

## 17VL020 RF INTEGRATED CIRCUIT DESIGN

Hours Per Week :

| L | T | P | C |
|---|---|---|---|
| 3 | 1 | - | 4 |

Total Hours :

| L  | T  | P | WA/RA | SSH/HSB | CS | SA | S | BS |
|----|----|---|-------|---------|----|----|---|----|
| 45 | 15 | - | 15    | 30      | -  | 5  | 5 | -  |

### Course Objectives:

To develop electronic circuits for radio frequency applications, specific to CMOS integrated circuits. To design integrated circuits, and specific to radio frequencies.

### Course Outcomes:

- Upon successful completion of this course student should be able to understand circuits for radio front-ends for mobile phone handsets.
- Understand low noise amplifiers, mixers and voltage controlled oscillators power amplifiers.

### SKILLS:

- In-depth understanding of RF and analog circuit blocks such as LNAs, Mixers, Power Amplifiers, VCOs, PLL, LO generation and base-band amplifiers.

**UNIT-1**

**INTRODUCTION:** RF systems- Basic Architectures, Transmission Media and Reflections, Maximum Power Transfer, Passive RLC Networks for Matching, Passive Impedance Transformation, Noise Models for Active and Passive Components, Classical Two-Port Noise Theory, Noise Figure, Friis Equation, Nonlinearity, Sensitivity and Dynamic range

**UNIT-2**

**HIGH FREQUENCY AMPLIFIER DESIGN & LOW NOISE AMPLIFIERS 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.Low Noise Amplifier (LNA) Design – LNA Topologies, Large Signal Performance, Design Examples.

**UNIT-3**

**MIXERS:** Mixer Fundamentals, Multiplier-Based Mixers, Sub-Sampling Mixers.

**UNIT-4**

**VOLTAGE CONTROLLED OSCILLATORS:** Resonators, Negative Resistance Oscillators.

**UNIT – 5**

**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.

**REFERENCE BOOKS**

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

**ACTIVITIES:**

- o Design LNA,Mixer, VCO,PLL and Power Amplifier