Module Name: Mobile Communications Systems

Module Acronym: MCS

Module Manager: Professor Izzat Darwazeh

Course Summary:

This module considers the fundamentals of the mobile and wireless communications systems. The module starts with a detailed view of the wireless propagation channel, the wireless and cellular environments and the signals, coding, modulation and multiple access techniques used in wireless systems. We focus on the detailed implementation of two key mobile systems, namely; GSM and UMTS from the viewpoints of system architecture, the physical layer and system implementation and take a detailed look at the physical and logical channel implementation. The 2.5 and 3.5/3.75 Generations are also discussed with a description of HSCSD, GPRS, EDGE, HSDPA and HSUPA. Issues of network planning, mobile services and business are also considered in the module and non-mobile systems are introduced. 4th generation systems are covered, in the form of LTE and LTE advanced, at both the physical layers and network architectural aspects (the Evolved Packet Core). Students are also introduced to future concepts through looking at 5G proposals and some of the current research into possible 5G systems.

Intended Learning Outcomes

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

- know and understand the engineering principles of wireless transmission, cellular systems and the different cellular/mobile systems
- analyse and calculate the path loss, fading profiles and effects of multi-path propagation in various cellular environments (based on thorough understanding of the wireless channel)
- develop a thorough knowledge of system architecture, signal formats channel structure and services for GSM, UMTS and 4G/LTE systems.
- analyse error-correcting capabilities of different forward-error correcting schemes and justify the choice of particular schemes for given applications
- understand the standardisation processes of wireless systems and the different cellular generations and be familiar with the IP issues associated with the development of technologies and standards
- compare the different cellular generations and standards in terms of capabilities, technologies (core and wireless access/physical layer), services, cost, complexity and history

- make a learned guess at what is 'next step' in 5G cellular systems development on the basis of a thorough understanding of existing systems and of systems under development

Course Content

- **Introduction**

o Introduction and historical background
o The wireless and cellular environments
o The wireless propagation channel
o Modulation and multiple access techniques (analogue and digital, BPSK, QPSK and QAM, OFDM; TDMA, FDMA and CDMA)

- **GSM**

o System architecture
o The physical layer
o Logical and physical channels
o Data and services
o 2.5 G Basics (HSCSD, GPRS, EDGE, EGPRS)

- **UMTS**

o System architecture
o The physical layer
o Coding and channel allocation
o Network design
o 3.5 and 3.75 systems (HSDPA, HSUPA and HSPA)

- **4th generation systems and LTE**
- LTE system architecture and and evolved packet core (EPC)
- The LTE physical layer
- Beyond 4G and the move towards 5G systems

- **Other aspects and technologies**
- Mobile networks implementation and planning
- Standardization activities and standards

structures

Assessment:

A two and half hour unseen written examination will be held under UCL MSc examination regulations at UCL.

Tutorials/Workshops:

A three hour tutorial will follow a week after the completion of the module.