Module Name: Internet of Things

Module Acronym: IOT

Module Manager: Dr Ryan Grammenos

Course Summary:
This module is designed to provide students with solid technical knowledge and skills to build Internet of Things (IoT) systems. The course has a significant practical element in that 75% of the technical content will be delivered during lab sessions in which students are expected to complete exercises involving system design, device programming and cloud development.

Full Description:

**ATTENTION:** This is an intensive, highly interactive and very practical course. Over 75% of the course material is delivered through flipped lectures. This means that students need to carry out pre-work and read the background theory before coming to the sessions. Most of these sessions are hands-on workshops during which students will perform programming and development tasks.

Pre-requisites:

It is expected that students will have a background in electronic engineering, computer systems engineering or a related subject. The following are essential:

- Knowledge of basic electronics design (for example, ADCs/DACs, PWM, voltage dividers).
- Experience programming devices using C / C++ / Python.
- Familiarity with the OSI model and the seven abstraction layers.

The following are considered an advantage:

- Familiarity with networking and TCP/IP.
- Experience programming Arduino and/or Raspberry Pi devices.
- Experience programming in HTML and/or JavaScript.

**NOTE:** Students will be required to make use of all the above knowledge and skills during the course to configure sensors, edge computing platforms and to carry out development in the cloud. The practical experience acquired will be fundamental to completing the group project.

Structure:

A systems engineering approach is adopted throughout the course reviewing the key technologies employed at different levels of the IoT stack and how they are integrated to form complete IoT systems.

A number of devices, platforms and software tools will be introduced during the course from different vendors including but not limited to Texas Instruments (TI), ARM, Dust Networks and IBM. Examples include:
MSc Communications Programmes

- **Devices**: TI CC3200 Launchpad, TI STK2650 SensorTag.
- **Connectivity**: Dust Networks Smart Mesh IP.
- **Edge programming**: TI Energia.
- **Cloud development**: IBM Bluemix (NodeRED, Watson IoT, Data Science Experience).

The course will be complemented with guest speakers from industry who will demonstrate how the Internet of Things fits within the context of “Smart and Connected, Products and Services” and generally within the ICT industry.

The module is assessed through pre-work, as well as a group project, which combined carry 100% of the marks. Students will need to build an end-to-end IoT system followed by the submission of reports, a project presentation, and finally a demonstration and viva.

**Pre-work:**

Students will be expected to carry out pre-work to setup and familiarise themselves with the platforms and tools that will be used during the course. Further details will be provided nearer to the start date of the course.

**Intended Learning Outcomes:**

On completion of this course, students should be able to:

- Explain the definition and usage of the term “Internet of Things” in different contexts.
- Take account of the key components that make up an IoT system.
- Differentiate between the levels of the IoT stack and be familiar with the key technologies and protocols employed at each layer of the stack.
- Apply the knowledge and skills acquired during the course to build and test a complete, working IoT system involving prototyping, programming and data analysis.
- Understand where the IoT concept fits within the broader ICT industry and possible future trends.
- Appreciate the role of big data, cloud computing and data analytics in a typical IoT system.

**Course Content:**

1. **Introduction to the Internet of Things**
   - What is the IoT and why is it important?
   - Elements of an IoT ecosystem.
   - Technology and business drivers.
   - IoT applications, trends and implications.

2. **Sensors and sensor nodes**
   - Sensing components and devices.
   - Sensor modules, nodes and systems.

3. **Connectivity and networks**
   - Wireless technologies for the IoT.
   - Edge connectivity and protocols.
   - Wireless sensor networks.
4. **Analytics and applications**
   - Signal processing, real-time and local analytics.
   - Databases, cloud analytics and applications.

5. **Industry perspective**
   - Business considerations.
   - Legal challenges.

6. **IoT lab exercises**
   - Local processing on the sensor nodes.
   - Connecting devices at the edge and to the cloud.
   - Setting up wireless mesh networks.
   - Processing data offline and in the cloud.

**Assessment:**

Assessment is via quizzes, reports, presentation, demonstration and viva examination. Coursework deliverables will be examined both through group work and through individual contribution.

**Guest Speakers:**

Visiting speakers from industrial partners will be invited to share their perspective on the current state-of-the-art in the IoT industry.

**Recommended Reading:**

**Technical**


**Business**

- European Alliance for Innovation (EAI), "Internet of Things: Exploring the potential", Innovation Academy Magazine, Issue No. 03, 2015
- ITU and Cisco, "Harnessing the Internet of Things for Global Development", A contribution to the UN broadband commission for sustainable development