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# ECE 448 - Wireless Sensor Networks

## Syllabus - Spring 2015

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**Time:** Monday and Wednesday, 2-3:15PM

**Location:** Computer Studies Building (CSB) 523

**Website:** Blackboard

**Instructor:** Cristiano Tapparello

**Office hours:** Monday and Wednesday 4 - 5 PM, 334 Hopeman Building

**Teaching Assistant:** Mohammad Razeghi-Jahromi

**TA office hours:** Friday 4 - 5 PM, 341 Hopeman Building

**Textbook:** *Protocols and Architectures for Wireless Sensor Networks*, H. Karl and A. Willig, Wiley Publishers, 2005.

**Additional course material:** Lecture slides and research papers (Blackboard)

**Prerequisites:** No specific requirement. ECE 445: Wireless Communications (or another communication class) can be beneficial.

**Credit distribution:** Homework assignments (~5, 20 points), project report and presentation (35 points), final (45 points).

**Academic dishonesty:** Academic dishonesty will be dealt with according to the University of Rochester's Academic Honesty Policy.

### **Class description:**

This course will cover the latest research in the area of Wireless Sensor Networks. We will cover all aspects of these unique and important systems, from the hardware and radio architecture through protocols and software to applications. Topics will include sensor network architectures, hardware platforms, physical layer techniques, medium access control, routing, topology control, quality of service (QoS) management, localization, time synchronization, security, storage, and other advanced topics. Each student must complete a semester-long course project related to wireless sensor networks.

### **Class objectives:**

The goal of the class is to learn the basic principles behind a Wireless Sensor Network. Following the ISO Open Systems Interconnection (OSI) model, the class presents the particular challenges of designing network protocols, services and applications for WSNs composed of large numbers of constrained devices. Moreover, the class provides an introduction to Network Simulator 3 (ns-3), a well-know and widely adopted network simulator, focusing in particular on the simulation of wireless networks.

## Topics outline:

#	Title	Description
1	Introduction to Wireless Sensor Networks	Course Informations, Introduction to Wireless Sensor Networks: Motivations, Applications, Performance metrics, History and Design factors
2	Network Architecture	Traditional layered stack, Cross-layer designs, Sensor Network Architecture
3	Hardware Platforms	Motes, Hardware parameters
4	Introduction to ns-3	Introduction to Network Simulator 3 (ns-3)
5	ns-3 core	Description of the ns-3 core module and simulation example
6	Medium Access Control Protocol design	Fixed Access, Random Access, WSN protocols: synchronized, duty-cycled
7	Introduction to Markov Chain	Discrete time Markov Chain definition, properties, classification and analysis
8	MAC Protocol Analysis	Asynchronous duty-cycled. X-MAC Analysis (Markov Chain)
9	Routing protocols	Introduction, MANET protocols
10	Routing protocols for WSN	Resource-aware routing, Data-centric, Geographic Routing, Broadcast, Multicast
11	Opportunistic Routing Analysis	Analysis of opportunistic routing (Markov Chain)
12	Clustering	Clustering goals, types, high-level overview, clustering in WSNs
13	QoS management	Basic functions, centralized solution, Topology control, Sensor mode selection
14	Localization	Overview of different localization techniques
15	Time Synchronization	Overview of different time synchronization protocols
16	Security	Possible attacks, countermeasures, SPINS, Static and dynamic key distribution
17	Programming in WSNs	Challenges and limitations of programming WSNs. Introduction to TinyOS.
18	Energy Harvesting WSNs	Energy harvesting for self-sustainable WSNs.
19	Open Research Issues	Complement to the previous lectures, course conclusion and general discussion
20	Projects presentation	