III Year I Semester

Code:20EC5315

RF AND MIXED SIGNAL CIRCUITS

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Course Objectives:

- 1. To understand the design bottlenecks specific to RF circuit design, linearity related issues and ISI.
- 2. To have a comprehensive idea about different multiple access techniques, wireless standards and various transceivers architectures.
- 3. To understand the design of basic cells like Op-Amp, against process and temperature variations meeting the mixed signal specifications.
- 4. To be able to design comparators that can meet the high speed requirements of digital circuitry.
- 5. To be able to design a complete mixed signal system that includes efficient data conversion and RF circuits with minimizing switching.

UNIT-I:

Introduction to RF and Wireless Technology: Complexity comparison, Design bottle necks, Applications, Analog and digital systems, Choice of Technology. BASIC CONCEPTS IN RF DESIGN: Nonlinearity and time variance, ISI, Random process and noise, sensitivity and dynamic range, passive impedance transformation.

UNIT-II:

Multiple Access: Techniques and wireless standards, mobile RF communication, FDMA, TDMA, CDMA, Wireless standards.

Transceiver Architectures: General considerations, receiver architecture, Transmitter Architecture, transceiver performance tests, case studies.

Amplifiers, Mixers and Oscillators: LNAs, down conversion mixers, Cascaded Stages, oscillators, Frequency synthesizers.

UNIT-III:

Basic Building Blocks, Op-Amp, Capacitors, Switches, Non-overlapping Clocks, Basic Operation and Analysis, Resistor Equivalence of a Switched Capacitor, Parasitic-Sensitive Integrator, Parasitic- Insensitive Integrators, Signal-Flow-Graph Analysis, Noise in Switched-Capacitor Circuit.

UNIT-IV:

Ideal D/A Converter, Ideal A/D Converter, Quantization Noise, Deterministic Approach, Stochastic Approach, Signed Codes, Performance Limitations, Resolution, Offset and Gain, Error, Accuracy and Linearity, Integrating Converters, Successive - Approximation Converters, DAC - Based Successive Approximation, Charge - Redistribution A/D, Resistor-Capacitor Hybrid, Speed Estimate for Charge-Redistribution Converters, Error Correction in Successive-Approximation Converters.

UNIT-V: Wave Propagation:

Basic Phase-Locked Loop Architecture, Voltage Controlled Oscillator, Divider Phase Detector, Loop Filer, The PLL in Lock, Linearized Small-Signal Analysis, Second-Order PLL Model, Limitations of the Second-Order Small-Signal Model, PLL Design Example, Jitter and Phase Noise, Period Jitter, P-Cycle Jitter, Adjacent Period Jitter, other Spectral Representations of Jitter, Probability Density Function of Jitter, Ring Oscillators, LC Oscillators, phase Noise of Oscillators, jitter and Phase Noise in PLLS.

Course Outcomes:

A student who successfully fulfils this course requirement will be able to:

S. No	Course Outcome	BTL
1.	Understand the design bottlenecks specific to RF Circuit design, linearity related issues and ISI.	L2
2.	Comprehend different multiple access techniques, wireless standards and various transceiver architectures.	L3
3.	Design basic cells like Op-Amp, against process and temperature variations meeting the mixed signal specifications.	L4
4.	Design comparators that can meet the high speed requirements of digital circuitry.	L4
5.	Design a complete mixed signal system that includes efficient data conversion and RF circuits with minimizing switching.	L4

Correlation of Cos with Pos & PSOs:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	3	2	-	-	-	-	-	-	-	-	-	-	3	-
CO 2	2	3	1	-	-	-	1	-	-	-	-	2	2	-
CO 3	3	2	1	-	-	-	-	-	-	-	-	-	3	-
CO 4	2	3	3	-	-	-	-	-	-	-	-	2	2	-
CO 5	1	3	3	-	-	-	-	-	-	-	-	-	2	-

Text Books:

- 1. David A Johns, Ken Martin: Analog IC design, Wiley2008.
- 2. Behzad Razavi, RF Microelectronics Prentice Hall of India, 2001.

Reference Books:

- 1. Roubik Gregorian: Introduction to CMOS Op-amps and comparators, Wiley, 2008.
- 2. R Gregorian and GCTemes: Analog MOS integrated circuits for signal processing, Wiley 1986.
- 3. Thomas H. Lee, The Design of CMOS Radio Integrated Circuits, Cambridge University Press.