***EC113 RF and Microwave Engineering***

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| **L-T-P: 3-1-0; Total 42 Lectures**  |

*Prerequisites:* i) Vector Calculus ii) Differential Equation iii) Electromagnetic Field Theory

***Objective:*** This course is intended to provide students with a good understanding and working knowledge of the circuits, components, and sources at RF and microwave frequency range.

***Course Outcome***: Upon successful completion of this course, students should be able to:

Solve transmission line related problems using Smith Chart and design impedance matching networks.

Understand and apply the important concepts and theorems of microwave engineering.

Analyze wave propagation modes in rectangular waveguide, circular waveguides, coaxial lines etc.

Analyze and design cavity resonator.

Understand the general concepts in analysis of microwave networks and design microwave network using various waveguide components.

Design planar transmission lines and planer microwave components.

Analyze and model various microwave sources.

**Topics Covered**

**Unit I: Smith Chart and its Application (3 Lectures)**

Smith Chart and its Application; Single Stub Matching; Introduction to Double Stub Matching and its Advantage; Slotted Line Guide and Microwave Test Bench

**Unit II: Important Concepts and Theorems (3 Lectures)**

Uniqueness Theorem; Image Theory; Duality; Reciprocity Theorem; Equivalence Principle – Love’s Equivalence; Perfect Electric and Perfect Magnetic Boundary Condition; Surface Current Density and its Relation with Magnetic Field

**Unit III: Rectangular Waveguide and Cavity (10 Lectures)**

Construction of Plane Wave Function; TEM, TE, and TM Wave; TE and TM Mode Propagation in Rectangular Wave Guide; Current Distribution on Wave Guide; Radiating and Non-Radiating Slot; Perturbation Technique; Power Loss and Attenuation in Rectangular Wave Guide; Resonant Cavity; Q of Resonant Cavity

**Unit IV: Cylindrical Waveguide (4 Lectures)**

Cylindrical Wave Function; TE and TM Mode Propagation in Cylindrical and Coaxilal Wave Guide

**Unit V: Introduction to Microwave Network (7 Lectures)**

Two Port Networks, ABCD, Z, Y and S Matrix; Impedance and Admittance of N-Port Network; Scattering Parameter; Calculation of S-Parameter of a Resistive T-Network and a Transmission Line Section; Loss-Less Network and Reciprocal Network; Various Wave Guide Components

**Unit VI: Planar Transmission Line (4 Lectures)**

Strip Line, Microstrip Line, Coplanar Strips, Slot Line; Microstrip Impedance Transformer, Power Divider, Directional Coupler etc.

**Unit VII: Microwave Sources (11 Lectures)**

Klystron; Reflex Klystron; Magnetron; Travelling Wave Tube; IMPATT Diode; Gunn Oscillator

**Book List**

1. 1. C. A. Balanis, Advanced Engineering Electromagnetics, 2nd Ed. John Wiley, 2012. (Textbook for concepts and theorems, waveguide, and cavity resonator)

2. 2. R. E. Collin, Foundation of Microwave Engineering, 2nd Ed. John Wiley, 2007. (Textbook for impedance matching and microwave network)

3. 3. P. A. Rizzi, Microwave Engineering: Passive Circuits, 1st Ed. Prentice Hall India, India, 2008. (Textbook for planar transmission line)

4. 4. S. Y. Liao, Microwave devices and circuits, 3rd Ed. Pearson, 2003. (Textbook for Microwave Sources)

5. 5. D. M. Pozzar, Microwave Engineering, 4th Ed. John Wiley, 2012. (Reference Book)

6. 6. R. F. Harrington, Time-Harmonic Electromagnetic Fields. John Wiley, 2001 (Reprint). (Reference Book)