

CN8871: Advanced Wireless Networks

Calendar Description

The course provides a detailed exploration of the fundamentals of the advanced 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).

This advanced course will start with new and Next Generation of wireless technologies (wireless-NG). Two important areas of wireless technologies will be followed: The ITU-3GPP and the IEEE standards:

- 1) Cellular technology propagation will be covered in detail covering the 4G and the advanced LTE (5G technologie).
- 2) The IEEE802.16 will be covered in detail (WiMAX).

The second part of the course will focus on Wireless Mesh Networks (WMN), Vehicular Ad hoc Networks (VANETs), and Wireless Sensor Networks (WSN). Finally the last part of the course will cover Radio Resource Management (RRM), Quality of Service (QoS), Security, and Routing all in wireless Ad-hoc networks with emphasis on network architecture, applications, MAC and NET layer protocols

Course Details

TEXTBOOK

- Lte-advanced: A Practical Systems Approach To Understanding 3gpp Lte Releases 10 and 11 Radio Access Technologies by Sassan Ahmadi. ISBN - 10: 0124051626.

References

- Beyond 3G - Bringing Networks, Terminals and the Web Together: LTE, WiMAX, IMS, 4G Devices and the Mobile Web 2.0, by Martin Sauter

- LTE for UMTS : Evolution to LTE-Advanced. Wiley. 2nd Edition by Harri Holma, Antti Toskala, April 2011,
- Ad Hoc Wireless Networks: Architectures and Protocols. Prentice Hall: ISBN-10: 013147023X
ISBN-13: 9780131470231. By Murthy and Manoj
- Next Generation Mobile Communications Ecosystem: Technology Management for Mobile Communications. Wiley by Saad Z. Asi
- Wireless Sensor Networks. Wiley. I. Akyldiz and M. Vuran. Aug.2010, ISBN: 978-0-470-03601-3.

Course Schedule (tentative)

	Tuesday	Thursday
May	05 Introduction Cellular Networks and 4G	07 Cellular Networks 4G and LTE
	12 Cellular Networks LTE Advances	14 Cellular Networks LTE Advances Lab 1 due
	19 Cellular Networks LTE Advances	23 Cellular Networks LTE Advances Lab 2 due
	26 Mesh Networks Midterm	30 Sensor Networks Lab 3 due
June	02 VANETs Networks Lab 4 due	04 Radio Resource Management (RRM) Lab 4 due
	09 Quality of Service (QoS) Security	11 Review Lab 5 due
	16	18 Final Exam

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. 4G wireless network technology performance comparison between WiMAX and LTE technologies using OPNET simulation environment

2. Handover test between two cells, then measuring the throughput and signal levels at the time of the handover. Connecting to the internet from one mobile device in one cell. While downloading a file from the internet, the mobile user will move between the two cells. Then we measure the time delay, packet drop, and throughput.
3. Setup a voice over LTE (VoLTE) between two mobile users each in a different cell. Then measure the voice quality based on QoS setup parameters on the MME and PDN.
4. Wireless security lab: in this lab the students will setup and configure an enterprise wireless network security using Cisco WLC and LWAP with internal and external AAA server options
5. Wireless Ad-Hoc and mesh network setup and configurations using WLC and LWAP devices

Evaluation

Laboratory	5 x 5% = 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
- **Final Exam:** 3-hour closed-book exam

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. 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.

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 2nd floor) provides research workshops and individual assistance. Inquire at the Reference Desk or at 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
- **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/student services/learningsuccess/>
- **English Language Support** (VIC B-17) offers workshops to improve overall communication skills www.ryerson.ca/student services/els/

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>