# ECE 257A: Modern Communication Networks, Fall 2018

University of California San Diego

## Instructor:

Prof. Xinyu Zhang,
*Email:* **xyzhang@ucsd.edu**
*Personal website:* google "Xinyu Zhang"
*Office:* Atkinson Hall 4314
*Office hours:* Tue. Thu. 1:50pm-2:50pm

## Teaching Assistant:

Xiao Sai
*Email:* xsai@eng.ucsd.edu
*Office:* Atkinson Hall 4th floor open space, west wing
(After exiting the elevator, turn right and then left, and then walk to the end. See map on TritonEd)
*Office hours:* Mon. Thu. TBA

## Course info:

*Location:* EBU1 (Jacobs Hall) 2315
*Time:* 12:30pm-1:50pm
*Website:* **http://xyzhang.ucsd.edu/ece257a.html**

## Prerequisite:

- Basic understanding of computer networks
- Low level courses in communication engineering

## Textbooks:

N/A.

## Course description:

This is a graduate level course in communication networks, aiming to synthesize the knowledge you learned in communication signal processing and computer networks. The course will have an interdisciplinary flavor, spanning the traditional EE and CS fields, aiming to cultivate you as a full-stack

wireless network engineer. Through this course, you will get a big-picture of modern Internet and mobile network architectures. You will understand the fundamental signal/packet processing modules in modern wireless access technologies, especially WiFi and LTE. You will also acquire knowledge about the network protocol issues unique to wireless networks, including medium access control, mobile IP, and TCP over wirleess. Finally, the course will also cover the design principles and working mechanisms of modern mobile applications (e.g., mobile Web, real-time mobile telephony, video streaming, and virtual reality).

## Lecture schedule and course content:

Below is a tentative list of topics to be covered in the course. Detailed course schedule and reading assignments will be updated on the course website. The content may change according to our progress.

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Lecture 1-2: Modern network architecture

1. Course overview.
2. Hierarchical architecture of the Internet; modern mobile network architecture
3. Overview of wireless access technologies

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Lecture 3-5: PHY layer: from signals to packets

1. Wirelss channel models;
2. Practical modulation (OFDM, DSSS);
3. Packet detection, synchronization, and channel estimation;
4. Bit rate adaptation.

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Lecture 6-7: PHY layer: MIMO, multi-user MIMO, and network MIMO

1. Basic capacity theorems and models; theoretical foundations of MIMO
2. Multi-user MIMO and network MIMO
3. Protocol and network architecture design issues

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Lecture 8-11: MAC layer:

1. A taxonomy of MAC: operations, tradeoffs;
2. Stochastic models of MAC protocols
3. Other MAC design: FHSS (Bluetooth); OFDMA (4G LTE); polling scheduling
4. Next-genreation MAC for millimeter-wave (core 5G communication technology)

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Lecture 12-13: Routing and network layer

1. Modeling routing as an integer optimization problem
2. Mobile IP addresing

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Lecture 14-15: Congestion control for wireless

1. TCP recap; Modeling TCP as an optimization problem
2. Challenges and solutions for TCP over wireless

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Lecture 16-17: Mobile and wireless applications

1. VoIP, video streaming, video telephony, virtual reality

2. Energy efficiency issues

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Lecture 18-19: Team project presentation

## Grading:

- Homework assigment: 20%
- Project: 40% (Proposal: 5%, Final Report: 30%, Final presentation: 5%)
- Class participation: 5%
- Final exam: 35%

## Exams:

There will be a final exam, scheduled at 11:30am-2:29pm, 12/14/2018. The exam will be close-book.

## Course project:

The course project should address a topic closely related with wireless networking. It could be:

- System design: Measurement and analysis of protocol/application behavior; OR design and validation of new network algorithms/protocols.
- Theoretical modeling: Modeling and performance evaluation of emerging protocols/applications, e.g., data center congestion control, millimeter-wave networking, etc.
- A comprehensive and indepth survey of a state-of-the-art topic in networking, e.g,. software-defined mobile networks, millimeter-wave networking, backscatter communications, low-power wide-area IoT networking.

Up to 3 people can work in a group for the first two options; and up to 2 for the third option. The project topic should be based on discussion between the students and the instructor, and should be approved by the instructor. Several example topics will be provided before the second lecture. Students are expected to submit a proposal by 10/11/2018 and a final report by 12/12/2018. A final project presentation will be scheduled in the final week.

## Class participation:

Many of the research issues covered in this course are still hot topics and open problems. So feel free to raise questions or comments during class. When questions are raised, you are strongly encouraged to present your opinioins and lead the discussion by yourself. Class participation will be graded based on how active you are throughout the course.