Computer Engineering II: Applied Circuit Design and Microcomputers

Course Information

Grade(s):	9-12
Discipline/Course:	Technology Education
Course Title:	Computer Engineering II: Applied Circuit Design and Microcomputers
Prerequisite(s):	Computer Engineering I
Course Description: *Program of Studies*	Students will advance their knowledge and understanding of applied circuit design and construction of complex computer-controlled projects using Arduino microcontrollers and Raspberry Pi microcomputers. Student work and activities will support theoretical concepts through applied experiences with tools, equipment, components, and software. This course meets for one semester.
Course Essential Questions:	● What is a computer and how were computers created? ● What are all of the components inside a computer that make it work? ● How does computer hardware and software connect and work together? ● What kinds of computer technology are coming next?
Course Enduring Understandings:	● Compatibility of hardware in a functional computer ● Operating systems; how each type communicates between the hardware and other software. ● Physical computing and creating circuits with microcomputers ● The troubleshooting process related to computer hardware and software
Duration / Credit(s):	½ year/ .5 credit(s)
Course Materials/Resources:	Computers hardware, software, and operating systems Arduino and Raspberry Pi Breadboards and Electrical Components
FPS Course Academic Expectation(s):	Exploring and Understanding Conveying Ideas

Year at a Glance (Units)	Unit 1: Computer Hardware (6 weeks) Unit 2: Computer Software and Operating Systems (6 weeks) Unit 3: Microcontrollers and Microcomputers (6 weeks)

Unit Number and Title:	Unit 1: Computer Hardware
Duration:	6 weeks
Resource(s):	PCs, Microcomputers, Peripherals, Cables
Unit Overview:	Computers operate by performing four basic tasks: accept information, store the information, process the information, and output a result. These four basic tasks are what make a computer, a computer. This unit will use hands-on experiences to understand how a computer is able to execute the 4 tasks and what role each hardware component plays in the functioning of a computer.
Learning Goals	
Standard(s):	ITEEA Standards for Technological and Engineering Literacy (STEL) 2Y. Implement quality control as a planned process to ensure that a product, service, or system meets established criteria. 7W. Determine the best approach by evaluating the purpose of the design. 8P. Apply appropriate methods to diagnose, adjust and repair systems to ensure precise, safe, and proper functionality. CSTA Standards 1B-CS-01 Describe how internal and external parts of computing devices function to form a system.
Essential Question(s):	● What is computer hardware? ● What does a computer actually do? ● How can physical parts in a computer be safely upgraded?
Enduring Understanding(s):	● What are all of the components inside a computer that make it work? ● How do all of these components connect and work together?
Learning Goal(s): *Students will be able to use their learning to:* (Content/ Skills)	**Content:** (Students will know…) ● computers are physical devices made up of electronic components that work together. ● the essential components that go into a computer and how to remove and install them safely. ● types of memory and storage devices; difference between short-term and long-term storage.

	Skills: (Students will be able to…) ● describe computer hardware and processes. ● describe how computers store and transfer data. ● keep safe when working on interior parts. ● identify internal computer components. ● remove, test, and install components into a desktop computer.

Unit Number and Title:	Unit 2: Computer Software and Operating Systems
Duration:	6 weeks
Resource(s):	PCs, Microcomputers, Peripherals, Cables
Unit Overview:	Computer applications can do an incredible amount of different things, from managing our personal contacts and appointments to creating videos and 3D animations to games and streaming to managing data for large corporations. Computers are capable of doing nearly anything we want them to. An operating system interprets all of the electronic signals into something we can use. An operating system is the program that communicates between the hardware and other software,
Learning Goals	
Standard(s):	ITEEA Standards for Technological and Engineering Literacy (STEL) 2V. Analyze the stability of a technological system and how it is influenced by all of the components in the system, especially those in the feedback loop. 8N. Use various approaches to communicate processes and procedures for using, maintaining, and assessing technological products and systems. 8P. Apply appropriate methods to diagnose, adjust and repair systems to ensure precise, safe, and proper functionality. 8Q. Synthesize data and analyze trends to make decisions about technological products, systems, or processes. CSTA Standards 1B-CS-01 Describe how internal and external parts of computing devices function to form a system.
Essential Question(s):	● What does an operating system do? ● How is an operating system similar or different from applications? ● What features are similar between operating systems? ● What differences are there between operating systems? ● What types of applications are used to perform certain tasks?

Enduring Understanding(s):	● The function of an operating system. ● How an operating system interacts with hardware and applications. ● How the operating system manages computer resources. ● The different types of software and purpose of each
Learning Goal(s): *Students will be able to use their learning to:* (Content/ Skills)	**Content:** (Students will know…) ● how to install an operating system on a PC. ● how to access features in the operating system design. ● how to add or remove software from the operating system. **Skills:** (Students will be able to…) ● install and uninstall applications and operating systems. ● navigate the three main operating systems. ● use basic command line tools.

Unit Number and Title:	Unit 3: Microcontrollers, Microcomputers
Duration:	6 weeks
Resource(s):	PCs, Microcomputers, peripherals, cables, circuit component kit
Unit Overview:	This unit will introduce students to physical computing: the process of building circuits and programming a microcontroller (an Arduino UNO® or Raspberry Pi 4) to interact with them. The unit is broken into activities starting with foundational basics of setting up the microcomputer, identifying parts of it, and interacting with circuit components like LEDs, buttons, and resistors. The learning engagements will build on each other to prepare students for more advanced Arduino/Pi projects.
Learning Goals	
Standard(s):	ITEEA Standards for Technological and Engineering Literacy (STEL) 1R. Develop a plan that incorporates knowledge from science, mathematics, and other disciples to design or improve a technological product or system. 2T. Demonstrate the use of conceptual, graphical, virtual, mathematical, and physical modeling to identify conflicting considerations before the entire system is developed and to aid in design decision-making. 2V. Analyze the stability of a technological system and how it is influenced by all of the components in the system, especially those in the feedback loop. 7W. Determine the best approach by evaluating the purpose of the design. CSTA Standards 1B-CS-01 Describe how internal and external parts of computing devices function to form a system.
Essential Question(s):	● What are some examples of basic hardware and software problems? (using accurate terminology) ● What are the steps to debugging code? ● How can a microcomputer be used as a tool to measure and record data?

Enduring Understanding(s):	● Developing, testing, and running programs ● Using commands to program the microcomputer ● Understanding the basic difference between analog and digital components
Learning Goal(s): *Students will be able to use their learning to:* (Content/ Skills)	**Content:** (Students will know…) ● basics of computer hardware, software, and operating systems. ● programming language basics using integrated development software. **Skills:** (Students will be able to…) ● build circuits. ● use sensors to collect data. ● create a functioning microcomputer. ● measure temperature, pressure and altitude using sensors and circuits.