

	<b>UE-COM2: Advanced Wireless Communications</b>	Semester 1
Contributes to	MICAS	

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Volume:	45h	<b>4.5 ects</b>
Hours:	Lectures: 25.5h, Exercises: 9h, Labs: 3h, Seminars: 6h	
Assessment:	2 Quizzes and 1 Final Exam	
Language:	English	

**Objectives:**

The course provides advanced knowledge in a number of transmission techniques and technologies in wireless communications. It covers the fundamentals on MIMO communications ranging from single-user MIMO to multi-user MIMO and cooperative communications, then addresses massive MIMO and mmwave MIMO in contemporary wireless communication standards. Other advanced topics are also viewed to update students with emerging techniques and developments in 5G including: IoT technologies and communications, D2D communications, caching, green communications and various network architectures.

**Outcomes:**

On completion of the course students should be able to:

- Describe advanced transmission techniques and technologies in wireless communication systems -
- Examine major problems of wireless communication channels and propose appropriate solutions -
- Design wireless communication systems and investigate further researches in relevant topics -

**Prerequisite**

- Introduction to Probability and Statistics -
- Introduction to Communication Theory -

**Syllabus**

- Basics of single-user Multiple-Input-Multiple-Output (MIMO) communications
  - Channel models, outage capacity, ergodic capacity
  - Diversity techniques: time, frequency, space and diversity combiners
  - Precoding for spatial multiplexing, optimum, linear and nonlinear receivers
  - Space-time coding and MIMO decoding
- Advanced MIMO communications
  - Multi-user MIMO: interference management, limited feedback and precoding
  - Cooperative communications: Relay channels and protocols
  - Coordinated Multi-point techniques: Coordinated beamforming and scheduling, joint processing techniques
  - Wireless network coding
- Emerging techniques and applications in 5G
  - Recent advances in MIMO: massive MIMO and millimeter wave MIMO
  - Internet of Things (IoT) networks and Low Power Wide Area Network (LPWAN) technologies (Lora, SigFox, LTE-M, EC-GSM-IoT, NB-IoT)
  - Other topics: Caching, Device-to-device (D2D) communications, Massive IoT, Ultra-Reliable Low-Latency Communication (URLLC), Green and energy efficient communications, Mobile Cloud/Edge/Fog computing and C-RAN architectures

**Bibliography:**

- D. Tse and P. Viswanath, "Fundamentals of wireless communication", 2005.
- R. W. Heath Jr. and A. Lozano, "Foundations of MIMO Communication", 2018.
- T.L. Marzetta, E.G. Larsson, H. Yang, H.Q. Ngo, "Fundamentals of Massive MIMO", 2016. -
- E. Bjornsson, J. Hoydis, L. Sanguinetti, "Massive MIMO Networks: Spectral, Energy, and Hardware Efficiency", 2017.
- A. Osseiran, J. F. Monserrat and P. Marsch, "5G Mobile and Wireless Communications Technology", 2016.