

Course Code	Course Title	L	T	P	C
1152EC122	RF AND MICROWAVE INTEGRATED CIRCUITS	3	0	0	3

**a) Course Category**

Program elective

**b) Preamble**

RF & Microwave Engineering Circuits is a course designed for introducing the field of Microwave Engineering to students, engineers and academics. Practical design issues of microwave circuits will be emphasized and fabrication techniques of microwave integrated circuits will also be treated. Further new numerical analysis techniques as well as radio architectures are also introduced

**c) Prerequisite**

Transmission Lines and Waveguides, Antenna and Wave Propagation

**d) Related Courses**

Microwave Engineering

**e) Course educational objectives**

1. To understand the characteristics of transmission lines and waveguides.
2. To study and design of planar transmission lines for RF circuits.
3. To understand the MIC fabrication and measurement techniques.
4. To learn the design concepts of RF & MIC using various numerical analysis technique.
5. To study the concept of various radio architectures and applications

**f) Course Outcomes**

Upon the successful completion of the course, students will be able to:

CO Nos.	Course Outcomes	Knowledge Level (Based on Revised Bloom's Taxonomy)
CO1	Explain the propagation characteristics of electromagnetic waves in transmission lines.	K2
CO2	Explain the different planar strip line techniques.	K2
CO3	Explain the fabrication method of MIC and different measurement setups.	K2
CO4	Analyze the RF & microwave circuits using various numerical techniques.	K4
CO5	Describe some basic properties of different radio architectures. Explain the applications of RF & MIC.	K2

**g) Correlation of Cos with POs**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
<b>CO1</b>	H	M	-	M	H	-	-	-	-	-	-	-	-	-
<b>CO2</b>	H	M	M	M	H	M	L	-	L	L	L	M	L	-
<b>CO3</b>	L	M	M	M	-	L	-	-	M	M	L	H	H	-
<b>CO4</b>	H	M	-	M	L	-	L	-	L	-	L	-	L	-
<b>CO5</b>	L	M	-	M	L	-	-	-	L	M	-	M	H	-

**h) Course Content**

**UNIT I REVIEW OF BASIC MICROWAVE THEORY 9**

Transmission Lines and waveguides-Concepts of characteristic impedance, reflection coefficient, standing and propagating waves, Modes and evanescent waves

**UNIT II PLANAR TRANSMISSION LINES 9**

Planar transmission lines-strip line, microstrip line, coplanar waveguide, coplanar strips slot line, fin line and characteristics, properties; design parameters and its applications

**UNIT III MIC FABRICATION AND MEASUREMENT TECHNIQUES 9**

Introduction to MICs-Fabrication technology, Advantages and applications. Measurement techniques: Test fixture measurements, probe station measurements, thermal and cryogenic measurements, experimental field probing techniques and anechoic chamber measurements

**UNIT IV NUMERICAL ANALYSIS 9**

FDM, FDTD, FEM Analysis in 1D & 2D, Solution of integral equations using MoM, comparison of FDM, FDTD, FEM, and MoM.

**UNIT V RADIO ARCHITECTURES AND APPLICATIONS 9**

GSM radio architectures, UMTS radio architectures, Software defined radio. Radar sensors for traffic surveillance, cognitive radio applications, healthcare applications, space applications, defense and Wireless applications

**Total 45 Hrs**

## i) Learning Resources

### Text Books

1. D.M.Pozar, "Microwave Engineering", John Wiley, 3rd ed., 2004
2. B.Bhat and S.Koul, "Stripline Like transmission lines for MICS", John Wiley, 1989
3. T. Itoh, editor, Numerical Techniques for Microwave and Millimeter-wave Passive Structures Wiley, NY, 1989
4. Habil. MBA Frank Ellinger, "Radio frequency integrated circuits and technologies", Springer-Varlag Berlin Heidelberg, 2007.

### Reference Books

1. Ramesh Garg, "Analytical and Computational Methods in Electromagnetics" Artech House, 2008
2. Gupta. K.C and R. Garg, " Microstrip line and slot line" Artech House, Boston, 1996
3. Ravender Goyal, "Monolithic MIC; Technology & Design", Artech House, 1989
4. Robert Caverly, "CMOS RFIC Design Principles" Artech House, 2007.

### Online Resource

1. [http://bulletin.engineering.nyu.edu/preview\\_course\\_nopop.php?catoid=4&coid=6687](http://bulletin.engineering.nyu.edu/preview_course_nopop.php?catoid=4&coid=6687)
2. <http://home.sandiego.edu/~ekim/e194rfs01/>
3. [http://www.ece.mcmaster.ca/faculty/nikolova/4FJ4\\_6FJ4.htm](http://www.ece.mcmaster.ca/faculty/nikolova/4FJ4_6FJ4.htm)
4. <https://apps.ep.jhu.edu/course-homepages/2602-525.787-microwave-monolithic-integrated-circuit-mmich-design-penn-thompson>
5. <http://www.ece.ucsb.edu/Faculty/rodwell/Classes/ECE218a/ECE218a.htm>

### Practical Aspects

1. Available interactive software such as IE3D, HFSS, CST & FEKO.: To visualize the impedance matching and calculate the characteristics of RF & microwave devices.