Course name	Wireless Networking

Course ID:	40-???	Credits:	3	Program:	Graduate
Prerequisites:	Computer Networks and Probability Theory			Co-requisites:	
Prepared by:	Ali Movaghar- Rahimabadi				

Aim

This course covers an introduction to wireless networking. The focus will be on layers 2 and 3 of the OSI reference model with an emphasis on the modeling, performance analysis, design and optimization of the related protocols. The course intends to provide a one-step view of cellular, WiFi, and WiMAX networks, as well as the emerging wireless ad hoc and sensor networks. Rather than provide descriptive accounts of these technologies and standards, it emphasizes conceptual perspectives on the modeling, analysis, design and optimization of such networks. Furthermore, the course is taught within a unifying framework of resource allocation, using simple abstractions of the underlying wireless communication.

Outline

1) **Introduction**
   a) Networking as Resource Allocation.
   b) A Taxonomy of Current Practice.
2) **Wireless communication: concepts, techniques, and models**
   a) Digital Communication over Radio Channels.
   b) Channel Capacity.
   c) Diversity ad Parallel Channels: MIMO.
   d) Wideband Systems: CDMA and OFDMA.
3) **Application models and performance issues**
   a) Network Architectures and Application Scenarios.
   b) Types of Traffic and QoS Requirements.
4) **Cellular FDM-TDMA**
   a) Principles of FDM-TDMA Cellular Systems.
   b) SIR Analysis
   c) Channel Reuse Analysis
   d) Spectrum Efficiency
   e) Channel Allocation and Multi-cell Erlang Model
   f) Handovers: Techniques, Models, Analysis.
5) **Cellular CDMA**
   a) The Uplink SINR Inequalities.
   b) A Simple Case: One Call Class.
   c) Admission Control of Multiclass Calls.
   d) Association and Power Control for Guaranteed QoS Calls.

6) **Cellular OFDMA-TDMA**
   a) The General Model.
   b) Resource Allocation over a Single Carrier.
   c) Multicarrier Resource Allocation: Downlink.
   d) WiMAX: The IEEE 802.16 Broadband Wireless Access Standard.
7) **Random Access and Wireless LANs**
   a) Random Access: From Aloha to WLAN Protocols.
   b) CSMA/CA and WLAN Protocols
   c) Saturation Throughput of a Colocated IEEE 802.11-DCF Network.
   d) Service Differentiation and IEEE 802.11e WLANs.
   e) Data and Voice Sessions over 802.11.
   f) Association in IEEE 802.11 WLANs.
8) **Mobile Ad-hoc Networks (MANETs)**
   a) Applications of MANETs.
   b) Challenges of MANETS.
   c) Topology-Based Routing Protocols.
   d) Position-Based Routing Protocols.
   e) Other Routing Protocols.
   f) The Broadcast Storm.
   g) Multicasting.
   h) Geocasting.
   i) TCP over MANETs.
9) **Wireless Mesh Networks(WMNs)**
   a) Network Architecture.
   b) Challenging Technologies.
10) **Wireless Sensor Networks(WSNs)**
   a) Applications of WSNs.
   b) Empirical Energy Consumptions.
   c) Sensing and Communication Range.
   d) Design Issues.
   e) Localization Schemes.
   f) Clustering of SNs.
   g) MAC Layer.
   h) Routing Layer.
   i) Flat Versus Hierarchical.
   j) High-Level Application Layer Support.

Evaluation Criteria

Homework:	**20%**
Project:	**40%**
Mid-Term Exam:	**15%**
Final Exam:	**25%**

Main References

1. **Wireless Networking, by A. Kumar, D. Manjunath, and J. Kuri, Morgan Kaufmann Publishers, 2008.**
2. **Ad Hoc and Sensor Networks: Theory and Applications, 2nd Ed, by C.M. Cordeiro and D.P. Agrawal, World Scientific, 2011.**

Secondary References

1. **Wireless Communications, by A. Goldsmith, Cambridge University Press, 2005.**
2. **Wireless Communications and Networks, 2nd Ed., by William Stallings, Pearson Education, Inc., 2005.**
3. **Wireless Ad Hoc and sensor Networks, by X.Y. Li, Cambridge University Press, 2008.**