Academic Course Description

BHARATH UNIVERSITY
Faculty of Engineering and Technology
Department of Electronics and Communication Engineering

BEC016 COGNITIVE RADIO

Seventh Semester, 2016-17 (Odd Semester)

Course (catalog) description

The Course describes the basics of the software defined radios. This Course provides Comprehensive coverage of hardware and software architecture of software defined radio .The Course deals with the design of the wireless networks based on the cognitive radios

Compulsory/Elective course: Elective for ECE students

Credit & Contact hours : 3 & 45

Course Coordinator : Dr.S.Arulselvi, Professor.

Instructors :

Name of the instructor	Class Handling	Office location	Office phone	Email (domain:@ bharathuniv.ac.in	Consultation
Dr.S.Arulselvi	IV ECE	SA003		arulselvi.ece	9.00-9.50 AM
Mr.Srinivasan	IV ECE	SA003		Srinivasan.etc	12.45-1.15 PM

Relationship to other courses:

Pre –requisites : Computer Communication Networks

Assumed knowledge : The students will have knowledge of Computer and Communication networks and Mobile Communication

Following courses : NIL

Syllabus Contents

UNIT I INTRODUCTION TO SOFTWARE DEFINED RADIO 9 HOURS

Definitions and potential benefits, software radio architecture evolution, technology tradeoffs and architecture implications.

UNIT II SDR ARCHITECTURE 9 HOURS

Essential functions of the software radio, basic SDR, hardware architecture, Computational processing resources, software architecture, top level component interfaces, interface topologies among plug and play modules.

UNIT III INTRODUCTION TO COGNITIVE RADIOS **9 HOURS**

Marking radio self-aware, cognitive techniques – position awareness, environment awareness in cognitive radios, optimization of radio resources, Artificial Intelligence Techniques.

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UNIT IV COGNITIVE RADIO ARCHITECTURE **9 HOURS**

Cognitive Radio - functions, components and design rules, Cognition cycle - orient, plan, decide and act phases, Inference Hierarchy, Architecture maps, Building the Cognitive Radio Architecture on Software defined Radio Architechture.

UNIT V NEXT GENERATION WIRELESS NETWORKS **9 HOURS**

Series and parallel resonance – their frequency response – Quality factor and Bandwidth - Self and mutual inductance – Coefficient of coupling – Tuned circuits – Single tuned circuits.

TOTAL 45 HOURS

Text Books

T1. Joseph Mitola III,"Software Radio Architecture: Object-Oriented Approaches to Wireless System Engineering", John Wiley & Sons Ltd. 2000.

T2. Thomas W.Rondeau, Charles W. Bostain, "Artificial Intelligence in Wireless communication",ARTECH HOUSE .2009.

T3. Bruce A. Fette, "Cognitive Radio Technology", Elsevier, 2009.

T4. Ian F. Akyildiz, Won – Yeol Lee, Mehmet C. Vuran, Shantidev Mohanty, "Next generation / dynamic spectrum access / cognitive radio wireless networks: A Survey" Elsevier Computer Networks, May 2006.

Reference Books:

R1. Simon Haykin, "Cognitive Radio: Brain –Empowered Wireless Communications", IEEE Journal on selected areas in communications, Feb 2005.

R2. Hasari Celebi, Huseyin Arslan, "Enabling Location and Environment Awareness in Cognitive Radios", Elsevier Computer Communications , Jan 2008.

R3. Markus Dillinger, Kambiz Madani, Nancy Alonistioti, "Software Defined Radio", John Wiley, 2003.

R4. Huseyin Arslan, "Cognitive Radio, SDR and Adaptive System", Springer, 2007.

R5. Alexander M. Wyglinski, Maziarnekovee, Y. Thomas Hu, "Cognitive Radio Communication and Networks", Elsevier, 2010 www.nptel.ac.in

Computer usage: Nil

Professional component

General	-	0%
Basic Sciences	-	0%
Engineering sciences & Technical arts	-	0%
Professional subject	-	100%

Broad area : Communication | Electronics | signal processing | VLSI|Embedded

Test Schedule

S. No.	Test	Tentative Date	Portions	Duration
1	Cycle Test-1	August 1st week	Session 1 to 14	2 Periods
2	Cycle Test-2	September 2nd week	Session 15 to 28	2 Periods
3	Model Test	October 2nd week	Session 1 to 45	3 Hrs
4	University Examination	TBA	All sessions / Units	3 Hrs.

