McGill

Department of Electrical & Computer Engineering
McConnell Engineering Building
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WINTER 2016

ECSE610: WIRELESS TELECOMMUNICATIONS, Wednesday/Friday, 16:05-17:25, ENGTR2100

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CONTENTS:

A. **Introduction:** An Overview of Wireless Communications: 1G to 5G
B. **Wireless Communication Channels:** Wireless Channel Properties: Radio Wave Propagation, LOS, NLOS, Path Loss, Shadowing, Multipath • Statistical Channel Modeling: Linear Time-Varying Channel Model, Time and Frequency Coherence.
C. **Digital Modulation and Detection:** Digital Modulation Techniques • Optimum Receiver Design • Performance
D. **Capacity of Wireless Channels and Diversity:** Channel Capacity • Frequency-Flat Fading and Diversity: Time, Frequency, Space, Constellation • Outage • Channel Information & Opportunistic Transmission Strategies
E. **Multi-carrier Modulation:** Frequency-Selective Fading • Multi-Carrier Transmission, OFDM
F. **Multi-antenna (MIMO) Transmission over Wireless Channels**: Channel Characteristics, Knowledge, Capacity • Space Diversity: Rx & Tx, Coding & Diversity Gains, Multiplexing Gain, Diversity & Mux Trade-off • Beamforming & Pre-Coding Techniques • Space-Time/Frequency Codes • Closed-loop, Open-loop MIMO • Massive MIMO
G. **Multi-User (MU) Communications**: Multi-user Channels: Uplink and Downlink • Multiple Access Techniques: FDMA, TDMA, CDMA, SDMA, Hybrid techniques • Multiuser Capacity: Downlink Broadcast Channel Capacity, Uplink (MA) Channel Capacity • Multiuser diversity.
H. **Cellular Systems**: Cellular System Fundamentals • Frequency Reuse, Spectrum Sharing • Intercell Interference Coordination, Coverage • Sectorization, System Capacity, Area Spectral Efficiency • Dynamic Resource Allocation • MIMO in cellular networks: SU-MIMO, MU-MIMO in LTE, LTE-Advanced, 5G
I. **Overview of WiFi and Ad Hoc networks:** Protocol Layers, Random Access Techniques: ALOHA, CSMA, IEEE 802.11ac overview

MARKING: Assignments (35%); Open-book Midterm Exam (30%), Term-Project (35%)
GRADING: A≥85%, A-≥80%, B+≥75%, B≥70%, B-≥65%, C≥55%, F<55%

SOME REFERENCES:

- A. Goldsmith, *Wireless Communications,* Cambridge University Press, 2005
- D. Tse, P. Viswanath, *Fundamentals of Wireless Communication,* Cambridge University Press, 2005
- Andreas F. Molisch, *Wireless Communications*, John Wiley & Sons, 2011
- Moray Rumney (Editor), *LTE and the Evolution to 4G Wireless: Design and Measurement Challenges*, 2nd Edition, Wiley 2013
- S. O. Haykin, M. Moher, *Modern Wireless Communications*, Prentice-Hall, 2005

and materials from various sources, e.g., 4G Americas, 3GPP, journals, conferences, books

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