Ministry of Higher Education and Scientific Research
University of Mosul
College of Engineering
Computer Engineering Department
Detailed Description of the Wireless Networks Course

## Course: Wireless Networks Code: ENCO506 Class: M.Sc.

**Course Description:** This course will cover the fundamental aspects of wireless networks, with emphasis on current and next-generation wireless networks. The course should provide the students with a good understanding of the wireless networking concepts and research directions. Various aspects of wireless networking will be covered including: Fundamentals of Wireless LAN IEEE 802.11, IEEE 802.11 Distributed Coordination Function (DCF) , Multiple Access Techniques and Hidden Node Problem, Bluetooth IEEE 802.15.1, Introduction of Wireless Mesh Networks (WMNs), MAC and Network Layers of WMNs, Introduction of Mobile Ad-Hoc Networks (MANET), MAC and Network Layers of Mobile Ad-Hoc Networks (MANET), Introductions, Applications and Challenges of wireless sensor networks (WSNs), Energy Consumption and MAC (Media Address Control) Layer of Wireless Sensor Networks, Routing Protocols of WSNs, Introduction of Wireless Network Coding (WNC), Introduction of ZigBee and IEEE 802.15.4, MAC Layer of ZigBee, Introduction of Introduction to Internet of Things (IoT), Introduction to Vehicular Wireless Networks, Networking Layer Protocols for Internet of Things 6LoWPAN and RPL**,** The goal of this course is to introduce the students to state-of-the-art wireless network protocols and architectures. We will introduce the students to wireless networking research and guide them to investigate novel ideas in the area via semester-long research projects. Some of the course material will be drawn from research papers, industry white papers and Internet RFCs.

## Textbook ( S ) :

1- Ian F. Akyildiz , Mehmet Can Vuran, “Wireless Sensor Networks”, John Wiley and Sons, Ltd, Publication, first edition 2010

2- C. Siva Ram Murthy, and B. S. Manoj “Ad Hoc Wireless Networks Architectures and Protocols”,Prentice Hall Professional Technical Reference, 2004

3- Ian F. Akyildiz “Wireless Mesh Networks”, John Wiley and Sons, Ltd, Publication, first edition 2009

4- Vijay K. Grag and Joseph E. Wilkes, Wireless and Personal Communications Systems, 1996

5- Cory Beard and William Stallings, Wireless Communication Networks and Systems

**Course Objectives:** The course should provide the students with a good understanding of the wireless networking concepts and research directions.

Upon completing the course, the student will:

- Be familiar with the basics of wireless networks
- Be familiar with various types of wireless networks IEEE 802.11
- Be familiar with the Bluetooth IEEE 802.15.1
- Be familiar with the Wireless Mesh Networks
- Be familiar with the Wireless Mobile Ad-Hoc Networks
- Be familiar with the Wireless Sensor Networks
- Be familiar with the Wireless Network Coding
- Be familiar with the Wireless Mesh Networks

- Be familiar with the ZibBee IEEE 802.145.4
- Be familiar with the Internet of Thing (IoT)
- Be familiar with the Vehicular Wireless Networks

**Details Covered Topics and the required time / Daily :**

| | |
|---|---|
| **Week 1** | **Lecture 1: IEEE 802.11 Wireless Local Area Network (WLAN)**<br><br>Protocol Stacks, MAC Sublayer, Wireless Architecture, basic service set (BSS) and the extended service set (ESS), Wireless Characteristics, CSMA/CA (carrier sense multiple access with collision avoidance), Frame format for IEEE 802.11,Addressing Mechanism, Wireless Physical Layer |
| **Week 2** | **Lecture 2: IEEE 802.11 Distributed Coordination Function**<br><br>IEEE 802.11 Group Standards, IEEE 802.11: Basics Access, Hidden Station Problem, Exposed Station Problem, 802.11MAC Protocol: Distributed Coordination Function (DCF), Basic access scheme v.s RTS/CTS access scheme, Contention Period Protocol, RTS/CTS Frame Format, Performance Analysis of the IEEE 802.11 Distributed Coordination Function |
| **Week 3** | **Lecture 3: Bluetooth IEEE 802.15.1**<br><br>Overview of Bluetooth, Bluetooth applications, Bluetooth architecture, Protocols in the Bluetooth Protocol Architecture, piconet and Scatternet, Bluetooth Layers, Logical Link Control and Adaptation Protocol, Baseband Layer, Single-secondary communication, Multiple-secondary communication, Synchronous Connection-oriented link and Asynchronous Connectionless Link, Frame format types, Radio Layer |
| **Week 4** | **Lecture 4: Overview of Wireless Mesh Networks (WMNs)**<br><br>Introduction to WMNs, Challenges of WMNs,Medium Access Control (MAC) Protocol for Wireless Mesh Networks, MAC Protocols Classification, Single-Channel Single-Radio MAC Protocols, TDMA over CSMA/CA, Multi-Channel Single-Radio MAC Protocols, Multi-Radio MAC Protocols, Routing Protocols for Wireless Mesh Networks, Proactive Routing Protocols |
| **Week 5** | **Lecture 5: Wireless Mesh Networks : Part 2**<br><br>Networks devices and links type of WMNs, Mesh vs. Ad-Hoc Networks, Mesh vs. Sensor Networks,Broadband Internet Access,Extend WLAN Coverage,Mobile Internet Access,Broadband Internet Access,Comparison with existing technologies,Existing Routing Protocols,Routing - Optimization Criteria,Routing – Cross-Layer Design,TCP Problems |
| **Week 6** | **Lecture 6: Mobile Ad hoc Networks (MANET) Part I**<br>Mobile Ad hoc Networks overview, Mobile Ad hoc Versus Mobile Cellular Networks, Mobile Ad hoc Networks Applications, Challenges Facing Ad hoc Mobile Networks, Medium Access Control Protocols in Mobile Ad hoc Networks, Hidden Terminal Problem, MAC Protocols Classification, Design Goals of a MAC Protocol for Ad hoc Networks, Existing Ad hoc MAC Protocols, 1- Multiple Access with Collision Avoidance (MACA), 2-Multiple Access with Collision |

