

## ELC 629: Software-Defined Radio and Cognitive Radio Networks

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**Office Hours:** Sunday 3:00-5:00 (or Wednesday by e-mail appointment)

**Course Webpage:** [eece.cu.edu.eg/~akhattab/elc629.html](http://eece.cu.edu.eg/~akhattab/elc629.html)

**Credit Hours:** 3

**Course Overview:** This course covers the fundamentals of software-defined radios (SDR) and cognitive radio networks (CRN). SDR and CRN are expected to shape the future of wireless communications systems. They have recently gained tremendous popularity as an effective way to tackle the scarcity of the wireless spectrum. SDR and CRN exploit the spectral opportunities that emerge when the licensed owners of the spectrum are not using their licensed bands. However, the cognitive radio users should vacate such bands once their primary licensed owners are willing to use them. This poses several challenges on the design of SDR and CRN that differentiate such opportunistic communications scheme from traditional communication schemes. This course covers the following topics:

- Cognitive Radio (CR) and Software-Defined Radios (SDR).
- CR Network Architectures.
- SDR Implementation and Experimentation.
- Spectrum Sensing.
- Dynamic Spectrum Access.

### Course Outcomes:

#### After completing this course the students should:

1. Differentiate dynamic and opportunistic wireless access from static long term access.
2. Understand and explain common SDR and CR hardware and networks architectures.
3. Demonstrate knowledge of spectrum sensing approaches developed for CRN.
4. Be able to carry out simple analysis of primary user detection.
5. Demonstrate knowledge of MAC protocols developed for CRN.
6. Be familiar with SDR/CRN standards.

### Grading System:

Final Exam	60 %
Research Report	20 %
Project	20 %

### Classroom Policy:

No chatting or use of mobile phones is allowed during lectures.

## Course Outline

1. Introduction to Cognitive Radio (*1 Lecture*)
  - Overview of CR Concept
  - Main Research Fields and Topics
  - History and Visions
  - Application Scenarios
2. Cognitive Radio and CR Network Architectures (*1 Lecture*)
  - Cognitive Radio Capabilities
  - Software Define Radios
  - CRN Network Architecture and Main Components
  - Overlay/Underlay Network Architectures
3. SDR Hardware Implementation (*2 Lectures*)
  - RF Implementation Issues
  - SDR capable Platforms
4. Spectrum Sensing (*3-4 Lectures*)
  - Primary Transmitter Detection
    - Matched Filter Detection
    - Energy Detection
    - Feature (Cyclostationary) Detection
  - Primary Receiver Detection
  - Interference Temperature Management
  - Sensing control
    - In-band sensing control
    - Out-of-band sensing control
  - Cooperation in Spectrum Sensing
  - Compressive Sensing
5. Dynamic Spectrum Access (*3 Lectures*)
  - Spectrum Decision
  - Spectrum Sharing
    - Centralized Spectrum Access
    - Distributed Spectrum Access
    - Cooperative Spectrum Access
  - Common Control Channel
  - Spectrum Mobility and Hand-off
6. SDR and CRN standards (*1 Lectures*)