RADIO FREQUENCY INTEGRATED CIRCUIT

Course Objective

1. Students will be able to design Power dividers, Couplers, and feed networks for antennas using ANSYS HFSS.
2. Students will be able to design Rectangular waveguides using ANSYS HFSS.
3. Students will be able to calibrate the Vector Network Analyzer and characterization of one port & two-port microwave devices.
4. Students will be able to test the RF switches and amplifier using Performance Network Analyzer (PNA)

Module-I

Review of transmission lines, impedance, reflection and network parameters. broadband impedance matching network design using passive elements.

Design of microwave and millimeter wave wireless frontend circuits including low noise amplifier, mixer, oscillator and implementation of microwave and millimeter wave integrated systems in CMOS and PHEMT technologies. Introduction to the techniques used in modern broadband wireless system design.(6hrs)

Module-II

Basic concept and properties of Scattering-parameters (S-parameters). Generalized S-parameters for N-port networks and T parameters and its application. Determination of S-parameters of a two-port network mathematically and graphically using signal flow graph. (6hr)

Module-III

Smith Chart analysis. Impedance matching of lumped elements (T and p-network) and distributed elements (one-port and two port networks) using analytical (mathematical calculation) method and graphical analysis using Smith chart (Z-Y Chart). Impedance matching using multiple transmission lines with different characteristic impedances and electrical lengths. (10 hrs)

Module-IV

Analysis and design of various RF microwave passive components: Impedance transformers, Branch line and Rat Race couplers, Wilkinson power divider, planar edge coupled coupler. Using insertion loss method microwave filter design. Low-pass filter design using stepped impedance method (Richard transformation). Planar edge coupled bandpass filter design in distributed domain. (6 hrs.)

Module-V

Stability analysis, Input and output stability circle. Various power gain circles and VSWR circle derivation. Simultaneous conjugate matching to implement small signal amplifier. Amplifier design with specific power gain. (8 hrs.)

Course Outcome

After the completion of this course, students will be able to.

CO1: Understand the design aspect of Power dividers, Couplers, and feed networks using HFSS.
CO2: Describe describe the working principle of Power dividers, Couplers, and feed networks qualitatively.
CO3: Analyze different parameters using HFSS.
CO4: Apply the knowledge to investigate the cause and effect qualitatively.
CO5: Design some basic design by their own.

Essential Reading

1. Thomas H. Lee, The Design of CMOS Radio-Frequency Integrated Circuits 2nd Edition, Cambridge University Press, 2nd Edition.
2. Stephen A. Mass, Non-linear Microwave and RF circuits, Artech House.

Supplementary Reading

1. S. K. Yong, P. Xia, A. Valdes-Garcia, 60GHz Technology for Gbps WLAN and WPAN: From Theory to Practice, John Wiley & Sons.
2. Anderi Grebennikov, Nathan Sokal, Marc Franco, Switched mode RF power amplifiers, Newnes