**PCAC2005 PROGRAMMING INTERNET OF THINGS (3-0-0)**

**OVERALL COURSE OBJECTIVES:** To empower students with a comprehensive understanding of IoT and Embedded Systems, Arduino and Raspberry Pi platforms, and C and Python programming. This will enable them to create innovative IoT designs and products and understand how these devices interact with the physical world. They will also learn debugging techniques and network protocols essential for embedded systems.

**Module 1: Introduction to the Internet of Things and Embedded Systems [12 Hours]**

This course explores the significant role of the "Internet of Things" (IoT) in the modern world and its future trends. It defines what IoT and embedded systems are, describes their impact on society, and enumerates their components. The lessons cover hardware and software interactions in an IoT device and the role of an operating system in supporting this software. The course highlights key components of networking, including an understanding of how to connect devices to the Internet, the structure of the Internet, and the meaning of a "network protocol". It also explains Mobile Ad-Hoc Networks (MANETs) in relation to IoT. While beneficial, this course does not include discussion forums.

**Sub-Topic**
Embedded Systems
Hardware and Software
Networking and the Internet
What Is the Internet of Things (IoT)?

**Formative Assessments:**
4 quizzes and 4 peer-review assignments.

**Module 2: The Arduino Platform and C Programming [13 Hours]**

This course provides in-depth knowledge about the Arduino platform, including the physical board, libraries, and the integrated development environment (IDE). It explores the role and usage of shields and touches on programming the Arduino using C code. The lessons delve into elements like reading board schematics, installing the Arduino IDE, understanding the significance of libraries, and running a program. The course provides a comprehensive understanding of C variables, types, common operators, conditionals, loops, functions, and the implications of global variables. Additionally, the course covers the Arduino build process, the role of tools in the IDE, the structure of an Arduino sketch, and accessing pins on the Arduino. It also covers embedded software debugging, common debugging architectures for embedded systems, and the UART Serial communication protocol. The course does not include discussion forums.

**Sub-Topic**
Arduino Environment
Arduino Programs
C Programming
Basic C Operators
Arduino Sketches

**Formative Assessments:**
4 quizzes and 4 peer-review assignments.

**Module 3: The Raspberry Pi Platform and Python Programming for the Raspberry Pi [19 Hours]**

The Raspberry Pi is a small, affordable single-board computer that you will use to design and develop fun and practical IoT devices while learning programming and computer hardware. In addition, you will learn how to set up the Raspberry Pi environment, get a Linux operating system running, and write and execute some basic Python code on the Raspberry Pi. You will also learn how to use Python-based IDE (integrated development environments) for the Raspberry Pi and how to trace and debug Python code on the device.

**Sub-Topic**
Raspberry Pi Processor
Operating System Benefits
Raspberry Pi Configuration
Navigating the Filesystem
Linux Graphic User Interface
Python on Raspberry Pi

**Formative Assessments:**
4 quizzes and 4 peer-review assignments.

**LEARNING OUTCOMES: On successful completion of the course the students shall be able to:**

1. Understand and define the key concepts of “Internet of Things” and its impact on society, focusing specifically on design considerations and components of IoT devices.
2. Master the composition and firmware programming of the Arduino development board, as well as the usage of "shields" and libraries.
3. Gain the ability to compile and run a program using C language, understanding variables, types, and operators specifically relevant to Arduino sketches.
4. Acquire knowledge on the Raspberry Pi setup and operation, including executing a Linux operating system.
5. Develop expertise in writing and executing basic Python code on Raspberry Pi, also learning to use Python-based IDEs and debugging Python code.
6. Understand the fundamental aspects of networking, including network protocol, structure of the Internet, and their specific implications in IoT devices.