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 environment and the modulation 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, GRS, EDGE, HSDPA and HSUPA. Issues of network planning, mobile services and business are also considered in the module and non-mobile (tetherless) systems are described with a focus on the 802.11 (WiFi), 802.15 (Bluetooth and Zigbee) and 802.16(WiMAX) standards.

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.
- Based on thorough understanding of the wireless channel, analyse and calculate the path loss, fading profiles and effects of multi-path propagation in various cellular environments.
- Develop thorough knowledge of GSM system architecture, signals and signal formats and services.
- Develop thorough knowledge of UMTS system architecture, signals and signal formats and services.
- Understand the details of channels used in GSM and UMTS and differentiate between downlink/uplink channels, data/control channels and broadcast/dedicate channels and justify the use of a particular channel for a specific function.
- Understand and contrast the interaction between users' base, service demand and choice of wireless technologies.
- Gain knowledge of wireless non-cellular systems (802.11 and 802.16).
- Analyse the effect of various signal deterioration mechanisms and on the basis of such analysis choose an appropriate modulation scheme.
- Choose an appropriate cellular technology for a particular user demand.
- Choose an appropriate cellular technology by contrasting service/user requirements, cellular environment and cost of installation and running of services.
- Understand the coding mechanisms used for error control, compression and multiple access in wireless systems.
- Analyse error correcting capabilities of different forward error correcting schemes and justify the choice of particular schemes for given applications.
- Generate appropriate orthogonal codes, on the basis of user demand, service requirements and fairness of resource allocation, for use in FDD and TDD UMTS systems.
• 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 of what is "next step" in cellular systems development on the basis of
thorough understanding of existing systems and of systems under development.
• Express the concepts learned mathematically and in words.

Course Content

• Introduction
  o Introduction and historical background
  o The wireless and cellular environments
  o The wireless propagation channel
  o Legacy systems and brief introduction
to AMPS and TACS

• Modulation and coding for wireless systems
  o Modulation techniques (analogue and digital, BPSK,
    QPSK and QAM, OFDM)
  o Multiple access techniques (TDMA, FDMA and CDMA)
  o Coding (error control and source coding)

• 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)

• Other aspects and technologies
  o Mobile networks implementation and planning
  o Mobile services and business aspects

• Business case study and lecture
  o Lecture by invited experts from the mobile industry. Discussion normally focuses on IP issues,
business, commercial and financial aspects and on recent/future developments.
MSc Communications Programmes

- Personal Area Networks (Bluetooth and Zigbee)
- Wireless data services (WiFi and WiMAX)

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

**Tutorials/Workshops:**
A two hour tutorial will follow a week after the completion of the module.