EE600: Propagation and Channel Modelling

Module Details

Short Title:	Propagation and Channel Modelling APPROVED
Full Title:	Propagation and Channel Modelling

Module Code:	EE600	**NFQ Level:**	9	**ECTS Credits:**	10

Valid From:	Academic Session - 2011/12 (September 2011)
Administrator:	Noel Murphy
Module Coordinator:	Conor Brennan

Description:	Wireless mobile communications are continuously adapting to new areas and services. Much attention has been spent over the last 15 years on network planning for mobile services such as GSM and UMTS. Attention is now turning more to micro-cells, pico-cells and femto-cells and related networks concepts such as personal area networks and body area networks. For these systems a profound knowledge of indoor and outdoor wave propagation, multiple input multiple output (MIMO) systems, ultra-wideband (UWB) techniques as well as RF system level characterization is essential. This module will provide a thorough grounding in propagation phenomena and channel modelling for PhD students embarking on research on any aspect of wireless systems. The course shall be delivered in two blocks, each lasting a week. This module is being developed under the Telecommunications Graduate Initiative (TGI) as part of which it has the course code TGI_P04. In 2011-2012 the module will be delivered by Professors Werner Wiesbeck, Karlsruhe Institute of Technology and Thomas Kurner, University of Braunschweig.

Learning Outcomes:

On successful completion of this module the learner will be able to

1. Describe basic wave propagation effects such as reflection, scattering, refraction and diffraction.
2. Explain, model and manipulate key propagation concepts such as polarization, multipath and Doppler effect.
3. Derive and apply commonly used deterministic and stochastic models of propagation phenomena as they occur in a variety of environments and in the context of a variety of modern wireless systems.
4. Derive and apply narrow-band, wide-band and ultra-wideband propagation channel models for use in a variety of environments and wireless systems.
5. Describe and implement more advanced techniques such as those based on the Uniform Theory of Diffraction, parabolic equation and integral equations, as well as articulate how they differ from simpler models.
6. Explain the concept of diversity and the fundamentals underpinning Multiple Input Multiple Output systems.
7. Apply their practical knowledge of propagation and channel modelling to radio coverage and network planning problems.
8. Identify and critique current research activities relating to the area of propagation and channel modelling.

Pre-requisite learning

Module Recommendations

This is prior learning (or a practical skill) that is mandatory before enrolment in this module is allowed. You may not enrol on this module if you have not acquired the learning specified in this section.

No recommendations listed

Requirements

This is prior learning (or a practical skill) that is mandatory before enrolment in this module is allowed. You may not enrol on this module if you have not acquired the learning specified in this section.

This is an advanced-level module in telecommunications. It is assumed that participants have an appropriate background in time-varying electromagnetics, multi-variate calculus and ray or geometrical optics, and a basic knowledge of structured programming in C or Matlab. More details are available from the module coordinator.

EE600: Propagation and Channel Modelling

Module Content & Assessment

Indicative Content

- **Propagation and scattering models**
  Overview, Geographical databases, ray-optical models, 2D Parabolic Equation methods, 2D integral equation models, numerical methods for scattering computation, ITU-R 1546, Stochastic models, SISO channel modelling, Coverage planning.
- **Mobile Communication Systems**
  Overview, GSM,UMTS, Mobile Channel System Theory, Narrowband Channel, Wideband Channel, C2C Applications, OFDM.
- **Virtual Drive**
  Overview, Realisation, Urban, Freeway, Virtual Drive VHF, Virtual Drive Link C2C 802.11a, PHY 802.11p, Simulations 802.11p.
- **Multiple Input Multiple Output**
  Overview, MIMO Channel Characterisation, MIMO Techniques, MIMO Antenna Design, LMS Beamforming, MIMO Antennas
- **Ultrawideband Channel characterization**
  UWB definition, UWB standards and protocols, UWB channel modelling

Assessment Breakdown	%
Course Work	100%
End of Semester Formal Examination	0%

Coursework Breakdown

Type	*Description*	*Outcome addressed*	*% of total*	*Assessment Date*
Assignment	The students are required to develop Matlab code to implement and examine modern propagation models.	1,2,3,4,5,6,7	50	n/a
In Class Test	There will be a class test held at the end of the second week examining all aspects of the course.	1,2,3,4,5,6,7,8	50	n/a

DCU reserves the right to alter the nature and timings of assessment

EE600: Propagation and Channel Modelling

Module Workload & Resources

Workload	Full-time hours per semester	
Type	*Description*	*Hours*
Lecture	Block release classroom sessions	40
Tutorial	Block release tutorial sessions	20
Assignment	Computer modelling based assignment	60
Independent learning	Students will be given a comprehensive reading list comprising recent and classic journal papers and textbooks.	130
Examination	Class test	3
	Total Workload	253.00

Resources
Other Resources
• **CD: 2011*Official TGI_P04 notes***