III B.Tech – II Semester
(17EC603) MICROWAVE ENGINEERING

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
40	60	100	4	1	-	3

Pre-Requisites: Electromagnetic Waves and Transmission lines, Antenna and Wave Propagation

Course Objectives:

- Understand fundamental characteristics of waveguides and Microstrip lines through electromagnetic field analysis.
- Understand the basic properties of waveguide components and Ferrite materials composition
- Understand the function, design, and integration of the major microwave components oscillators, power amplifier.
- Understand a Microwave test bench setup for measurements.

UNIT-I:

MICROWAVE TRANSMISSION LINES: Introduction, Microwave spectrum and bands, Applications of microwaves. Rectangular Waveguides-TE/Tm mode analysis, Expressions for Fields. Characteristic Equation and Cut-off Frequencies, Filter Characteristics, Dominant and Degenerate Modes, Sketches of TE and Tm mode fields in the cross –section, Mode Characteristics-phase and Group Velocities, Wavelengths and impedance Relations; Power Transmission and power losses n Rectangular Guide, Impossibility of TEM mode. Related problems.

UNIT-II:

CIRCULAR WAVEGUIDES: Introduction, Nature of Fields, Characteristic Equation, Dominant and Degenerate Modes. Cavity Resonators- Introduction, Rectangular and Cylindrical Cavities, Dominant Modes and Resonant Frequencies, Q factor and Coupling Coefficients, Excitation Techniques-waveguides-waveguides and cavities, Related problems.

MICROSTRIP LINES - Introduction, Zo Relations, Effective Dielectric Constant, Losses, Q factor.

UNIT-III:

MICROWAVE TUBES: Limitations and Losses of conventional tubes at microwave frequencies. Re-entrant Cavities, Microwave tubes – O type and M type classifications. O-type tubes:2Cavity Klystrons Structure, Velocity Modulation process and Applegate Diagram, Bunching process and small signal Theory Expressions for o/p power and Efficiency, Applications, Reflex Klystrons- structure, Applegate Diagram and principle of working, Mathematical Theory of Bunching, Power Output, Efficiency, Electronic admittance; Oscillating Modes and o/p Characteristics, Electronic and mechanical Tuning, Applications, Related Problems

UNIT-IV

HELIX TWTS: Significance, Types and Characteristics of slow Wave Structures: Structure of TWT and Suppression of Oscillations, Nature of the four Propagation Constants (Qualitative treatment).

M-TYPE TUBES

Introduction, Cross- field effects, Magnetrons – Different Types, 8-Cylindrical Traveling wave Magnetron-Hull Cut – off Condition, Modes of Resonance and PI-Mode Operation, Separationof PI-characteristics.

UNIT-V:

WAVEGUIDE COMPONENTS AND APPLICATIONS –I: Coupling Mechanisms – probe, Loop, Aperture types. Waveguide Discontinuities – Waveguide irises, Tuning –Screws and Posts, Matched Loads. Waveguide Attenuators – Resistive Card, Rotary Vane types: Waveguide phase shifters –

Dielectric, Rotary vane types. Scattering Matrix- Significance, Formulation and properties. S-Matrix Calculations for – 2 port junction, E-plane and H-plane Tees, Magic Tee, Hybrid Ring; Directional Couplers – 2Hole, Bethe Hole types, Ferrite Components – Faraday rotation. S – Matrix Calculations for Gyrator, lsolator, Related Problems.

UNIT-VI:

MICROWAVE SOLID STATE DEVICES: Introduction, Classification, Applications. TEDs – Introduction. Gunn Diode – Principle, RWH Theory, Characteristics, Basic Modes of Operation, Oscillation Modes. Avalanche Transit Time Devices – Introduction, IMPATT and TRAPATT Diodes – Principle of Operation and Characteristics.

MICROWAVE MEASUREMENTS: Description of Microwave bench – Different Blocks and their Features, Precautions: Microwave Power Measurement – Bolometer Method. Measurement of Attenuation. Frequency, Q factor, Phase shift, VSWR, Impedance Measurement.

Course Outcomes:

After successful completion of the course, the students can be able to:

S. No	Course Outcome	BTL
1.	Understand the advantages and important engineering applications of microwave frequencies	L1
2.	Apply electromagnetic wave equations for the analysis of circular waveguides.	L2
3.	Identify the limitations and losses of conventional vacuum tubes and study the performance of O type microwave tubes	L2
4.	Analyze M-type tubes and obtain their characteristics.	L3
5.	Understand the structure and applications of waveguide components.	L1
6.	Analyze and measure various microwave parameters using a Microwave test bench.	L4

Correlation of COs with POs & PSOs:

CO	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	3	2	1	1	-	1	-	-	2	1	-	1	3	2
CO 2	3	2	2	1	-	1	-	-	2	1	-	1	3	2
CO 3	3	3	2	1	-	1	-	-	2	1	-	1	3	3
CO 4	3	3	2	1	-	1	-	-	2	1	-	1	3	3
CO 5	3	3	2	1	-	1	-	-	2	1	-	1	3	3
CO 6	3	3	3	2	-	1	-	-	2	1	-	1	3	3

Text Books:

1. Microwave Devices and Circuits – Samuel Y. Liao, PHI, 3rd Edition, 1994.
2. Foundations for Microwave Engineering – R.E. Collin, IEEE Press, John Wiley, 2nd Edition, 2002.

Reference Books:

1. Microwave Principles – Herbert J. Reich, J.G. Skalnik, P.F. Ordung and H.L. Krauss,CBS publishers and distributors, New Delhi,2004
2. Microwave Engineering Annapurna Das and Sisir K.Das, McGraw H ill Education, 3rd Edition
3. Microwave and Radar Engineering M. Kulkarni, Umesh Publications, 3rd Edition.
4. Microwave Engineering – G S N Raju, I K International
5. Microwave and Radar Engineering – G Sasibhushana Rao Pearson