Instructor:

- **Name: Huseyin Arslan**
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- **Instructors research interests and background:**

Dr. Arslan has received his PhD. degree in 1998 from Southern Methodist University (SMU), Dallas, Tx. From January 1998 to August 2002, he was with the research group of Ericsson Inc., NC, USA, where he was involved with several project related to 2G and 3G wireless cellular communication systems. Since August 2002, he has been with the Electrical Engineering Dept. of University of South Florida. He has also been working for Anritsu Company, Morgan Hill, CA (as a visiting professor during the summers of 2005 and 2006) as a part-time consulting since August 2005. Dr. Arslan's research interests are related to advanced signal processing techniques at the physical layer, with cross-layer design for networking adaptivity and Quality of Service (QoS) control. He is interested in many forms of wireless technologies including cellular, wireless PAN/LAN/MANs, fixed wireless access, and specialized wireless data networks like wireless sensors networks and wireless telemetry. The current research interests are on UWB, OFDM based wireless technologies with emphasis on WIMAX, and cognitive and software defined radio. He has served as technical program committee member, session and symposium organizer in several IEEE conferences. He is editorial board member for Wireless Communication and Mobile Computing journal, and was technical program co-chair of IEEE wireless and microwave conference 2004. Dr. Arslan is a senior member of IEEE.

Prerequisite:

The most important prerequisite is the desire to learn the topics that will be presented in this course. The rest is rather easier to handle. Some background on communications systems and digital signal processing is needed to follow the course easily. EEL-6593 (Mobile and Personal Comm. Sys.) or EEL6534 (Digital communications, Comm. Sys. 1) would be perfect preparations for this course. However, students who haven't taken this course should be able to follow the course with some communications and signal processing background.

Focus:

This course will cover recent developments in wireless communication systems. The future generation of wireless communications systems will be overviewed and the technologies behind these systems will be discussed. Both practical and simplified theoretical aspects will be covered. Rather than providing in-dept theoretical details, introduction of main concepts and overview of the important aspects will be given. The targeted students are the graduate students as well as the non-degree seeking engineers that are working in wireless communications area in local companies. The course will include the following topics:

- **Ultrawideband (UWB) communications**

- **Multicarrier systems and orthogonal frequency division multiplexing (OFDM)**
- **Multi-input multi-output (MIMO) antenna systems**
- **Ad-hoc and wireless sensor networks**
- **Cognitive radio and Software defined radio**
- **Spread Spectrum Systems and CDMA**

Objective:

To provide students the recent developments in wireless communications area. At the end of this course, students will get a flavor of new and future wireless communications technologies, the ideas, main concepts, and simple theories behind these technologies, as well as application of these technologies to the future wireless services.

Grading, course and Office hours:

Grading (tentative):

- **Project (final report and project proposal): %60**
- **Class presentations: %20 (except APEX students who can not physicaly present)**
- **Final exam : %20 ((%40 for APEX students who can not do or prefer the presentation)**
- **Note: 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.**
- **Note: PLUS AND MINUS GRADES WILL NOT BE USED. Questions concerning grading of homework and exams must be addressed within 10 days from when the student received the graded material.**

Course Hours:

- **Tuesday and Thursday 11:30 am to 12:45 pm**

Office hours:

- **Tuesday: 1:00 to 2:00 pm**
- **Thursday: 1:00 to 2:00 pm**

Off-campus students: Please e-mail me to get an appointment for telephone conversation
On campus students: Please do not send me an e-mail unless it is necessary. I prefer office hours for technical discussions.

Note: One presentation is required from each student (except APEX students who can not pysically present). If this is a group work, one mid-semester presentation, and one end of the semester presentation is needed (the group members should decide who will present each of these). Mid-semester presentation will be based on the reading of a few papers (initial literature search and outcomes). The student will be asked to discuss what they have learned from the papers. In the final presentation, student will be asked to present their project. Both presentations will be about 30 minutes long. Single-person projects should be presented at the end of the

semester.

The final exam will be based on all the materials covered throughout the course including the presentations.

BOOKS & REFERENCES

As the topics are based on recent developments, there is no text book required for the course. Instead, selected reading materials (papers, magazine articles etc.) will be used as reference materials for this course. The instructor will provide the list of the materials. Students are not permitted to sell notes or tapes of class lecturers.

Tentative outline of the course:

The following topics will be covered during this course:

- **Ultrawideband (UWB)**
- **Multi-carrier and OFDM**
- **Spread Spectrum Systems and CDMA**
- **Multi-antenna systems, including diversity, smart antennas, and Multi-input multi-output (MIMO) antenna systems**
- **Ad-hoc and wireless sensors networks**
- **Cognitive radio and software defined radio**

THE COURSE WILL BE COVERED IN 3 PARTS:

- **First part of the course (expected to be covered during the first month and half): During this part, mostly, the instructor will provide some background and prepare students for their project. Since students might not have enough background to be able to do a project, quick overview of the technologies, key issues will be covered during this month. The outline of the first month is as follows:**
- **Introduction**
- **Overview of wireless communication systems, requirements, trends etc.**
- **Wireless channel characteristics**
- **Overview of UWB, OFDM, CDMA, and Multi-antenna technologies**
- **Overview of Ad-hoc and wireless sensors networks and Software defined radio**

- **Second part of the course (Detailed description of the technologies): This part will be highly interactive.**
- **Tentative topics that will be covered during this period:**
- **UWB channel model**
- **UWB transmitter and receiver structures**

- **Correlator and Rake reception of UWB signals**
- **Low complexity and non-coherent transceiver designs**
- **Multiple access issues in UWB**
- **Interference issues in UWB**
- **UWB antenna and pulse generation issues**
- **OFDM transceiver design**
- **Power amplifier and peak-to-average ratio issues in OFDM**
- **Coherent receiver design in OFDM systems (including timing and frequency offset synchronization, channel estimation, data detection etc.)**
- **OFDM RF and system issues; RF impairements and compensation techniques**
- **Adaptive modulation and other adaptation strategies for OFDM systems**
- **OFDM based technologies: 802.11a/g (Hyperlan-2), WiMax**

Spread Spectrum Systems and CDMA

- **Diversity**
- **Antenna combining techniques**
- **Smart antennas and adaptive beamforming**
- **Angle spread, spatial correlation, and multi-antenna channel models**
- **MIMO transceiver design**
- **MIMO channel model**
- **MIMO capacity**
- **MIMO receiver architectures**
- **Space-time processing**

Cognitive Radio and SDR

- **Ad-hoc networks and wireless sensors networks requirements**
- **Applications**
- **Network, MAC, and physical layer issues**
- **Power aware design issues and techniques**
- **Cross-layer design issues**
- **...**

- **Third part of the course (last two/three weeks of the semester): This part will also be interactive and mostly be based on the presentation of the student projects. Each project will take 20 minutes including question and answers.**

- **Schedule: Some variation from the above topical coverage and/or scheduling may occur. Also, some additional topics may be included. Notification of these will be given by the instructor during the lecture period. The student is responsible for all material covered in lecture.**