

Subject Code: 1RI3000102	Subject Title: Essentials of Disciplinary Research Subject-1 Subject Sub-Title: Basics of Microwave Components
Pre-requisite Subject	Electromagnetic Theory

Objectives of course: The objective of this course is to introduce the fundamental principles of microwave components and to apply them to the design and analysis of RF systems. Students will learn how to characterize microwave components and how to use microwave components. Different types of components and their applications will be introduced, with focus on microwave resonator, power divider, couplers, isolators, phase shifters circulators, filters. Main focus of the course will be design of various microwave components and on 2D planar methodology.

Learning outcomes:

- Students would be able to design various components of microwave engineering.
- Students would be able to characterize power divider, filter, circulators, directional couplers, isolators on planar technology.
- Students would be able to integrate various components on MMIC for various applications used in defense system, commercial wireless systems.

Teaching Scheme (Credit Distribution)				Assessment Scheme (Weightage)	
Lecture	Tutorial	Practical	Credit	Hall Exam	Continuous Evaluation
4	--	--	4	60%	40%

Continuous evaluation is based on assignments/quiz/presentation/small projects as per the supervisor instructions.

Subject Content			
Unit	Topic	No. of Lecture	Weightage %
1	Transmission Line Theory: The Lumped-Element Circuit Model for a Transmission Line, Field Analysis of Transmission Lines, The Terminated Lossless Transmission Line, The Smith Chart, The Quarter-Wave Transformer, Generator and Load Mismatches, Lossy Transmission Lines	---	10
2	Transmission Lines And Waveguides: General Solutions for TEM, TE, and TM Waves; Parallel Plate Waveguide; Rectangular Waveguide; Circular Waveguide; Coaxial Line; Coaxial Line; Microstrip Line	---	15
3	Microwave network analysis: Impedance and equivalent voltages and currents, impedance and admittance matrices, the scattering matrix, the transmission matrix, signal flow graphs	---	15
4	Microwave resonators: Series and parallel resonant circuits, transmission line resonators, rectangular and circular waveguide cavities, dielectric resonators	---	20

5	Microwave components: Basic properties of dividers and couplers, the T-junction power divider, the Wilkinson power divider, waveguide directional couplers, the quadrature hybrid, the 180° hybrid, ferrite isolators, ferrite phase shifters, ferrite circulators	---	20
6	Microwave Filters: Periodic Structures, Analysis of Infinite Periodic Structures, Terminated Periodic Structures, k- β Diagrams and Wave Velocities, 8.2 Filter Design by the Image Parameter Method, Filter Design by the Insertion Loss Method, Filter Transformations, Filter Implementation	---	20

List of References:

“Microwave Engineering”, D. M. Pozar, second edition, John Wiley & Sons Inc., 1999

List of Tutorials: (Not limited to following list)

- Design of 50 ohm microstrip line at 2.4 GHz, 5.8 GHz using SIMULATION TOOL
- Design and implementation of Wilkinson powder dividers using SIMULATION TOOL
- Design and implementation of directional couplers using SIMULATION TOOL
- Design and implementation of filter at 2.4 GHz using SIMULATION TOOL.
- Design and implementation of filter at 10 GHz using SIMULATION TOOL.

Continuous Assessment includes assignments, tutorials, literature survey of 5 research papers from peer-reviewed international journals and presentation`

Subject Code: 1RI3000103	Subject Title: Essentials of Disciplinary Research Subject-2 Subject Sub-Title: Basics of Antenna Engineering
Pre-requisite Subject	Electromagnetic Theory

Objectives of course: The objective of this course is to introduce the fundamental principles of antenna engineering and to apply them to the design and analysis of RF systems. Students will learn how to characterize antennas and how to use design the antenna. Different types of components and their applications will be introduced, with focus on microstrip patch antenna, array antenna Main focus of the course will be design of various microwave components and on 2D planar methodology.

Learning outcomes:

- Students would be able to design various 2D planar antenna.
- Students would be focus on fundamentals of the antenna engineering
- Students would be able to characterize microstrip patch antenna, array antennas
- Students would be able to integrate various components on MMIC for various applications used in defense system, commercial wireless systems.

Teaching Scheme (Credit Distribution)				Assessment Scheme (Weightage)	
Lecture	Tutorial	Practical	Credit	Hall Exam	Continuous Evaluation
2	--	--	2	60%	40%

Continuous evaluation is based on assignments/quiz/presentation/small projects as per the supervisor instructions.

Subject Contents			
Unit	Topic	No. of Lecture	Weightage %
1	Introduction: Types of Antennas, Radiation Mechanism, Current Distribution on a Thin Wire Antenna, Historical Advancement.	---	05
2	Antenna parameters and definitions: beam area, beam width- Half- Power Beam width (HPBW)and First Null Beam width(FNBW) ,Polarization, Radiation Intensity ,Beam Efficiency, Directivity and directive gain, radiation resistance, radiation efficiency, resolution, Antenna aperture- physical and effective apertures, effective height, transmission formula, antenna field zones, Transmission loss as a function of frequency . Antenna temperature and signal to noise ratio.	---	35
3	Arrays: Linear, Planar, and Circular: Introduction, Two-Element Array, <i>N</i> -Element Linear Array: Uniform Amplitude and Spacing, <i>N</i> -Element Linear Array: Directivity, Design	---	30

	Procedure, <i>N</i> -Element Linear Array: Three-Dimensional Characteristics, Rectangular-to-Polar Graphical Solution, <i>N</i> -Element Linear Array: Uniform Spacing, Nonuniform Amplitude, Super directivity, Planar Array, Design Considerations, Circular Array.		
4	Microstrip Antenna: Introduction, rectangular patch, circular patch, quality factor, bandwidth, efficiency, input impedance, coupling, and circular polarization.	---	30

List of References:

- (1) “Antenna Theory: Analysis and design”, C. Balanis Wiley India
- (2) “Antennas for all applications”, J.D. Krauss 3RD Edition (TMH)

List of Tutorials: (Not limited to following list)

- Design of rectangular and circular microstrip patch antenna at 2.4 GHz using simulation tool.
- Design of rectangular and circular microstrip patch antenna at 5.8 GHz using simulation tool.

Continuous Assessment includes assignments, tutorials, literature survey of 5 research papers from peer-reviewed international journals and presentation`