Microwave Engineering

Course Code	23EC4602B	**Year**	III	**Semester**	II
Course Category	PE-III	**Branch**	ECE	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Pre requisites**	Electromagnetic and wave propagation
Continuous Internal Evaluation	30	**Semester End Evaluation**	70	**Total Marks**	100

Course Outcomes		
Upon successful completion of the course, the student will be able to		BL
CO1	Design of different mode waveguide structures	L4
CO2	Calculate S-matrix for various waveguide components and splitting the microwave energy in a desired direction.	L3
CO3	Distinguish between Microwave tubes and Solid State Devices, calculation of efficiency of devices.	L4
CO4	Measure various microwave parameters using a Micro wave test bench.	L4

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of Correlations (3:High, 2:Medium, 1:Low)

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO 11**	**PSO 1**	**PSO 2**
CO1	3	3	1								1	2	
CO2	3	2									1	2	
CO3	3	3									1	2	
CO4	3	3			2						1	2	
Avg.	3	3	1		2						1	2	

Syllabus		
Unit No.	**Contents**	**Mapped CO**
1	**Microwave Transmission Lines:** Introduction, Microwave Spectrum and Bands, Applications of Microwaves. Rectangular Waveguides – Transverse Electric (TE) and Transverse Magnetic (TM) mode analysis – Field expressions, Characteristic equation, Cut-off frequency, Phase velocity, Group velocity, Attenuation and Phase constants, Wavelength and Impedance.	CO1
2	**Microwave Tubes:** Limitations and Losses of conventional tubes at microwave frequencies. Microwave Tubes-O type and Mtype classification, Linear Beam Tubes (O-type): Two Cavity Klystron: Velocity modulation,Bunching process, Output power and Beam loading.Reflex Klystron: Velocity modulation, Power output andEfficiency.	CO3
3	**Helix Traveling -Wave Tubes (TWTs)**: Slow Wave Structures, Amplification Process (qualitative treatment), Suppression of Oscillations, Gain Considerations. **M-Type Tubes** - Introduction, Cross-field Effects, Cylindrical Traveling Wave Magnetron –Hull Cut-off and Hartree Conditions,	CO3

	Modes of Resonance and PI-Mode Operation, Separation of PI-Mode, o/p characteristics	
4	**Microwave Waveguides and Components**– Probe, Loop, Aperture types. Tuning Screws and Posts, Matched Loads. Waveguide Attenuators – Resistive Card and Rotary Vane type; Waveguide Phase Shifters – Dielectric and Rotary Vane type. Scattering Matrix Properties - Waveguide Multiport Junctions - E plane and H plane Tees, Magic Tee, S- matrix. Multi–Hole Directional Coupler S-matrix. Ferrites– Composition and Characteristics, Faraday rotation – Isolator and Circulator.	CO2
5	**Microwave Solid State Devices**: Introduction, Classification, Applications. TEDs – Introduction, Gunn Diode – Principle, RWH Theory, Characteristics, Basic Modes of Operation, Oscillation Modes. **Microwave Measurements:** Description of Microwave Bench – Different Blocks and their Features, Precautions. Microwave Power Measurement – Bolometer Method. Measurement of Attenuation, Frequency, VSWR, Impedance Measurement.	CO3,CO4

Learning Resources
Text Books
1. R.E. Collin, Foundations for Microwave Engineering, IEEE Press, John Wiley, 2nd Ed., 2010. 2. Annapurna Das and SisirK.Das ,Microwave Engineering, Mc-Graw Hill Education, Ed., 2020. 3. Samuel Y. Liao, Microwave Devices and Circuits, PHI, 3rd Ed.,2013.
Reference Books
1. G S N Raju,Microwave Engineering, I K International, 2008. 2. M.Kulkarni,Microwave and Radar Engineering, Umesh Publications,3rd Ed.,2010.
e-Resources & other Digital Material
1. https://onlinecourses.nptel.ac.in/noc20_ee91/preview 2. https://onlinecourses.nptel.ac.in/noc21_ee72/preview 3. https://www.microwaves101.com/ 4. https://youtu.be/A9SNdF7UP18