Module Code	**EEP55C28**
Module Name	Digital Wireless Communications
ECTS Weighting[1]	5 ECTS
Semester taught	Semester 1
Module Coordinator/s	Arman Farhang
Module Learning Outcomes with reference to the Graduate Attributes and how they are developed in discipline	On completion of this module the student will be able to: 1. Identify the key building blocks of a digital communication system and design the fundamental system parameters. 2. Describe different channel access methods and associated standards for data transmission in digital communication systems and analyse the performance of various diversity reception techniques. 3. Interpret different types of multipath communication channels, analyse and model different channel effects. 4. Identify and deploy orthogonal signalling for data transmission, taking into account appropriate pulse-shape design considerations. 5. Discuss multicarrier data transmission technologies as well as spread spectrum communications. 6. Assess the energy efficiency of selected digital communication technologies. **Graduate Attributes: levels of attainment** To act responsibly - Enhanced To think independently - Enhanced To develop continuously - Enhanced To communicate effectively - Enhanced
Module Content	Communication systems have become an indispensable part of our lives. Massive amount of information is generated by multitude of different inter-connected devices, e.g., connected things, smart wearables, tablets, vehicles, etc. This has led to the emergence of new generation of applications such as autonomous driving, remote industrial management and control, remote surgery, etc. To support such applications, larger system bandwidths than in 4G/5G systems, massive connectivity, ultra-reliability, and low latency communication technologies are required. Therefore, it is of a paramount importance to build the background and fundamental knowledge on the design and development of the key technologies that underpin such systems while finding the answers to the questions such as: How to design the communication systems that can cope with the large amount of interference that is created by the large number of devices? How to optimize the use of the available spectrum? How to improve connectivity and reliability of the

[1] TEP Glossary

communication links? How to deal with the signal impairments that are created either by the communication devices or the communication channels?

This module encapsulates theoretical and practical principles that are required to model, analyse and design the digital communication systems. To this end, the module lays down the fundamental knowledge on the properties of wireless communication channel and the challenges in the emerging applications in future communication systems. In addition, the module focuses on the key building blocks of the digital communication systems. For instance, the module covers topics such as digital modulation and pulse-shaping, orthogonal signalling, multicarrier modulation, multiple access, and multiuser signal detection techniques.

Module syllabus:

1. Introduction to digital communication systems - digital communications model and system components.
2. Analog modulation of digital signals and complex baseband representation of the communication channel.
3. Digital modulation and pulse-shaping.
4. Wireless channel modelling and signal propagation in wireless environment while covering concepts such as coherence time, coherence bandwidth, and the scattering function, etc. Introduction to channel models in 4G and 5G wireless communications standards.
5. Orthogonal signalling and multitone modulation.
6. Spread spectrum communications.
7. Diversity reception techniques in time, frequency, and space.
8. Multiple access in time, frequency, and code domains.
9. Energy efficiency of selected digital communication technologies.

Teaching and Learning Methods

The module is taught using a combination of lectures and tutorials. Every week one lecture is allocated to tutorials.
Three software-based lab sessions will demonstrate some of the concepts covered in class. Students will be required to complete a research assignment where they write a report covering technical aspects of an emerging technology for future wireless communication systems.

Assessment Details[2]
Please include the following:

- **Assessment Component**
- **Assessment description**
- **Learning Outcome(s) addressed**

Assessment Component	Assessment Description	LO Addressed	% of total	Week due
Examination	2 hour written examination	LO1, LO2, LO3, LO4, LO5, LO6	75%	n/a

[2] TEP Guidelines on Workload and Assessment

• **% of total** • **Assessment due date**	Continuous Assessment	**Labs:** Written report based on two 2-hour lab sessions	**Labs:** LO3, LO4	25%	**Labs:** 9 - 10
Reassessment Requirements	Examination (2 hours, 100%)				
Contact Hours and Indicative Student Workload[2]	**Contact hours:** 50 hrs **Independent Study (preparation for course and review of materials):** 50 hrs **Independent Study (preparation for assessment, incl. completion of assessment):** 20				
Recommended Reading List	• Simon Haykin, Communication Systems (5th ed.), Wiley, 2010. • John Proakis, and Masoud Salehi, Digital Communications (5th ed.), McGraw-Hill, 2008. • Michel C. Jeruchim, Philip Balaban, and K. Sam Shanmugan, Simulation of Communication Systems (2nd ed.), Springer Science & Business Media, 2006.				
Module Pre-requisite	EEU33C01, EEU33E03, EEU33C05				
Module Co-requisite	n/a				
Module Website	Material available on BlackBoard				
Are other Schools/Departments involved in the delivery of this module? If yes, please provide details.	No				
Module Approval Date					
Approved by					
Academic Start Year					
Academic Year of Date					