ECE6027	RFIC DESIGN	L	T	P	J	C
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Pre-requisite	**ECE5016 - Analog IC Design**				**v 1.0**	

Course Objectives:

The course is aimed at

1. To become familiarize with the design of integrated radio front-end circuits.

Expected Course Outcomes:

At the end of the course the student should be able to

1. Understand the concepts of RF IC Design.
2. Understand the High Frequency model of MOS and importance of Impedance Matching.
3. Analyse the various transceiver and radio architectures.
4. Design Low Noise amplifiers and Mixers with specifications.
5. Realize VCOs and Frequency synthesizers and their applications to transceiver design.
6. Classify and comprehend the design of Power Amplifiers.
7. Gain RFIC design experience in Cadence CAD tools.

Student Learning Outcomes (SLO):	**2,5,17**

Module:1	**Introduction to RF & Wireless Technology:**	**5hours**	

Complexity design and applications - Choice of Technology - Basic concepts in RF Design: Nonlinearly - Time Variance - Intersymbol Interference - random processes - Noise. Definitions of sensitivity - dynamic range -conversion Gain and Distortion.

Module:2	**High Frequency Model of RF Transistors and Matching Networks:**	**4hours**	

MOSFET behaviour at RF frequencies - Noise performance and limitation of devices - Impedance matching networks - transformers and baluns.

Module:3	**Analog& Digital Modulation for RF Circuits:**	**4hours**	

Coherent and Non coherent detection - Mobile RF Communication systems and basics of Multiple Access techniques - Receiver and Transmitter Architectures and Testing: Heterodyne - Homodyne, Image-reject, Direct-IF and subsampled receivers - Direct Conversion and two steps transmitters.

Module:4	**Low Noise Amplifiers and Mixers**	**4hours**	

Low Noise Amplifiers: Common Source LNA - Common Gate LNA -Cascode LNA. Mixers: Design of Active and Passive Mixers.

Module:5	**Voltage Controlled Oscillators and Frequency Synthesizers:**	**3hours**	

Oscillators: Basic topologies VCO and definition of phase noise. Noise-Power trade-off. Resonatorless VCO design - Quadrature and single-sideband generators - Radio Frequency Synthesizers: PLLs.

Module:6	**RF Power Amplifiers:**	**4hours**	
Class A, AB, B, C amplifiers - Class D, E, F amplifiers - RF Power amplifier design.			
Module:7	**Radio architectures:**	**4hours**	
GSM radio architectures, CDMA, UMTS radio architectures.			
Module:8	**Contemporary issues:**	**2hours**	
	Total Lecture hours:	**30hours**	

Text Book(s)	
1.	B.Razavi, RF Microelectronics, Pearson Education Limited, Second Edition, 2013.
2.	HoomanDarabi, Radio-Frequency Integrated Circuits and Systems, Cambridge University Press, First Edition, 2015.
Reference Books	
1.	Gu, Qizheng, RF System Design of Transceivers for Wireless Communications, Springer, 2010
2.	Bosco Leung, VLSI for Wireless Communication, Springer, Second Edition, 2011

Mode of Evaluation:Continuous Assessment Test –I (CAT-I) , Continuous Assessment Test –II (CAT-II), Seminar / Challenging Assignments / Completion of MOOC / Innovative ideas leading to solutions for industrial problems, Final Assessment Test (FAT).

List of Projects(Indicative)

1. I-V Characterisation study of RF device/circuit
2. Design of Low Noise Amplifier
3. Design of Voltage Controlled Oscillators
4. Design of Power Amplifiers
5. Design and Implement- any one of the Receiver architecture

Mode of Evaluation: Review I, II & III

Recommended by Board of Studies	13-12-2015	
Approved by Academic Council	No. 40	18-03-2016