III B.Tech – I Semester
(20EC5315) RF AND MIXED SIGNAL CIRCUITS
(Program Elective-I)

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
30	70	100	3	-	-	3

Pre-Requisites: Electronic Devices and Circuits

Course Objectives:

- To understand the design bottlenecks specific to RF circuit design, linearity related issues and ISI.
- To have a comprehensive idea about different multiple access techniques, wireless standards and various transceivers architectures.
- To understand the design of basic cells like Op-Amp, against process and temperature variations meeting the mixed signal specifications.
- To be able to design comparators that can meet the high speed requirements of digital circuitry.
- 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:

After successful completion of the course, the students can 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
CO1	3	2	-	-	-	-	-	-	-	-	-	-	3	-
CO2	2	3	1	-	-	-	1	-	-	-	-	2	2	-
CO3	3	2	1	-	-	-	-	-	-	-	-	-	3	-
CO4	2	3	3	-	-	-	-	-	-	-	-	2	2	-
CO5	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.