

Course Code	Course Title	L	T	P	C
1152EC250	Cognitive Radio Networks	2	0	2	3

a) Course Category

Program elective

b) Preamble

This course introduces an intelligent wireless communication system that is aware of its surrounding environment, learns from the environment and adapts its internal states to statistical variations in order to achieve predefined objectives.

c) Prerequisite

Data Communication Networks

d) Related Courses

Software Defined Networking, Network Security, Network Management

e) Course educational objectives

- i) Provide highly reliable communications whenever and wherever needed and to utilize the radio spectrum efficiently by intelligently exploiting licensed spectrum.
- ii) To obtain useful information about their surrounding environment with the primary users and the appearance of spectrum holes.
- iii) To maximize probability of detection, throughput and false alarm and to minimize sensing time.
- iv) To find the optimal path from the source of data to its destination and to improve the throughput and QOS metrics.
- v) To address the attacks and categorize the attacks according to the layers.

f) Course Outcomes

Upon the successful completion of the course, students will be able to:

CO Nos.	Course Outcomes	Knowledge Level (Based on Revised Bloom's Taxonomy)
CO1	Understand the basics of SDR and how it evolves from Software Defined Radio to Cognitive Radio.	K2
CO2	Interpret the basics of various spectrum sensing techniques and	K3

	algorithms	
CO3	Recognize the concepts of cooperative spectrum sensing and handoff process	K2
CO4	Understand the functions of MAC layer and Network layer and its various protocols	K2
CO5	Interpret the basics of security management and the various attacks & its countermeasures.	K2

e)	Correlation of COs with POs													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	-	-	-	-	1	-	-	-	-	-	1	-	-
CO2	1	1	1	-	-	-	-	-	-	-	-	-	-	-
CO3	1	-	-	-	-	-	-	-	-	-	-	1	-	-
CO4	1	1	1	-	1	-	-	-	-	-	-	-	-	-
CO5	1	-	-	-	1	-	-	1	-	-	1	1	1	1

f) **Course Content**

UNIT I Introduction to Cognitive Radio 9

Introduction –Software Defined Radio: Architecture–Digital Signal Processor and SDR Baseband architecture – Reconfigurable Wireless Communication Systems – Digital Radio Processing –Cognitive Radio: Cognitive radio Framework – Functions – Paradigms of Cognitive Radio

UNIT II Spectrum Sensing 9

Introduction –Spectrum Sensing – Multiband Spectrum Sensing – Sensing Techniques – Other algorithms – Comparison – Performance Measure & Design Trade-Offs : Receiver operating characteristics – Throughput Performance measure –Fundamental limits and trade-offs

UNIT III Cooperative Spectrum Acquisition 9

Basics of cooperative spectrum sensing–Examples of spectrum acquisition techniques – cooperative transmission techniques – sensing strategies– Acquisition in the Presence of Interference: Chase-combining HARQ –Regenerative cooperative Diversity– spectrum overlay– spectrum handoff

UNIT IV MAC Protocols and Network Layer Design 9

Functionality of MAC protocol in spectrum access –classification –Interframe spacing and MAC challenges – QOS – Spectrum sharing in CRAHN –CRAHN models – CSMA/CA based MAC protocols for CRAHN – Routing in CRN– Centralized and Distributed protocols – Geographical Protocol

UNIT V Trusted Cognitive Radio Networks 9

Trust for CRN :Fundamentals – Models – Effects of Trust Management –Security properties in CRN – Route Disruption attacks –Jamming attacks –PU Emulation attacks

g) Practical Exercises 15

Name of the experiment	CO level	Skill Level
Simulate Cognitive radio network in MATLAB	CO1	SO2
Simulate combination of maximum-minimum eigenvalue (CMME) based spectrum sensing using MATLAB	CO2	SO3
Simulate energy detection in Cognitive radio network using MATLAB	CO2	SO3
Comparison of various non cooperative sensing techniques in cognitive radio networks using MATLAB	CO3	SO3
Centralized cooperative spectrum sensing in cognitive radio networks using NS3	CO3	SO3
Spectrum Handoff model based on Hidden Markov model in cognitive radio networks using NS3	CO3	SO3
Security Reliability in cognitive radio networks using NS3	CO5	SO3

Total 60 Hrs

h) Learning Resources

Text Books

- Mohamed Ibnkahla, "Cooperative Cognitive Radio Networks:The complete Spectrum Cycle" 1 edition.
- AhamedKhattab, Dmitri Perkins,BagdyByoumi,"Cognitive Radio Networks from Theory to practice" 2013th edition.

Reference Books

- Kwang– Cheng Chen and Ramjee Prasad, "Cognitive Radio Networks, Wiley Pub
- Alexander M.Wyglinski,MaziarNekovee, ThomasHou," Cognitive Radio Communications and Networks".I edition.

Online Resource

www.vtt.fi/.../muut/2008/CHESS_Research_Report.pdf
www.cs.cmu.edu/~prs/NSF_CRN_Report_Final.pdf