



### **Course Description**

#### **CEN2212C | Introduction to Programming the Internet of Things (IoT) | 4.00 credits**

This course teaches the principles of programming Internet of Things devices using a computer language. The student will learn fundamental programming concepts and systematic design techniques. At the end of the course, the student will be able to write programs that control development boards, with sensors, connected to the Internet. Prerequisites: CEN2211; EET1033C.

### **Course Competencies:**

**Competency 1:** The student will demonstrate an understanding of the development of Internet of Things (IoT) products by:

1. Explaining the IoT Business Value Proposition
2. Defining the features of an Internet of Things product
3. Describe the available developer boards (such as Arduino Uno and Raspberry Pi) and compare their strengths and weaknesses
4. List the strengths and weaknesses of the different programming languages (C, C#, Java) used for programming IoT devices with Python
5. Identify the challenges of IoT security and privacy

**Competency 2:** The student will demonstrate an understanding of how to set, boot, and run a program on a development board (such as Raspberry Pi) by:

1. Manipulating a development board to set it up
2. Configuring the wiring necessary to boot the board and connect it to an external display
3. Performing the Booting and the installation of the Operating Systems (OS) (Such as Raspbian or Windows IoT core) on the board
4. Modifying the user parameters of the OS running on the board through the graphical user interface (GUI) and the shell

**Competency 3:** The student will demonstrate an understanding of an Integration Development Environment (IDE) by:

1. Utilizing IDLE and the tools necessary to build an app that can run on a development board
2. Creating an app that will perform a numerical calculation when the user presses a button and deploying it to a development board

**Competency 4:** The student will demonstrate an understanding of how to write and execute programs in a language, such as Python by:

1. Using appropriate data types
2. Defining and using objects
3. Using functions and defining the function's arguments
4. Using flow control statements
5. Using modules, classes, and methods
6. Using I/O functions to read/write files from the hard drive and accessing the internet

**Competency 5:** The student will design an app with a Graphical User Interface (GUI) by:

1. Utilizing a GUI (such as Tkinter) to design how the user will interact with the program
2. Creating a list with all the variables, input, and output methods needed for the program
3. Writing a program that demonstrates the use of different views and widgets (such as buttons, canvas, check button, frame, menu, etc.)

**Competency 6:** The student will demonstrate an understanding of how to interface with the hardware by:

1. Describing the use of GPIO pin connections in developer boards (such as Raspberry Pi and Arduino UNO) and identifying the pin functions, serial interface pins, power pins, and hat pins
2. Connecting the breadboard to the GPIO pins and turning on an LED with a program
3. Writing a program that will vary an LED brightness connected to an analog output pin and using Pulse Width Modulation (PWM).
4. Writing a program that will show a message on the console when a button (digital input) connected to the breadboard is pressed

**Competency 7:** The student will demonstrate an understanding of how to use socket in Python to act as both a client and a server by:

1. Researching the basic networking concepts (such as network, secure Shell, SSH Client/Server) and Internet Protocols (IP addresses, Domain Names, Client/Server)
2. Describing the functions of a socket, how to send and receive data, exceptions, and server codes
3. Writing a program that runs on a development board (such as Raspberry Pi) that sends and receives data from the internet

**Competency 8:** The student will demonstrate an understanding of how to use cloud services and data analytics with development boards (such as Raspberry Pi) by:

1. Defining client and server and listing their characteristics
2. Installing Apache on a development board
3. Creating a static web page hosted on the development board
4. Using an API to communicate the development board with Twitter, Instagram, Tumblr, etc

**Competency 9:** The student will demonstrate an understanding of how to prototype devices that have internet connection capabilities by:

1. Estimating the effect of location, movement, power consumption, cost, and data on the product
2. Describing WiFi, Bluetooth, cellular modem, ZigBee/Z-wave, Near Field Communication (NFC), and iBeacon
3. Defining HTML, HTTP, and web server
4. Modifying sample programs that use the development board as a web server
5. Modifying sample programs that use the development board as a web browser using ifttt.com

**Learning Outcomes:**

- Use quantitative analytical skills to evaluate and process numerical data
- Solve problems using critical and creative thinking and scientific reasoning
- Use computer and emerging technologies effectively