Mapping of Instructional Objectives with Program Outcome

To develop problem solving skills and understanding of circuit theory through the application of techniques and principles of electrical circuit analysis to common circuit problems. This course emphasizes:	Correlates to program outcome		
	H	M	L
1.Describe the basics of the software defined radios.	a,h,j	e,f,i	
2.To learn the hardware and software architecture of software defined radio	G	a,b,c,e	
3.Design the wireless networks based on the cognitive radios.	b,k	b,g	
4.Gives an understanding of cognitive radio architecture	B	a,g,h,j	d
5.Explain the concepts behind the wireless networks and next generation networks	E	b,c,f,h,i,k	
6. To have a better understanding of cognitive techniques	e,f	d,i,l	

H: high correlation, M: medium correlation, L: low correlation

Draft Lecture Schedule

Session	Topics	Problem solving (Yes/No)	Text / Chapter
UNIT I	**INTRODUCTION TO SOFTWARE DEFINED RADIO**		
1.	Definitions and potential benefits	No	[T1] Chapter -1,2 [T3]Chapter-1,2
2.	Software radio architecture evolution,	No	
3.	Spectrum Management	No	
4.	Dynamic Spectrum Access	No	
5.	Cognitive Radio Impact on Communication Policy	No	
6.	Security Issues in cognitive Radio	No	
7.	Interference Avoidance	No	
8.	Technology tradeoffs	No	
9.	Architecture implications.	No	
UNIT II	**SDR ARCHITECTURE**		
10.	Essential functions of the software radio	No	[T1] Chapter -1,2 [T3]Chapter-3
11.	Basic SDR,	No	
12.	Hardware architecture	No	
13.	Computational processing resources	No	
14.	Software architecture	No	
15.	SDR development and design	No	
16.	Cognitive waveform development	No	
17.	Top level component interfaces,	No	
18.	Interfac topologies among plug and play modules.	No	
UNIT III	**INTRODUCTION TO COGNITIVE RADIOS**		
19.	Marking radio self-aware	No	[T1] Chaper-12 [T3]Chapter-4 [R2]
20.	Cognitive techniques – position awareness	No	
21.	Environment awareness in cognitive radios	No	
22.	Aware Radios	No	
23.	Adaptive Radios	No	
24.	Available Technologies	No	
25.	Applications	No	
26.	Optimization of radio resources,	No	
27.	Artificial Intelligence Techniques	No	
UNIT IV	**COGNITIVE RADIO ARCHITECTURE**		
28.	Cognitive Radio - functions	No	[T3] Chapter -14
29.	Cognitive Radio components	No	
30.	Design rules	No	
31.	Cognition cycle - orient, plan, decide and act phases	No	
32.	Inference Hierarchy	No	
33.	CRA-Reinforced Hierarchical sequences	No	

34.	Architecture maps	No	
35.	Behaviours in CRA	No	
36.	Building the Cognitive Radio Architecture on Software defined Radio Architecture.	No	
	UNIT V NEXT GENERATION WIRELESS NETWORKS		
37.	The XG Network architecture	No	[T4]
38.	Spectrum sensing	No	
39.	Spectrum management	No	
40.	Spectrum mobility	No	
41.	Spectrum sharing	No	
42.	Upper layer issues	No	
43.	Cross – layer design.	No	
44.	The XG Network on Unlicensed band	No	
45.	The XG Network applications	No	

Teaching Strategies

The teaching in this course aims at establishing a good fundamental understanding of the areas covered using:

- Formal face-to-face lectures
- Tutorials, which allow for exercises in problem solving and allow time for students to resolve problems in understanding of lecture material.
- Laboratory sessions, which support the formal lecture material and also provide the student with practical construction, measurement and debugging skills.
- Small periodic quizzes, to enable you to assess your understanding of the concepts.

Evaluation Strategies

Cycle Test – I	-	5%
Cycle Test – II	-	5%
Model Test	-	10%
Assignment /Seminar/online test/quiz	-	5%
Attendance	-	5%
Final exam	-	70%

Prepared by: Dr S.Arulselvi , Professor . **Dated :**

Addendum

ABET Outcomes expected of graduates of B.Tech / ECE / program by the time that they graduate:

a) an ability to apply knowledge of mathematics, science, and engineering fundamentals.

b) an ability to identify, formulate, and solve engineering problems

c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability

d)an ability to design and conduct experiments, as well as to analyze and interpret data

e)an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice

f)an ability to apply reasoning informed by a knowledge of contemporary issues

g)an ability to broaden the education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context

h) an ability in understanding of professional and ethical responsibility and apply them in engineering practices

i) an ability to function on multidisciplinary teams

j) an ability to communicate effectively with the engineering community and with society at large

k) an ability in understanding of the engineering and management principles and apply them in Project and finance management as a leader and a member in a team.

Program Educational Objectives

PEO1: PREPARATION:
To provide strong foundation in mathematical, scientific and engineering fundamentals necessary to analyze, formulate and solve engineering problems in the field of Electronics And Communication Engineering.

PEO2: CORE COMPETENCE:
To enhance the skills and experience in defining problems in Electronics And Communication Engineering design and implement, analyzing the experimental evaluations, and finally making appropriate decisions.

PEO3: PROFESSIONALISM:
To enhance their skills and embrace new Electronics And Communication Engineering Technologies through self-directed professional development and post-graduate training or education

PEO4: SKILL:
To provide training for developing soft skills such as proficiency in many languages, technical communication, verbal, logical, analytical, comprehension, team building, inter personal relationship, group discussion and leadership skill to become a better professional.

PEO5: ETHICS:
Apply the ethical and social aspects of modern communication technologies to the design, development, and usage of electronics engin

Course Teacher	Signature
Dr. S.Arulselvi	
Mr.Srinivasan	

Course Coordinator **HOD/ECE**