ELEN90013 Mobile and Wireless Networks and Design

Credit Points:	12.5
Level:	9 (Graduate/Postgraduate)
Dates & Locations:	2015, Parkville This subject commences in the following study period/s: Semester 1, Parkville - Taught on campus.
Time Commitment:	Contact Hours: 1 x 3 hour lecture per week Total Time Commitment: 200 hours
Prerequisites:	4-year Electrical Engineering degree or equivalent.
Corequisites:	None
Recommended Background Knowledge:	None
Non Allowed Subjects:	Credit may not be obtained for both ELEN90013 Mobile and Wireless Networks and Design and (431-633) Mobile and Wireless Networks
Core Participation Requirements:	For the purposes of considering request for Reasonable Adjustments under the Disability Standards for Education (Cwth 2005), and Students Experiencing Academic Disadvantage Policy, academic requirements for this subject are articulated in the Subject Description, Subject Objectives, Generic Skills and Assessment Requirements of this entry. The University is dedicated to provide support to those with special requirements. Further details on the disability support scheme can be found at the Disability Liaison Unit website: http://www.services.unimelb.edu.au/disability/
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Subject Overview:	**AIMS** This subject introduces the fundamentals of mobile and wireless network design with a focus on the design and performance evaluation of the Radio Access Network of 2G, 3G and beyond cellular wireless networks. It develops the theoretical and conceptual underpinnings of the mathematical models of radio propagation, SINR, diversity and queuing that provide the basis for designing and performance evaluation of wireless networks. It introduces the specific design elements that are common to these networks with reference to the models and develops a framework for students to apply to solving their specific design problem in the project. Practical engineering constraints and requirements including radio and teletraffic performance targets are included in this approach, providing the network performance objective for the design. In the laboratory, students get hands-on exposure to analysis and design methodologies that are needed for current and emerging technologies and can learn how the modelling and simulation environments can be applied as tools for network design and performance evaluation. There is access to tools in Excel or Matlab developed within the theoretical discourse that students utilise for their design and problem solving. Students are exposed to a range of technologies covering GSM/EDGE, WCDMA, HSDPA and LTE and the underlying multiple access techniques of FDAM, TDMA, CDMA and OFDMA. Models of these access technologies are covered and student learn how to apply these along with the propagation and queueing models to the design problems. **INDICATIVE CONTENT** This subject provides the fundamentals of mobile and wireless network design. In particular it includes the following topics:

	# Introduction to wireless communications # Frequency division, orthogonal frequency division, time division and code division multiple access. Frequency division duplexing and time division duplexing # The cellular concept, frequency reuse, channel allocation schemes, handoff, call control, interference, C/I analysis, interference limited capacity, sectorisation, system capacity based on call blocking # Teletraffic models for cellular mobile networks, Erlang loss function (Erlang B), Erlang delay (Erlang C), M/M/m, M/G/1 Processor Sharing queue and their application to dimensioning cellular communications networks for voice and data, system capacity, demand modelling and performance, Grade of Service and Quality of Service # Propagation, free space propagation, basic propagation mechanisms, two ray model, empirical path loss models (Hata, Cost231-Hata, Erceg), log-normal shadow fading, small-scale multipath propagation and Rayleigh fading # SNR, sensitivity and link budget calculations, micro and macro diversity to combat fading, calculation of radio coverage for cellular networks: multiple access techniques for cellular communications # CDMA system principals & spread spectrum for 3G wireless systems # Cellular broadband wireless systems (3G+ and 4G) including simulation models for performance evaluation. This material is complemented by the use of software tools (e.g. excel and MATLAB) for computation and simulation, and practical experience with network design.
Learning Outcomes:	**INTENDED LEARNING OUTCOMES (ILO)** On completion of this subject, students should have developed the skills and knowledge required to understand the fundamentals of the design and evaluation of mobile and wireless networks. It is expected that the student to be able to solve technical problems in the following areas: 1 Analysis and evaluation of re-use planning via the calculation of key performance indicator such as CIR 2 Application and evaluation of propagation models to wireless networks 3 Teletraffic modelling and performance analysis for wireless networks 4 Dimensioning of wireless networks 5 Modelling and design of wireless systems 6 Performance evaluation of wireless broadband networks 7 Design and evaluation of coverage for wireless networks based on a link budget 8 Large and small scale fading mitigation using space diversity techniques The student should be able to perform a basic design of a wireless system for both coverage and capacity for given performance targets. They should also be able to evaluate the coverage, capacity and or performance of a wireless system.
Assessment:	An examination of three hours duration held at the end of the semester, worth 70%; A network design project equivalent to 3000 words (approximately 40-45 hours of work per student), worth 30%. Hurdle requirement: Students must pass the end of semester examination to pass the subject. Intended Learning Outcomes (ILOs) 1-8 are assessed in the final written examination and the submitted project report.
Prescribed Texts:	Reading: H. Holma and A. Toskala, WCDMA for UMTS – HSDPA Evolution and LTE, J. Wiley & Sons, New York, 4th Ed., 2007E. Dahlman, S. Parkvall, J Skold and P. Bemming, “3G Evolution HSDPA and LTE for Mobile Broadband”, Elsevier, Amsterdam, 2nd Ed., 2008H. Holma and A. Toskala, WCDMA for UMTS, J. Wiley & Sons, New York, 3rd Ed., 2005H.Holma and A. Toskala, HSDPA/HSUPA for UMTS, J. Wiley & Sons, New York, 2006T.S. Rappaport, Wireless Communications: Principals and Practice, 2nd Edition, Prentice Hall, 2002L. Kleinrock, Queuing Systems: Volume 1 - Theory, John Wiley & Sons New York, 1975W.C. Jakes, Microwave Mobile Communications, Wiley-Interscience, 1974
Breadth Options:	This subject is not available as a breadth subject.
Fees Information:	Subject EFTSL, Level, Discipline & Census Date, http://enrolment.unimelb.edu.au/fees
Generic Skills:	On completion of this subject, the students should have developed:

	# Problem solving and analytical skills # Critical and creative thinking, with an aptitude for continued self-directed learning # Sense of intellectual curiosity # Ability to interpret data and research results # Ability to learn in a range of ways, including through information and communication technologies # Capacity to confront unfamiliar problems # Ability to evaluate and synthesise the research and professional literature # Ability to develop models of practical applications and evaluate their performance by rigorous analytical means.
Notes:	**LEARNING AND TEACHING METHODS** The subject is delivered through lectures, tutorials and a workshop class with a hands-on laboratory activity. The design project provides a problem based learning activity. **INDICATIVE KEY LEARNING RESOURCES** Students are provided with lecture slides, tutorials and worked solutions, introductory and background material and proofs, and list of reference texts. **CAREERS / INDUSTRY LINKS** This course is designed and delivered by an industry based expert in the field who brings and industry perspective and industrial experience to the subject.
Related Course(s):	Master of Telecommunications Engineering