

GUJARAT TECHNOLOGICAL UNIVERSITY

ELECTRONICS & COMMUNICATION (WIRELESS COMMUNICATION SYSTEMS & NETWORKS) (27)

SOFTWARE DEFINED RADIO AND COGNITIVE RADIO NETWORKS

SUBJECT CODE: 2742703

M.E. 4TH SEMESTER

Type of course: Major Elective-V

Prerequisite: Wireless Communication, Data Communication and Networking

Rationale: Now a day, many receivers are implemented using software and they are called Software Defined Radios. Cognitive radio network is an emerging technology which utilizes available frequency resources in most efficient way and provides reliable communication. Cognitive radio network is an advanced research area in the field of wireless communication and networking. By learning this subject the students will appreciate the recent trends of software defined radios and cognitive radio networking.

Teaching and Examination Scheme:

Teaching Scheme			Credits C	Examination Marks						Total Marks	
L	T	P		Theory Marks		Practical Marks					
				ESE (E)	PA (M)	ESE (V)		PA (I)			
						ESE	OEP	PA	RP		
4	0	2#	5	70	30	20	10	10	10	10	150

Content:

Sr. No.	Content	Total Hrs	% Weightage
1	Introduction to Software Radio Concepts The need for software radios, what is a software radio, characteristics and benefits of a software radio, Design principles of a software radio.	04	8
2	Radio Frequency Implementation Issues The purpose of the RF front-end, Dynamic range: The principal Challenge of receiver design, RF receiver front-end topologies, Enhanced flexibility of the RF chain with software radios, Importance of the components of overall performance, transmitter architectures and their issues, noise and distortion in the RF chain, ADC and DAC distortion.	10	20
3	Digital Hardware Choices Introduction, Key Hardware Elements, DSP Processors, FPGA, Trade-offs in using DSPs FPGAs and ASICs, Power Management Issues , Combinations of DSPs , FPGAs and ASICs	08	15
4	INTRODUCTION TO COGNITIVE RADIOS: Digital dividend, cognitive radio (CR) architecture, functions of cognitive radio, dynamic spectrum access (DSA), components of cognitive radio, spectrum sensing, spectrum analysis and decision, potential applications of cognitive radio.	08	15
5	SIGNAL PROCESING - SPECTRUM: Spectrum sensing, detection of spectrum holes (TVWS), collaborative sensing, geo-location database and spectrum sharing business models (spectrum of commons, real time	12	22

	secondary spectrum market).		
6	DYNAMIC SPECTRUM ACCESS AND MANAGEMENT: Spectrum broker, cognitive radio architectures, centralized dynamic spectrum access, distributed dynamic spectrum access, learning algorithms and protocols.	10	20

Reference Books:

1. Software Radio: A Modern Approach to Radio Engineering By Jeffrey H. Reed Pearson Education Low Price Edition
2. Dynamic Spectrum Access and Management in Cognitive Radio Networks, Ekram Hossain, Dusit Niyato, Zhu Han, Cambridge University Press.
3. Cognitive radio networks, Kwang-Cheng Chen, Ramjee Prasad, John Wiley & Sons Ltd.
4. Cognitive Radio, Software Defined Radio, and Adaptive Wireless Systems, Huseyin Arslan, Springer.

Course Outcomes:

After learning the course the students should be able to:

1. Learn various design principles of software defined radio.
2. Understand challenges of receiver design.
3. Select hardware for SDR.
4. Understand the basic architecture of cognitive radio.
5. Study various techniques like spectrum sensing and spectrum analysis.

List of Experiments:

To implements following hardware using SDR
ASK, FSK, BPSK, QPSK, MSK, GMSK, OFDM based communication system

Design based Problems (DP)/Open Ended Problem:

Study / Implementation of

1. Cognitive Algorithms for Adaptation and Resource Management
2. Network Security
3. Cognitive Networks and the Internet
4. Protocol Architectures for Cognitive Networks

Major Equipment:

USRP/WRAP/GNU radio development board

List of Open Source Software/learning website:

www.crew-project.eu, GNU Radio , sdrforum.org, ecewp.ece.wpi.edu

Review Presentation (RP): The concerned faculty member shall provide the list of peer reviewed Journals and Tier-I and Tier-II Conferences relating to the subject (or relating to the area of thesis for seminar) to the students in the beginning of the semester. The same list will be uploaded on GTU website during the first two weeks of the start of the semester. Every student or a group of students shall critically study 2 papers, integrate the details and make presentation in the last two weeks of the semester. The GTU marks entry portal will allow entry of marks only after uploading of the best 3 presentations. A unique id number will be generated only after uploading the presentations. Thereafter the entry of marks will be allowed. The best 3 presentations of each college will be uploaded on GTU website.