

## EEL 6935 – SELECTED TOPICS IN COMMUNICATIONS: FOUNDATION TECHNOLOGIES FOR LTE ADVANCED, 5G AND BEYOND

**Instructor:** Dr. Hüseyin ARSLAN  
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### Instructor's research interests and background:



Dr. Arslan (FIEEE) has received his BS degree in electrical and electronics engineering from Middle East Technical University (METU), Ankara, Turkey in 1992; M.S. and Ph.D. degrees in electrical engineering in 1994 and 1998 from Southern Methodist University (SMU), Dallas, TX, USA. From January 1998 to August 2002, he was with the research group of Ericsson Inc., NC, USA, where he was involved with several projects related to 2G and 3G wireless communication systems. Since August 2002, he has been with the Electrical Engineering Dept. of University of South Florida, Tampa, FL, USA, where he is currently a Professor. In December 2013, he joined Istanbul Medipol University to found the Engineering College, where he has worked as the Dean of the School of Engineering and Natural Sciences. He has also served as the director of the Graduate School of Engineering and Natural Sciences in the same university. In addition, he has worked as part-time consultant for various companies and institutions including Anritsu Company, Savronik Inc., and The Scientific and Technological

Research Council of Turkey.

Dr. Arslan's research interests are related to advanced signal processing techniques at the physical and medium access layers, with a cross-layer design for networking adaptivity and Quality of Service (QoS) control. He is interested in many forms of wireless technologies including cellular radio, wireless PAN/LAN/MANs, fixed wireless access, aeronautical networks, underwater networks, *in vivo* networks, and wireless sensors networks. His current research interests are on 5G and beyond, physical layer security, signal intelligence, cognitive radio, small cells, powerline communications, smart grid, UWB, multi-carrier wireless technologies, dynamic spectrum access, co-existence issues on heterogeneous networks, aeronautical (High Altitude Platform) communications, *in vivo* channel modeling and system design, and underwater acoustic communications. He has served as technical program committee chair, technical program committee member, session and symposium organizer, and workshop chair in several IEEE conferences. He is currently a member of the editorial board for the IEEE Transactions on Cognitive Communications and Networking (TCCN), and IEEE Communications Surveys and Tutorials. He has also served as a member of the editorial board for the IEEE Transactions on Communications, the Elsevier Physical Communication Journal, the Hindawi Journal of Electrical and Computer Engineering, and Wiley Wireless Communication and Mobile Computing Journal.

**Course Hours:** Monday: 5:00 pm to 7:45 pm (Location: CMC 120)

**Office hours:** Monday: 3:30 pm to 4:30 pm

**TA:** Ali Fatih DEMİR, ENB 380B, afdemir@mail.usf.edu

**Level:** Graduate

**Credits:** 3      **Class Time:** Three hours lecture

**Catalog Description:** Providing the students with a comprehensive knowledge of most technical aspects, operations, and applications of fourth/fifth generations and future cellular mobile and personal communication technology. Offering technical, practical, and up-to-date treatment of the latest wireless

communication technologies and system design implementations. Describing the emerging personal communications systems and emerging personal communications services.

**Course Prerequisites:**

Students should have a B or better grade in EEL-6593 (Mobile and Personal Comm. Sys.). Some background on communications systems and digital signal processing is needed to follow the course easily. However, the students who haven't taken this course should be able to register with a Faculty approval.

**Courses that require this as a direct prerequisite:** None

**Courses that can form a sequence with this:**

- EEL 6936/4936 Wireless Communications System Laboratory
- EEL 6593/4595 Mobile Personal Communication
- EEL 7931 Selected Topics in Communications
- EEL 6936 Advanced Topics in Wireless Communications
- EEL 6597 Wireless Network Architecture and Protocol
- EEL 6534 Digital Communication Systems

**Course Objectives:**

- Providing the students with a comprehensive knowledge of most technical aspects, operations, and applications of fourth/fifth generation and future cellular mobile and personal communication technology standards and their evolution.
- Offering a technical, practical and up-to-date treatment of the latest technologies, and system (frame structure, numerologies) design implementations. Also, describing the emerging personal communications systems and emerging personal communications services.
- Introduction to the technology and underlying principles of wireless communications; building blocks of wireless networks; elementary examination of the science and technology of wireless communications including radio signal propagation (including multipath effect), radio channel modeling, interference-limited communications, massive multiple-input multiple-output (MIMO) systems, beamforming, anti-fading techniques like transmit and receiver antenna diversity, equalization, etc.; essential functions of all cellular telephone systems like scheduling, rate adaptation, interference management, multi-layer operations, heterogeneous and 5G networks, coordination of multi-point transmission etc. are discussed.
- Review of the 4G LTE standard and systems and basic issues involved in the design of wireless systems. Discussion of the potential problems associated with the access technology for the fourth/fifth-generation systems and providing the vision of the future-generation systems.
- The introduction of other subjects related to wireless communications, like multicarrier techniques including orthogonal frequency division multiple access (OFDM), random access, security in wireless communications etc.

**GRADING:**

Homeworks and class participation	<b>30</b>
Project	<b>40</b>
Final exam	<b>30</b>
Total	<b>100</b>

**Note: Homeworks must be submitted on time. All quizzes, tests, exams, etc. MUST be taken during regularly scheduled class or exam times either on campus or with an approved proctor. Any deviation from this policy MUST be pre-approved by the instructor in writing.**

**BOOKS & REFERENCES**

We will not be using a specific text book for the course. The related references will be provided by the instructor. The lecture slides will be provided to the students through Canvas. Check the course web-site

for other useful references. Feedbacks on course materials, errors in the presentation slides, and others for the improvement of the course are welcomed. Lectures will be based on required reading from magazine and journal articles, textbook sections, or supplemental handouts.

## **Tentative Outline:**

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Lecture-1:

Review of cellular evolution and standards.

Lecture-2:

Review of channel and channel counteraction techniques

Lecture-3:

LTE basics – brief introduction to LTE

Lecture -4:

Equalization (time and frequency domain)

Lecture-5 and Lecture 6:

OFDMA and SC-FDMA, and 5G numerology

Lecture-7:

Scheduling, frame structures and rate adaptation

Lecture 8:

Multiple antenna systems, massive MIMO and beamforming

Lecture 9:

Interference management, multi-layer operations and HetNets  
Multi-point transmission and coordination

Lecture 10:

Random Access

Lecture 11:

Secure Wireless Communications

Lecture 12:

mmWave

Lecture 13:

5G network architecture

Lecture 14:

Review and student presentations

## Holidays

Jan 15 (Monday) --> Martin Luther King JR. Day

March 12 (Monday) --> Spring Break

Note: In the event of an emergency, it may be necessary for USF to suspend normal operations. During this time, USF may opt to continue delivery of instruction through methods that include but are not limited to: Canvas, Skype, and email messaging and/or an alternate schedule. It's the responsibility of the student to monitor Canvas site for each class for course specific communication, and the main USF, College, and department websites, emails, and MoBull messages for important general information.

For students taking this course as the Portfolio Course: the final grade may be affected by the evaluation of the student's MSEE Portfolio, as described in the EE Department Portfolio Guidelines.

**Standard Syllabus Prepared by:** Huseyin ARSLAN