

**DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING
NATIONAL INSTITUTE OF TECHNOLOGY, TIRUCHIRAPPALLI**

COURSE PLAN – PART I			
Name of the programme and specialization	<i>M. Tech.</i> COMMUNICATION SYSTEMS		
Course Title	Cognitive Radio		
Course Code	EC664	No. of Credits	3 (Three)
Course Code of Pre-requisite subject(s)	<i>nil</i>		
Session	January 2021	Section (if, applicable)	A
Name of Faculty	<i>Dr. P.Muthu Krishnammal</i>	Department	ECE
Email	muthup@nitt.edu	Telephone No.	+919884588247
Name of Course Coordinator(s) (if, applicable)	<i>Nil</i>		
E-mail	---	Telephone No.	---
Course Type	<input type="checkbox"/> Core course	<input checked="" type="checkbox"/> Elective course	
Syllabus (approved in BoS)			
<p>Filter banks-uniform filter bank. Direct and DFT approaches. Introduction to ADSL Modem. Discrete multi-tone modulation and its realization using DFT.QMF. STFT. Computation of DWT using filter banks.</p> <p>DDFS- ROM LUT approach. Spurious signals, jitter. Computation of special functions using CORDIC. Vector and rotation mode of CORDIC. CORDIC architectures.</p> <p>Block diagram of a software radio. Digital down converters and demodulators Universal modulator and demodulator using CORDIC. Incoherent demodulation - digital approach for I and Q generation, special sampling schemes. CIC filters. Residue number system and high speed filters using RNS. Down conversion using discrete Hilbert transform. Under sampling receivers, Coherent demodulation schemes.</p> <p>Concept of Cognitive Radio, Benefits of Using SDR, Problems Faced by SDR, Cognitive Networks, Cognitive Radio Architecture. Cognitive Radio Design, Cognitive Engine Design.</p> <p>A Basic OFDM System Model, OFDM based cognitive radio, Cognitive OFDM Systems, MIMO channel estimation, Multi-band OFDM, MIMO-OFDM synchronization and frequency offset estimation. Spectrum sensing to detect Specific Primary System, Spectrum Sensing for Cognitive OFDMA Systems</p>			
ESSENTIAL READINGS : Textbooks, reference books Website addresses, journals, etc			
<p>Text Books</p> <ol style="list-style-type: none"> 1. J. H. Reed, "Software Radio", Pearson, 2002. 2. U. Meyer – Baese, "Digital Signal Processing with FPGAs", Springer, 2004. <p>Reference Book</p> <ol style="list-style-type: none"> 1. H. Arslan "Cognitive Radio, Software Defined Radio and Adaptive Wireless Systems", 			

University of South Florida, USA, Springer, 2007.

2. S. K. Mitra, "Digital Signal processing", McGrawHill, 1998
3. K.C.Chen, R.Prasad, "Cognitive Radio Networks", Wiley, 2009-06-15.
4. T.W.Rondeau, C.W.Bostian, "Artificial Intelligence in Wireless Communications", 2009.
5. Tusi, "Digital Techniques for Wideband receivers", Artech House, 2001.
6. T. DarcChiueh, P. Yun Tsai, "OFDM baseband receiver design for wireless communications", Wiley, 2007

7. Recent literature in Cognitive Radio

COURSE OBJECTIVES

This subject introduces the fundamentals of multi rate signal processing and cognitive radio.

COURSE OUTCOMES (CO)

Course Outcomes	Aligned Programme Outcomes (PO)
1. Gain knowledge on multi-rate systems.	PO1,PO2,PO3
2. Develop the ability to analyze, design, and implement any application using FPGA.	PO1,PO2,PO3
3. Be aware of how signal processing concepts can be used for efficient FPGA based system design.	PO1,PO2,PO3,PO4, PO5,PO7,PO8
4. Understand the rapid advances in Cognitive radio technologies..	PO1,PO2,PO3,PO4, PO5,PO7,PO8
5. Explore DDFS, CORDIC and its application.	PO1,PO2,PO3,PO4, PO5,PO7,PO8

COURSE PLAN – PART II

COURSE OVERVIEW

To give introduction to the fundamentals of multi rate signal processing and cognitive radio.

