

ECMC2T3: Microwave Networks and Measurements

Unit I Introduction to Circuit Concepts

The Network concept, One-port network, Two-port network, Impedance and Equivalent voltages and currents, Impedance and Admittance Matrices, The Transmission (ABCD) Matrix-relation to Impedance Matrix, Equivalent circuits for two port networks, H-Matrix, Parameter conversion, Signal flow graphs.

Unit II Scattering Matrix and Matching Networks

Formulation for N-port network, S-Matrix for Reciprocal and Lossless junctions, shift in reference plane, Generalized S-Matrix, conversion of S-parameters to other network parameters, S-Matrix for common systems-Transmission Line, Transition between a co-axial line and waveguide. Matching Networks: Matching with Lumped elements (L Networks), The Quarter-wave Transformer, Single-stub tuning, Double-stub tuning.

Unit III Power Dividers and Couplers

Basic properties of Dividers and Couplers, The T-junction-E-plane, H-plane, Magic Tee and their S-matrices, Applications of Magic Tee, Waveguide Directional Coupler- Bethe-hole, Two-hole (Multi hole), Design of Multi-hole Directional coupler, S-Matrix of Directional coupler, Applications

Unit IV Transmission Devices

Obstacles in waveguides, Posts in waveguides, Diaphragms in waveguides, Waveguide Feeds, Excitation of waveguides-Electric and Magnetic current, Aperture coupling. Phase Shifters- Dielectric Linear Phase shifter, Quarter-wave and Half-wave plates phase shifters, Precision rotary phase shifter and S-Matrix. Attenuators- Fixed and Variable. Circulators- Types and S-Matrix.

Unit V Microwave Cavities and Filters

Rectangular cavity, Cylindrical cavity, Equivalent circuits for cavities-Aperture coupled cavity, Loop coupled cavity. Field expansion in a general cavity, Excitation of cavities.

Filters: Introduction, Filter Design- Image parameter and Insertion Loss methods. Filter Transformations, Filter Implementation (Richard's Transformation and Kuroda Identities), Stepped-line Low pass filters and Coupled line Filters.

Unit VI Periodically Loaded Lines and System Applications

Capacitively loaded Transmission Line, Wave analysis of periodic structures, periodic structures composed of unsymmetrical two port networks, Terminated periodic structures, Matching of periodic structures, K_0 - β diagram, Group velocity and Energy Flow, Floquet's Theorem and

spatial harmonics. System Applications: Microwave communication systems, Radar Systems, Radiometry, Microwave Propagation, Other applications

Unit VII Microwave Measurements-I

Measurement of : Attenuation, RF Voltage, Noise, Power, Frequency Stability, Phase Noise and Dielectric properties of materials at RF/microwave frequencies.

Unit VIII Microwave Measurements-II

Microwave Network Analyzers- Introduction, Elements of Network Analyzer, Block Diagram, Scalar and Vector Network Analyzers. Spectrum Analyzer- Signal Analysis, Measurement domains, Oscilloscope display, Spectrum analyzer display. Working of spectrum analyzer, Important specification points and Applications.

Text Books:

1. "Microwave Engineering", 3rd Edition, David M. Pozar, Wiley student Edition.
2. "Foundations for Microwave Engineering", 2nd Edition, Robert E. Collin, Tata McGraw Hill.
3. "Microwave Measurements", Richard J. Colliner, A. Douglas Skinner, IET Electrical Measurement Series 12.
4. "Principles of Microwave Measurements", Geoff H. Bryant, IEE Electrical Measurement Series 5.
5. "Microwave Circuits", Jerome L. Altman, The Von Nostrad Series.