The University Of Sheffield.

Electronic & Electrical Engineering.

EEE6431 BROADBAND WIRELESS TECHNIQUES

Credits: 15

Course Description including Aims

This module will give an understanding of the most up to date communication techniques used in the design and operation of broadband wireless systems based on multicarrier technology such as OFDM as used in LTE, WiFi and WiMAX. Specifically, the module explores the physical layer functionalities of broadband wireless systems. The outline syllabus will include an introduction to broadband wireless systems; the principles of radio propagation including pathloss and shadowing; narrowband and frequency selective fading; the information capacity of wireless channels; multicarrier techniques including OFDM; and the application of OFDM to broadband wireless communication systems.

Outline Syllabus

1. Broadband wireless system concepts;
2. Signal propagation, pathloss models and shadowing;
3. Statistical narrowband and wideband multipath fading models;
4. Capacity of wireless channels;
5. Principles of multicarrier modulation;
6. Orthogonal frequency division multiplexing (OFDM).

Learning Outcomes

By the end of the module, a student will be able to demonstrate the ability to:

1. Appreciate how broadband wireless systems operate (US1, US1m, US2, US2m, US3, US3m, E1, E1m, E2, E3m, E4);
2. Understand how radio signals are affected by terrestrial propagation effects (US1, US1m, US2, US2m, US3, US3m, E1, E1m, E2, E2m, E3, E3m, E4);
3. Understand how frequency selective fading due to multipath propagation impairs system performance (US1, US1m, US2, US2m, US3, US3m, E1, E1m, E2, E2m, E3, E3m, E4);
4. Analyze the capacity of a radio channel affected by narrowband or frequency selective fading (US1, US1m, US2, US2m, US3, US3m, E1, E1m, E2, E2m, E3, E3m, E4);
5. Understand how spectrally efficient wireless transmission is achieved using multicarrier techniques and high order modulation (US1, US1m, US2, US2m, US3, US3m, E1, E1m, E2, E2m, E3, E3m, E4);
6. Appreciate current broadband wireless systems, in particular OFDM (US1, US1m, US2, US2m, US3, US3m, E1, E1m, E2, E2m, E3, E3m, E4, D1, S1, P6)

Time Allocation

30 one hour lectures and 6 one hour problem solving classes.

Recommended Previous Knowledge

UG level 3 (or equivalent) understanding of basic electronic and electrical engineering, digital communications theory, signal processing, MATLAB programming and/or applied mathematics.

Recommended Books

Title: Wireless Communications
Author: Andrea Goldsmith
Edition: 1
Publisher: Cambridge University Press

Assessment

Two hour examination (75%).
In-Semester test (25%).

UK-SPEC/IET Learning Outcomes

Outcome Code	Supporting Statement
SM1m/SM1fl SM4m	The module covers underpinning scientific principles and methodologies related to broadband wireless communications by exploring topics in wireless system design; signal propagation and multipath fading; capacity; and multicarrier transmission techniques, in particular OFDM.
SM2m/SM2fl	The module covers underpinning mathematical and statistical principles in broadband wireless communications through the mathematical modeling of radio pathloss, statistical narrowband and frequency selective multipath fading; the analysis of system SNR and the formulation of Shannon capacity; the mathematical representation of multicarrier schemes using high order modulation, in particular OFDM; and the mathematical representation of broadband wireless communication systems and their performance.
SM6m/SM3fl	The course builds on a range of engineering disciplines that impart a working knowledge of signals and systems, digital communications theory, cellular mobile principles and stochastic processes. The module also requires an appreciation of the commercial drivers of broadband wireless systems in relation to spectrum and standards constraints.
EA1m/EA1fl EA2m /EA2fl EA5m	The module aims to provide analytical skills to underpin the students' ability to design and analyse the performance of a broadband wireless communication system, particularly ones based on multicarrier technology. The students determine pathloss, characterize frequency selective channels through *rms* delay spread; calculate SNRs and capacity for various channel types; and quantify the overall performance of a broadband wireless system based on OFDM.
EA3m EA4m	Problem solving classes involve the evaluation of a broadband wireless transmission system, such as IEEE802.11a/g WLAN, in terms of capacity. The system performance is assessed for different system configurations and types of communication channels.
D2m/D1fl/ ET5fl	This learning outcome is generically considered through the treatment of deployment practices for broadband wireless communication systems.

	Constraints due to spectrum, power and energy limitations influence design and the deployment options of a cellular mobile system.
ET2m/ET2fl	This learning outcome is also generically considered through the treatment of cell deployment practices for broadband wireless communication systems. The key factors that influence the cost of deployment are discussed such as the cost of spectrum and the number of base stations deployed.
EP6m/EP2fl	This learning outcome is considered through the treatment of technical standards for broadband wireless communication systems. The importance of standards in this technology is emphasized as enabling scales of economy and competition as well as defining communication interfaces.
EP9m	This learning outcome is considered through the treatment of technical standards for broadband wireless communication systems. The importance of standards in this technology is emphasized as enabling scales of economy and competition as well as defining communication interfaces.