1826

36000

7

500 +

Course: Systems for Internet of Things

Course summary: The course gives the basis for Internet of Things (IoT) engineering. The aim of the course is to familiarize students with practical use of hardware, software, communication and computing systems to create components of measurement networks for the Internet of Things. The main focus is on hardware components, low-level hardware-to-software interface, and middleware. Each of the discussed issues is immediately illustrated in practice during the laboratory part of the integrated course. During the project students design and implement a complete IoT measurement network connected to the computing cloud.
The scope of the course comprises: hardware platforms, software frameworks, real time operating systems, debugging in real time, communication protocols, security issues, cloud computing, all these in the context of IoT. This course is characterized by the emphasis on practical classes. Students can use the latest techniques and tools dedicated to IoT engineering.

Lecture (30 hours):
1. Basics for Internet of Things (IoT) engineering, Hardware and software platforms for IoT, CC13xx/CC260xx processors, MEMS sensors, ARM cors, hardware development kits.
2. Programming environment, Code Composer Studio, programming libraries, Software Development Kits, Real time debugging.
3. Real time operating systems, RTOS systems: TI-RTOS, FreeRTOS
4. Wireless connectivity, ISO/OSI model, Communication protocols: BLE 4.2,BLE 5, IEEE802.11g, IEEE802.14.2g, Security issues.
5. Single board computers and gates hardware, Raspberry Pi3, Beagle Bon Black.
6. Gates software, Node-RED, Pyton, Java script, JSON , BLE communication.
7. Sensor nodes and gates communication, WiFi communication, Simple internet page.
8. Cloud computing, MQTT protocol, connection to IBM Watson IoT Platform.
9. IoT security. Device authentication, exchange of security keys, asymmetric cryptography, privacy of the transmitted data, security strategy relates to device maintenance, Security and the Cortex-M MPU, BLE security.
10. Large Area Network, LP WAN, SigFox, LORAWAN, NB-IoT (LTE 3GPP R13), Wireless Sensor Network (WSN), „Sub 1GHz" net.
11. IoT and IIoT solutions. European Commission strategy, IEEE, IETF and W3C activities related to IoT, IoT specific problems, IoT platforms.

Project: The goal of the project is to connect sensors to the cloud over a long-range, Sub-1 GHz wireless network.

Laboratory (30 hours):
1. CCS Fundamentals. Introduction to the Code Composer Studio integrated development environment and using the environment on the hardware kits.
2. TI-RTOS Basic. This exercise introduces the concepts of threads step by step using TI-RTOS on the hardware kits.
3. Bluetooth Basics. This exercise is an introduction for the TI-RTOS based BLE-Stack. The first task shows how to download a project to the device and run it.
4. Raspberry Pi3, Hardware intro, First Time Configuration, Network Setup, Using SSH, Python Intro, GPIO Setup. Interfacing hardware with the Raspberry Pi.

5. BLE on Raspberry Pi3. Use Bluetooth to connect and get sensor readings from a hardware kits to a Raspberry Pi.
6. MQTT and Node-RED. Deploy a basic webpage in Node-RED, add JavaScript to make the webpage dynamic, and finally, use query parameters from the URL in the webpage.
7. MQTT connection. We first set up Bluetooth on the RPi3 and then set up Node-Red to convert the Bluetooth data to MQTT messages.
8. Long Range Communication. In this lab, we will run a pair of examples based on the complete TI-15.4 Stack, one Sensor and one Collector - creating a star network of sensor node(s) sending data to a collector.

Basic students skills required:

1. C programming,
2. Some basic familiarity with embedded programming,