| | |
|---|---|
| | Avoidance by Invitation (MACA-BI), 3- Power-Aware Multi access Protocol with Signaling (PAMAS), 4-Dual Busy Tone Multiple Access (DBTMA), 5- Receiver Initiated Busy Tone Multiple Access Protocol (RI-BTMA) |
| **Week 7** | **Lecture 7: Mobile Ad hoc Networks Part II**<br><br>**6 -** Media Access with Reduced Handshake (MARCH), 7- Distributed Packet Prevention Multiple Access Protocol (D-PRMA), 8- Soft Reservation Multiple Access with Priority Assignment (SRMA/PA), 9-MAC Protocol using Directional Antennas, Routing in Mobile Ad Hoc Networks, Design Goals of a Routing Protocol for Ad Hoc Networks, Routing Protocols Classifications, Classification Based on Route Availability, Classification Based on Routing Topology, Distance Sequence Distance-Vector (DSDV) Routing Protocol, Ad Hoc On Demand Distance Vector Routing (AODV), Dynamic Source Routing, Zone Routing Protocol (ZRP). |
| **Week 8** | **Lecture 8: Introductions, Applications and Challenges of WSNs**<br><br>Introduction of WSN, Sensor Node Architecture, Applications of WSNs, Mobile and Static Sensor Node, Issues and Challenges of WSNs (Deployment, Localization, Communications, Data Gathering, Coverage, Tracking), Main Components of a Sensor Node. |
| **Week 9** | **Lecture 9: Energy Consumption and MAC (Media Address Control) Layer of Wireless Sensor Networks**<br><br>The Main Consumers of Energy, Energy Consumption of Sensor Node, Multiple Power Consumption Modes, Some Energy Consumption Figures, Power Consumption vs. Transmission Distance, Computation vs. Communication Energy Cost, Difference between Ad hoc and Sensor Networks, Single-Hop vs. Multi-Hop Networks, Multiple Sinks, Multiple Sources WSN, Challenges of Wireless Sensor Node, Types of MAC (Media Address Control) Layer protocols for WSN. |
| **Week 10** | **Lecture 10: Routing Protocols of WSNs**<br><br>Network Structure Categorization, Overview of Routing Protocol of WSNs, Routing Challenges and Design Issues in WSNs, Network layer- Literature Review, Routing Protocols in WSNs: A taxonomy, Challenges and Problem statement, Energy Model , Low-Energy Adaptive Clustering Hierarchy (LEACH),Hierarchical Routing Protocols, Sensor Protocols for Information via negotiation (SPIN), Flat Based Routing, Hierarchical Routing, Location Based Routing, GAF (Geographic Adaptive Fidelity). |
| **Week 11** | **Lecture 11: Network Coding for Wireless Networks**<br>Introduction and overview of network coding, Multicast Problem, Types of Network coding, Digital and Analog Network Coding, overview of COPE network coding. |
| **Week 12** | **Lecture 12: ZigBee and IEEE 802.15.4 Protocol**<br><br>ZigBee Overview, Characteristics of Zigbee, IEEE 802.15.4 Basics,ZigBee Applications, Advanced Metering Platform with ZigBee and Some Application |

| | |
|---|---|
| | Profiles, IEEE 802.15.4 Device Types, ZigBee Topology Models, ZigBee Protocol architecture, ZigBee Application profiles, ZigBee IP, Basic Network Characteristics, IEEE 802.15.4 standard, IEEE 802.15.4 MAC Overview, MAC Options, Non-Beacon vs. Beacon Modes, General MAC Layer Frame Format, Data Transfer Types,Data Transfer From a Device to the PAN Coordinator, Data Transfer from the PAN Coordinator, Peer-to Peer Data Transfer. |
| **Week 13** | **Lecture 13: Introduction to Internet of Things (IoT)**<br><br>What are Things? What's Smart ? IoT applications, Selecting the right controller/processor for Things in IoT, Overview: Hardware Platform, Sensors & Actuators, Hardware of IoT, software of IoT, Driving Forces of IoT,ABCD's of IoT, Fundamental characteristics of IoT, Network Connectivity, IoT Layer Architecture, Legacy and Recent IoT Protocols, Standardization of IoT, Datalink Issues, Network Issues, Ten Types of IoT Protocol, How are the networks changing? IoT Data- Challenges. |
| **Week 14** | **Lecture 14: Introduction to Vehicular Wireless Networks (VANET)**<br><br>Overview of vehicular wireless networks, Vehicular Ad-Hoc Networks (VANET): Architecture, Applications, Requirements, Routing Types of VANET, VANET Technologies, DSRC Protocol Components, IEEE 802.11p PHY, DSRC Devices, 802.11p Channel Coordination Function, WBSS Formation, Non-WBSS Communication, 802.11p Products**.** |
| **Week 15** | **Lecture 15: Project Presentations** |

**Class Schedule : 2 hours / week**

**Examinations plan :**

30 % of the total marks is for the one semester examinations and works planned as follows:

10 % =10 % (1st Midterm Exam.) + 5 % (Quizzes)

and 10 % =10 % (2nd Midterm Exam.) + 5 % (Mini Project)

The other 70% is left for the final exam.

Scientific category of this course to ABET Criteria :

- ☐ College level mathematics
- ■ Engineering topics
- ☐ General education

Prepared by: Assist. Prof. Dr. Salah Abdulghani Alabady