

## **CN8817: Wireless Networks**

### **Calendar Description**

Wireless networks play an increasingly important role in the field of communications. The course provides a detailed exploration of the fundamentals of wireless network technologies. The main focus will be on the fundamental architectural and design principles used at the first three layers of the OSI model. Related principles, protocols and their performance are studied using formal analytical tools and realistic setups (labs). The course is divided into four parts:

The first part starts with the history and applications of the wireless networks. Then introduce topics in wireless transmissions such as: spectrums, signal propagation, antennas, multiplexing, Spread Spectrum (Frequency Hopping (FH) and Direct-Sequence Spread Spectrum (DSSS), CDMA, and 802.11 PHY (FH, DSS).

The second part deals with wireless networking: Satellite and Cellular networks. It starts with cellular architecture, frequency reuse, handover, location and mobility management. Then it will talk about 2G, 3G, LTE and IEEE 802.16. Lastly, it will introduce Mobile IP and the Wireless Access Protocol (WAP).

The third part deals with the wireless LAN technologies such as: IEEE 802.11 (DCF and PCF), and Personal Area Networks (PANs) IEEE 802.15 such as Bluetooth and ZigBee.

The fourth part deals with Mobile Ad hoc Networks (MANETs). Topics include routing protocols such as: Optimized Link State Routing (OLSR), Ad hoc On-demand Distance Vector Routing (AODV) and Dynamic Source Routing (DSR) protocols.

### **Course Details**

#### **TEXTBOOK**

- Stallings, W., "Wireless Communications and Networks", Pearson, 2006, second edition.
- Jochen Schiller "Mobile Communications", Second Edition, Pearson Education, 2003.

## Course Schedule (tentative)

	Monday	Wednesday
March	<b>02</b> Introduction Wireless Transmission Fundamentals	<b>04</b> Antennas and Propagations
	<b>09</b> Signal Encoding Techniques	<b>11</b> Spread Spectrum Lab 1 due
	<b>16</b> Wireless LANs	<b>18</b> Wireless LANs Lab 2 due
	<b>23</b> Mobile Network Layer  Midterm	<b>25</b> Personal Area Networks (Bluetooth and Zigbee) Satellite Communications Lab 3 due
	<b>30</b> Cellular Wireless Networks	
April		<b>01</b> Cellular Wireless Networks <b>Midterm</b> Lab 4 due
	<b>06</b> Cellular Wireless Networks	<b>08</b> Lab 5 due
	<b>13</b> Final Exam	<b>17</b>
	<b>21</b>	<b>24</b>

## Labs:

**Laboratory:** *Everyone must read the lab materials and do the preparation before each lab. In order to obtain a passing grade in this course, all students must attend the lab and hand in the lab report. Late submission will not be accepted.*

In this course there will be laboratory exercises to equip students with hands-on experience on wireless networks:

1. **Wireless network and directional antennas:** In this lab, you will design a simple radio network with a mobile jammer node and two stationary communications nodes, and then demonstrate the differences in the SNR of the network when the stationary nodes use an isotropic or directional antenna.
2. **Wireless network using Cisco AP350:** In this lab the students will demonstrate the hot stand by and repeater concepts in wireless networks.
3. **Unified Wireless Solution:** In this lab you will build a Cisco Unified Wireless Network including a 2106 wireless LAN controller, 1130 lightweight access points, Wireless Controller Software (WCS) and wireless clients. Basic controller configuration is

performed through CLI. The rest of wireless and AP configurations are performed through the web-mode (using an Internet browser) on the controller.

4. **Simple UMTS cellular network lab:** In this lab, you will learn how to build a simple cellular network that composed of one hexagonal cell with some mobile nodes. OPNET will be used to create a simple UMTS topology and to configure random mobile nodes movements. This network will be connected to an IP network that has a server with some application profiles.
5. **Handover in UMTS lab:** In this lab, you will build a multi cell network. Each cell has a single NodeB and many mobile nodes. The trajectory of each mobile node will be defined and each node will select the base station based on the signal to noise ratio (SNR). The students will collect statistics based on the active set count, cell throughput and node throughput.
6. **Mobile IP lab (Optional Lab):** In this lab, the students will learn how to configure mobile IP protocol using OPNET. The network is consists of two cells. Each cell has one access point and one mobile node. The two stations are connected through two routers and a server that has an FTP application profile. The students will configure a trajectory for each mobile node to move from their home agent (HA) to the foreign agent (FA) cell. The students will collect statistics about the number of visiting nodes, the received tunneled traffic, and the access point's connectivity report.

## **Evaluation**

Laboratory	25 %
Midterm	30 %
Final exam	45%

All grades will be posted in Blackboard.

