

Cognitive Radio Networks

(Elective Subject)

Course Code:	14B1WEC733	Semester:	7 th Sem. B. Tech (ECE)
Credits:	3	Contact Hours:	L-3, T-0,P-0

Course objectives

1. To understand the spectrum scarcity problem and how cognitive radio deals with this problem.
2. The contribution of cognitive radio systems in wireless networks and its architectures that enable the development of the cognitive radio network (both centralized and distributed).
3. Technologies to allow an efficient use of TVWS for radio communications.
4. Discussion about various cognitive radio standards.
5. Understanding the various research challenges for deployment of cognitive radio network.
6. Update about current research scenario in this field

Course outcomes

Upon successful completion of this course the students will have developed following skills/abilities

1. Fundamental issues regarding dynamic spectrum access and radio-resource management.
2. Emerging issues in cognitive radio network.
3. Different spectrum sharing models.
4. Efficient sharing of the unutilized spectrum among cognitive and licensed users.
5. Interference avoidance at licensed user due to cognitive user's transmission.

Unit	Topics	Lectures
1.	Introduction to Cognitive Radio: Spectrum scarcity, Spectrum white space, Fixed spectrum allocation, Software defined radio (SDR), Limitations of SDR, Evolution of cognitive radio, Dynamic spectrum access, Introduction to cognitive radio concept, Cognitive cycle, Functions of cognitive radio; spectrum sensing, spectrum management, spectrum mobility, Cognitive radio architecture, Interference temperature and its models.	8
2.	Spectrum Sensing and challenges in cognitive radio network: Hypothesis model for spectrum sensing, Types of spectrum sensing; Non-cooperative sensing, Cooperative sensing, Interference-based sensing, Matched filter detection, Energy detection, Cyclostationary feature detection, advantages and disadvantages of various spectrum	11

	<p>sensing techniques, False alarm, Miss detection, Optimal sensing framework for infrastructure based cognitive radio network.</p> <p>Research challenges in spectrum sensing, spectrum management and spectrum mobility, potential applications of cognitive radio, IEEE 802.22 for WRANs.</p>	
3.	<p>Spectrum sharing and management: Dynamic spectrum Access (DSA): models and architectures, Opportunistic spectrum access (OSA), Antenna Systems, MIMO systems, Smart antenna and beamforming.</p> <p>SDR architecture, Software tunable analog radio components, Reconfigurable digital radio technologies.</p>	8
4.	<p>Cross layer adaptation and security in cognitive radio: Why we need cross-layer design, adaptation and optimization, Cognitive radio cross layer design, security challenges in cognitive radio.</p> <p>OFDM for cognitive radio: OFDM based cognitive radio, Why OFDM is a good fit for Cognitive radio, Challenges to cognitive OFDM systems, Multiband OFDM, A step toward cognitive-OFDM: standards and technologies.</p>	9
5.	<p>Cognitive radio regulation and standardization: regulatory issues and new spectrum management regimes, spectrum planning, Spectrum authorization, Standards and international activities.</p> <p>UWB cognitive radio: Introduction, Fundamentals of impulse radio Ultra Wideband, Cognitive radio requirements versus IR-UWB, Merging impulse radio with cognitive radio.</p>	6
	Total Number of Lectures	42

Evaluation Scheme

1. Test 1 :15 marks
2. Test 2 : 25 marks
3. Test 3 : 35 marks
4. **Internal Assessment** : 25 marks
 - 10 Marks : Class performance, Tutorials & Assignments
 - 10 Marks : Quizzes
 - 5 marks : Attendance

Recommended Reading

1.	Dynamic Spectrum Access and Spectrum Management in Cognitive Radio Networks, Ekram Hossain, Dusit Niyato, and Zhu Han, Cambridge University Press, 2009.
2.	Cognitive Radio Networks, Yang Xiao and Fei Hu, CRC Press.
3.	Cognitive Radio Technology, Bruce Fette, Elsevier, 2006.
4.	Cognitive Radio, Software Defined Radio, and Adaptive Wireless Systems, Huseyin Arslan, Springer, 2007.
5.	Essentials of Cognitive Radio, Linda E. Doyle, Cambridge University Press, 2009.