inclusive, safe, and ethical computing culture. The course promotes computational thinking and coding fundamentals and introduces computational tools that foster creativity. CSP students develop programming expertise and explore the workings of the Internet. Projects and problems include app development, visualization of data, cybersecurity, and simulation. All components of this this course are aligned to the AP Curriculum Framework standards and the AP CSP assessment. Students completing the course will be well-prepared for a first course in Java or other object oriented language. Students should be sophomores in good standing. (This course is called **AP Computer Science Principles** in the DPS course catalog.)

The course of study includes: **Algorithms:** Graphics, and Graphical User Interfaces, Algorithms and Agile Development, Mobile App Design, Algorithms in Python, Images and Object Oriented Libraries GUIs in Python; **The Internet:** The Internet and the Web – protocols and hierarchy, Shopping and Social on the Web, Client and server side development, Security and Cryptography; **Raining Reigning Data:** Visualizing Data, Discovering Knowledge from Data Collection, Persistence, and Societal Concerns of "Big Data" ; **Intelligent Behavior**: Moore's Law and Modeling Intelligent Agents

Computer Science Applications (CSA - 5 GPA points): Introduces students to computer science through programming. Fundamental topics in this course include the design of solutions to problems, the use of data structures to organize large sets of data, the development and implementation of algorithms to process data and discover new information, the analysis of potential solutions, and the ethical and social implications of computing systems. The course emphasizes object-oriented programming and design using the Java programming language. (This course is called **AP Computer Science i**n the DPS course catalog.)

Cybersecurity (SEC – 4.5 GPA points): SEC engages students in interdisciplinary real-world challenges that help them develop the computational thinking and computer science knowledge and skills to be successful in any career path they take. This course exposes students to the ever-growing and far-reaching field of cybersecurity and allows students to explore concepts such as secure information technology systems, protection against cyber threats, and the ethical impact of cybersecurity situations. Students in SEC establish an ethical code of conduct while learning to defend data in today's complex cyberworld.