Students who miss the midterm, marks will be added to final exam

- **Assignments:** There will be some assignments problems for each section. The assignment will not be collected. However, students are expected to solve all assignment problems.
- **Lab report:** There will be 5 experiments. You can do the labs in a group of two students. Doing the lab helps you understand the course contents. You are expected to finish the lab assignment in one week.
- **Midterm:** 1.5 hour exam is scheduled on March. **23, 2015.**
- **Final Exam:** 3-hour closed-book exam is scheduled on April 13, 2015.

## **Missed Classes and/or Evaluations**

Students are required to inform their instructors of any situation which arises during the semester which may have an adverse effect upon their academic performance, and must request any considerations and accommodations according to the relevant policies and well in advance. Failure to do so will jeopardize any academic appeals.

- *Medical certificates* – If a student misses the deadline for submitting an assignment, or the date of an exam or other evaluation component because of illness, he or she must submit a Ryerson Student Medical Certificate AND an Academic Consideration form within 3 working days of the missed date. Both documents are available at [www.ryerson.ca/senate/forms/medical.pdf](http://www.ryerson.ca/senate/forms/medical.pdf). If you are a full-time or part-time degree student, then you submit your forms to your own program department or school. If you are a certificate or non-certificate student, then you submit your forms to the staff at the front desk of the Chang School.
- *Religious observance* – If a student needs accommodation because of religious observance, he or she must submit a Request for Accommodation of Student Religious, Aboriginal and Spiritual Observance AND an Academic Consideration form within the first 2 weeks of the class or, for a final examination, within 2 weeks of the posting of the examination schedule. If the required absence occurs within the first 2 weeks of classes, or the dates are not known well in advance as they are linked to other conditions, these forms should be submitted with as much lead time as possible in advance of the required absence. Both documents are available at <http://www.ryerson.ca/senate/forms/reobservforminstr.pdf>. If you are a full-time or part-time degree student, then you submit the forms to your own program department or school. If you are a certificate or non-certificate student, then you submit the forms to the staff at the front desk of the Chang School.
- *Students with disabilities* – In order to facilitate the academic success and access of students with disabilities, they should register with the Access Centre <http://www.ryerson.ca/studentervices/accesscentre/index.html>. Before the first graded work is due, students should also inform their instructor through an “Accommodation Form for Professors” that they are registered with the Access Centre and what accommodations are required.

## **Academic Integrity and Plagiarism**

Ryerson’s Policy 60 (the *Student Code of Academic Conduct*) applies to all students at the University. The policy and its procedures are triggered in the event that there is a suspicion that a student has engaged in a form of academic misconduct.

Forms of academic misconduct include plagiarism, cheating, supplying false information to the University, and other acts. The most common form of academic misconduct is plagiarism. Plagiarism is a serious academic offence and penalties can be severe. In any academic exercise, plagiarism occurs when one offers as one’s own work the words, data, ideas, arguments, calculations, designs or productions of another without appropriate attribution or when one allows one’s work to be copied.

All academic work must be submitted using the citation style approved by the instructor. The most common citation style is APA. Students may refer to the Ryerson Library for APA style guide references: <http://library.ryerson.ca/guides/toolbox/style/>

It is assumed that all examinations and work submitted for evaluation and course credit will be the product of individual effort, except in the case of group projects arranged for and approved by the course instructor. Submitting the same work to more than one course, without instructor approval, is also considered a form of plagiarism.

Students are advised that suspicions of academic misconduct may be referred to the Academic Integrity Office (AIO). Students who are charged with academic misconduct will have a Disciplinary Notation (DN) placed on their academic record (not on their transcript) and will be assigned one or more of the following penalties:

- A grade reduction for the plagiarized work
- A zero for the plagiarized work
- An F in the course
- More serious penalties up to and including expulsion from the University

For more detailed information on these issues, please refer to the full online text for the *Student Code of Academic Conduct* at <http://www.ryerson.ca/senate/policies/pol60-F2014.pdf> and the Academic Integrity Website at [www.ryerson.ca/ai](http://www.ryerson.ca/ai).

### **Important Resources Available at Ryerson**

Use the services of the University when you are having problems writing, editing or researching papers, or when you need help with course material:

- **The Library** (LIB 2<sup>nd</sup> floor) provides research workshops and individual assistance. Inquire at the Reference Desk or at [www.ryerson.ca/library/info/workshops.html](http://www.ryerson.ca/library/info/workshops.html)
- **The Writing Centre** (LIB 272- B) offers one-on-one tutorial help with writing and workshops [www.ryerson.ca/writingcentre/workshops.htm](http://www.ryerson.ca/writingcentre/workshops.htm)
- **Learning Success** (VIC B-15) offers individual sessions and workshops covering various aspects of researching, writing, and studying. You must book these directly through their website <http://www.ryerson.ca/studentervices/learningsuccess/>
- **English Language Support** (VIC B-17) offers workshops to improve overall communication skills [www.ryerson.ca/studentervices/els/](http://www.ryerson.ca/studentervices/els/)
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**There is one general site where you may see and register for all of the workshops offered by all of these areas:** <http://www.ryerson.ca/academicintegrity/workshops.html>