ELECTROMAGNETIC META MATERIALS

17ECMC2T6A **Credits: 4**

Lecture: 4 periods/week **Internal assessment: 40 marks**

Semester end examination: 60 marks

Prerequisites: Electromagnetic field theory, Antenna Theory

Course Objectives:

- To introduce basics of Meta Materials
- To explain fundamentals of Left handed Meta materials
- To explore Transmission line theory of Meta materials
- To explain and explore Two-dimensional Meta materials

Course Outcomes:

Student will be able to

- Express the basic concepts of Meta materials
- Describe the fundamentals of LH Meta materials
- Apply Transmission line theory to Meta materials
- Describe and discuss concept of Two-Dimensional Meta materials

UNIT I

Introduction: Definition of Metamaterials (MTMs) and Left-Handed (LH) MTMs, Theoretical Speculation by Viktor Veselago, Experimental Demonstration of Left-Handedness, Further Numerical and Experimental Confirmations, "Conventional" Backward Waves and Novelty of LH MTMs, Terminology, Transmission Line (TL) Approach, Composite Right/Left-Handed (CRLH) MTMs, MTMs and Photonic Band-Gap (PBG) Structures, Historical "Germs" of MTMs

UNIT II

Fundamentals of LH MTMs: Left-Handedness from Maxwell's Equations, Entropy Conditions in Dispersive Media, Boundary Conditions, Reversal of Doppler Effect, Reversal of Vavilov-Cerenkov Radiation, Reversal of Snell's Law: Negative Refraction, Focusing by a "Flat LH Lens", Fresnel Coefficients, Reversal of Goos-Ḧanchen Effect, Reversal of Convergence and Divergence in Convex and Concave Lenses, Subwavelength Diffraction

UNIT III

TL Theory of MTM: Ideal Homogeneous CRLH TLs, LC Network Implementation, Real Distributed 1D CRLH Structures, Experimental Transmission Characteristics, Conversion from Transmission Line to Constitutive Parameters

UNIT IV

Two-Dimensional MTMs: Eigenvalue Problem, Driven Problem by the Transmission Matrix Method (TMM), Transmission Line Matrix (TLM) Modeling Method, Negative Refractive Index (NRI) Effects, Distributed 2D Structures

Learning Resources

Text Books:

1. Christophe Caloz and Tatsuo Itoh, "Electromagnetic Metamaterials", Wiley –Inter science, 2006

References:

1. Nader Engheta and Richard W. Ziolkowski, Metamaterials: Physics and Engineering Explorations", IEEE Press and Wiley –Interscience, 2006