COURSE TEACHING AND LEARNING ACTIVITIES

S.No.	Week	Topic	Mode of Delivery
1	1 st week (3 contact hours)	Introduction to Multirate DSP, Polyphone Decomposition, Filter banks	PPT
2	2 nd week (3 contact hours)	Uniform filter bank. Direct and DFT approaches. Introduction to ADSL Modem. Discrete multi-tone modulation and its realization using DFT	PPT
3	3 rd week (3 contact hours)	QMF. STFT. Computation of DWT using filter banks.	PPT
4	4 th week (3 contact hours)	DDFS- ROM LUT approach. Spurious signals, jitter	PPT
5	5 th week (3 contact hours)	Computation of special functions using CORDIC. Vector and rotation mode of CORDIC. CORDIC architectures	PPT
6	6 th week (3 contact hours)	Block diagram of a software radio. Digital down converters and demodulators Universal modulator and demodulator	PPT

		using CORDIC	
7	7 th week (3 contact hours)	Incoherent demodulation - digital approach for I and Q generation, special sampling schemes. CIC filters. Residue number system and high speed filters using RNS	PPT
8	8 th week (3 contact hours)	Down conversion using discrete Hilbert transform. Under sampling receivers, Coherent demodulation schemes.	PPT
9	9 th week (3 contact hours)	Concept of Cognitive Radio, Benefits of Using SDR, Problems Faced by SDR, Cognitive Networks	PPT
10	10 th week (3 contact hours)	Cognitive Radio Architecture. Cognitive Radio Design, Cognitive Engine Design.	PPT
11	11 th week (3 contact hours)	A Basic OFDM System Model, OFDM based cognitive radio, Cognitive OFDM Systems, MIMO channel estimation, Multi-band OFDM,	PPT
12	12 th week (3 contact hours)	MIMO-OFDM synchronization and frequency offset estimation. Spectrum sensing to detect Specific Primary System, Spectrum Sensing for Cognitive OFDMA Systems	PPT

COURSE ASSESSMENT METHODS (shall range from 4 to 6)

S. No.	Mode of Assessment	Week/Date	Duration	% Weightage
1	Assessment - 1 (Descriptive exam) (1 st and 2 nd units)	5 th week	1 hour	20 Marks
2	Assessment - 2 (Descriptive exam) (3 rd unit)	10 th week	1 hour	20 Marks
3	Assignment- 3 (4 th or 5 th unit)	11 th week	1 hour	20 Marks
4	Assignment (3 rd and 4 th unit)	12 th week	One week	10 Marks
5	Final Assessment (Descriptive exam) (All units – End semester)	Final week	2 hours	30 Marks

Compensation assessment (CPA) will be conducted, if required

COURSE EXIT SURVEY (mention the ways in which the feedback about the course shall be assessed)

1. Feedback from students during class committee meetings
2. Feedback through questionnaire at the end of the semester

COURSE POLICY (preferred mode of correspondence with students, compensation assessment policy to be specified)

COURSE ASSESSMENT:

- 1 *Attending all the assessments are MANDATORY for every student*
- 2 *If any of the student is not able to attend any of the continuous assessment descriptive examination due to genuine reason (any academic related work through department or medical grounds only), student is permitted to attend CPA.*
- 3 *Submission of assignments is MANDATORY for every student within the stipulated time failing which 10% weightage will not be considered for final grade assessment*
- 4 *There will not be any improvement test for the students who score low marks in continuous assessment test.*
- 5 *Finally, every student is expected to score minimum marks as per the regulations of the institute out of the total assessments 1, 2, 3, 4 / CPA and 5 to pass the course. Otherwise the student will be declared fail and 'F' grade will be awarded. Further the student can take up only FORMATIVE ASSESSMENT.*

MODE OF CORRESPONDENCE (email/ phone etc.)

- 1 *All students are advised to check their NITT webmail regularly. All the details about the schedule of classes, schedule of assessments, course material and any other information regarding the course will be sent through webmail only.*
- 2 *Doubts regarding the course can be clarified by fixing proper timing with the teacher during working hours only.*
- 3 *Queries, if any regarding the course shall only through email to the teacher.*

COMPENSATION ASSESSMENT POLICY

- 1 *Any student who fails to maintain 75% attendance only on reasonable medical/official grounds needs to appear for the compensation assessment (CPA) classes.*
- 2 *The portion for compensation assessment will be the portion of assessment 1 and 2.*

ATTENDANCE POLICY (A uniform attendance policy as specified below shall be followed)

1. **At least 75% attendance in each course is mandatory.**
2. **A maximum of 10% shall be allowed under On Duty (OD) category.**
3. **Students with less than 65% of attendance shall be prevented from writing the final assessment and shall be awarded 'V' grade.**

ACADEMIC DISHONESTY & PLAGIARISM

1. *Possessing a mobile phone, carrying bits of paper, talking to other students, copying from others during an assessment will be treated as punishable dishonesty.*
2. *Zero mark to be awarded for the offenders. For copying from another student, both students get the same penalty of zero mark.*
3. *The departmental disciplinary committee including the course faculty member, PAC chairperson and the HoD, as members shall verify the facts of the malpractice and award the punishment if the student is found guilty. The report shall be submitted to the Academic office.*

The above policy against academic dishonesty shall be applicable for all the programmes.

ADDITIONAL INFORMATION

The faculty is available for consultation at times as per the intimation given by the faculty.

FOR APPROVAL


Course Faculty _____ CC-Chairperson  HOD  _____
(Dr.P.Muthu Krishnammal)