3/4 B.Tech - FIFTH SEMESTER

EC5T2 **Transmission Lines and Waveguides** **Credits: 4**

Lecture : 4 periods/week **Internal assessment: 30 marks**
Tutorial: 1 period /week **Semester end examination: 70 marks**

Course Objectives:

- To learn about Transmission Lines and their application in EM wave propagation
- To know about Smith chart and its applications in Impedance matching
- To study the characteristics of EM wave propagation in Parallel plate, Rectangular, Circular and Cavity resonators
- To understand the concept of Microstrip Line

UNIT-I

Basics of Transmission Lines: Concept and definition, Different kinds of transmission lines, Applications, Equivalent circuit, Primary constants- R, L, C and G, secondary constants – Propagation constant and Characteristic Impedance Z_o , General Transmission line equations . Attenuation and phase constants. Wavelength, phase velocity and group velocity. Time domain transmission line equations. **Types of Transmission Lines :** The Lossless Transmission line, The Infinite long transmission line, The Distortion less Transmission Line and condition for Distortionlessness and minimum attenuation, The low resistance Transmission Line .Loading and types of loading, Losses .

UNIT-II

Finite Transmission Lines: The load Reflection coefficient, Standing Wave Ratio, Line Impedance, Generalized Reflection coefficient, The Lossless terminated transmission line, The Lossless matched transmission line, The lossless shorted transmission line, The lossless open transmission line, The lossless resistively loaded transmission line. Power relations on a general Transmission line.

UNIT-III

UHF Lines : UHF lines as circuit elements: $\lambda/4$, $\lambda/2$, $\lambda/8$ lines, **Smith Chart:** Concept and construction of smith chart, Smith chart as Impedance chart, smith chart as admittance chart, Problems using smith chart. Impedance matching- Single stub with applications, Double stub matching, the quarter wave transformer.

UNIT- IV

Transients on Transmission Lines: Introduction, Propagation of narrow pulses on Finite, Lossless transmission lines, Propagation of Narrow pulses on Finite Distortionless transmission line. Transients on Transmission lines: Long pulses, Finite –Length Pulses. Reflections from Discontinuities, Transients on lines with reactive loading, Initial conditions on transmission lines.

UNIT-V

Guided waves: Review of Maxwell's Equations for Time varying and Time-Harmonic fields. Wave Equations, and Boundary conditions. **Parallel Plane Waveguides:** Concepts, Transverse Electric (TE) Waves, Transverse Magnetic(TM) Waves, Transverse Electromagnetic (TEM) waves. Propagation constant, phase constant, wavelength, phase velocity, Group velocity, Attenuation and wave impedance for TE, TM and TEM cases.

UNIT- VI

Rectangular Waveguides: Transverse Electric (TE) and Transverse Magnetic (TM) mode analysis – Derivation of Expressions for fields, characteristic equation, cut-off frequency, phase velocity, group velocity, attenuation and phase constants, wavelength and impedances. Filter characteristics, Dominant and degenerate modes, Sketches of TE and TM mode fields. Power Transmission and Power loss expressions.

UNIT-VII

Circular Waveguides: Review of Bessel Functions. Transverse Electric (TE) and Transverse Magnetic (TM) mode analysis – Derivation of Expressions for fields, characteristic equation, cut-off frequency, phase velocity, group velocity, phase constant, wavelength and impedances. Sketches of TE and TM mode fields.

UNIT-VIII

Cavity Resonators: Introduction, Rectangular and Cylindrical cavities, Dominant modes and Resonant Frequencies, Q factor, Types of coupling and coupling coefficients. **Microstrip Line:** Introduction, Characteristic Impedance, Effective Dielectric constant, Losses and Quality factor

Learning Resources

Text Books:

1. Engineering Electromagnetics – Nathan Ida, Springer International, 2nd Ed, 2008.
2. Electromagnetic Waves and Radiating Systems – E.C. Jordan and K.G. Balmain, PHI, 2nd Ed, 2009
3. Microwave Devices and Circuits – Samuel Y. Liao, Pearson Education, 3rd Ed, 2003.

References:

1. Transmission Lines and Networks – Umesh Sinha, Satya Prakashan India,5th Ed(Reprint) 2010.
2. Foundations for Microwave Engineering – R.E. Collins, Wiley student Edition, 2nd Ed, 2007.
3. Microwave Engineering- David M Pozar, wiley student Edition, 3rd Ed, 2007.