

20VL014 - CMOS RF INTEGRATED CIRCUITS

Course Objectives:

- ❖ The objective of this course is to introduce the theory and concept of radio frequency integrated system.

Course Outcomes: At the end of the course the student will be able to:

- CO1** Analyze the performance parameters of radio frequency circuits and identify design trade-off of radio frequency communication systems.
- CO2** Identify noise sources and develop noise models for the devices and systems.
- CO3** Identify various techniques to improve the bandwidth of RF amplifiers.
- CO4** Perform matching with complex loads
- CO5** Design of CMOS Low-Noise Amplifier & Mixer
- CO6** Design of LC Oscillator & Power amplifier.

UNIT-1

INTRODUCTION: RF systems- Basic Architectures, Transmission Media and Reflections, Maximum Power Transfer, Passive impedance transformation, Noise Models for Active and Passive Components, Classical Two-Port Noise Theory, Noise Figure, Friis Equation, Nonlinearity- 1 dB compression point, IIP3 at receiver front end, Sensitivity and Dynamic range.

UNIT-2

HIGH FREQUENCY AMPLIFIER DESIGN: High Frequency Amplifier Design – Bandwidth Estimation Using Open-Circuit Time Constants, Bandwidth Estimation Using Short-Circuit Time Constants, Risetime, Delay and Bandwidth, Zeros to Enhance Bandwidth, Shunt-Series Amplifier, Cascode Amplifier.

UNIT-3

LOW NOISE AMPLIFIER: Introduction, General Philosophy, Comparisons of Narrowband and wideband LNA.

Wideband LNA Design: DC Bias, Gain and Frequency Response, Noise Figure.

Narrowband LNA: Principles, Core amplifier design, Impedance matching, noise figure, power dissipation, trade-offs between noise figure and power dissipation, noise contribution from other sources.

UNIT-4

MIXERS: Active Mixer, modeling mixers, single balanced mixer circuit, double balanced mixer circuits, Quantitative description of Gilbert mixer, conversion gain, Distortion, analysis of Gilbert mixer.

Passive mixers: Switching mixer, distortion in unbalanced switching mixer, conversion gain and noise.

UNIT – 5

OSCILLATORS: VCO, LC oscillators, Ring oscillator;

RF POWER AMPLIFIERS: Class A, AB, B, C amplifiers, Class D, E, F Amplifiers, RF Power Amplifier Design Examples.

TEXT BOOKS

1. Thomas H. Lee ,”The Design of CMOS Radio-Frequency Integrated Circuits”. Cambridge University Press, 2004.
2. Behzad Razavi ,”RF Microelectronics”. Prentice Hall, 1998.
3. Bosco Leung , “VLSI for wireless communication” , second edition, PrenticeHall, 2002.

REFERENCEBOOKS

1. A.A. Abidi, P.R. Gray, and R.G. Meyer,” Integrated Circuits for Wireless communications”, New York: IEEE Press, 1999.
2. Jeremy Everard, “Fundamentals of RF Circuit Design With Low Noise Oscillators”,John Wiley & Sons Ltd.2001