

# GUJARAT TECHNOLOGICAL UNIVERSITY

## ELECTRONICS & COMMUNICATION (WIRELESS COMMUNICATION TECHNOLOGY) (44)

RF AND MICROWAVE ENGINEERING

SUBJECT CODE: 2724404

M. E. Semester – II

**Type of course: Major Elective-II**

**Prerequisite: Fundamental of Electromagnetic theory.**

**Rationale:** Today, microwave and RF technology is more pervasive than ever. This is especially true in the commercial sector, where modern applications include cellular telephones, smart phones, 3G and Wi-Fi wireless networking, millimeter wave collision sensors for vehicles, direct broadcast satellites for radio, television, and networking, global positioning systems, radio frequency identification tagging, ultra wide band radio and radar systems, and microwave remote sensing systems for the environment. Defense systems continue to rely heavily on microwave technology for passive and active sensing, communications, and weapons control systems. There will be a clear need for engineers having both an understanding of the fundamentals of microwave engineering and the creativity to apply this knowledge to problems of practical interest. Modern RF and microwave engineering predominantly involves distributed circuit analysis and design, in contrast to the waveguide and field theory orientation of earlier generations. The majority of microwave engineers today design planar components and integrated circuits without direct recourse to electromagnetic analysis. Microwave computer aided design software and network analyzers are the essential tools of today's microwave engineer.

**Teaching and Examination Scheme:**

Teaching Scheme			Credits C	Examination Marks						Total Marks
L	T	P		Theory Marks		Practical Marks				
			ESE (E)	PA (M)	ESE (V)		PA (I)			
					ESE	OEP	PA	RP		
3	2#	2	5	70	30	20	10	10	10	150

**Content:**

Sr. No.	Content	Total Hrs	% Weightage
1	Transmission Line Theory: Lumped Element circuit model, Field Analysis of Transmission line, Terminated Lossless line, Smith Chart, The Quarter-Wave Transformer, Generator and Load Mismatches, Lossy Transmission line	03	5%
2	Transmission Line and Waveguides: General Solutions of TEM, TE, and TM waves, Parallel Plate Waveguides, Rectangular Waveguides, Circular Waveguides, Strip-line, Micro-strip, Wave Velocities and Dispersion, summary of Transmission line and waveguides	07	20%
3	Microwave Network Analysis: Impedance and equivalent voltage and currents, Impedance and Admittance Matrices, Scattering	04	0%

	Matrix,ABCD Matrix,Signal Flow Graphs		
4	Impedance Matching and tuning: Matching with lumped elements,Single and Double Stub Matching,Quarter wave transformer,Theory of small reflections.	04	15%
5	Microwave Resonators: Series and Parallel Resonant Circuits,Transmission Line Resonators, Rectangular and Circular waveguide cavities	04	15%
6	Power Divider and Directional Coupler: Basic Properties of divider and couplers,T-junction divider,Wilkinson power divider,waveguide directional coupler, quadrature hybrid,Coupled line directional coupler,The Lange coupler, 180 hybrid, Ferrite Isolator, Ferrite Phase shifter, Ferrite circulators.	05	20%
7	Microwave Filters: Periodic Structures,Filter design by image parameter method,Filter design by insertion loss method, Filter transformations, Filter implementations.	05	10%
8	Introduction to Microwave System: System aspect of antenna,Microwave communication system, Radar system,Microwave Propagation.	04	05%

### Reference Books:

Microwave Engineering, David M.Pozar (Second Edition) JOHN WILEY and SONS

### Course Outcome:

After successful completion of said course, student must have knowledge of: Components of RF and microwave design ,Behavior of passive components ,Scattering parameters and signal flow diagrams ,Smith Chart design, Microstrip line circuits,Passive networks and RF filters,

### List of Experiments:

Based on Syllabus

### Design based Problems (DP)/Open Ended Problem:

1. Design and Implement of the 50 ohm microstrip line on FR4 material. Assume suitable height of the FR4.
2. Design and Implement Wilkinson power divider at 2.4 GHz.
3. Design and implement a low pass filter for fabrication using microstrip lines. The specifications are: cut off frequency of 2.4 GHz, third order, impedance of 50 ohm, and a 3 dB equal-ripple characteristic.
4. Write a MATLAB code for design of microstrip line for different combinations of impedance and width.

**Major Equipment:**

Microwave bench, Transmission Line Analyzer.

**List of Open Source Software/learning website:**

Use any Microwave simulator tool such as TRLINE,RFmatch

**Review Presentation (RP):** The concerned faculty member shall provide the list of peer reviewed Journals and Tier-I and Tier-II Conferences relating to the subject (or relating to the area of thesis for seminar) to the students in the beginning of the semester. The same list will be uploaded on GTU website during the first two weeks of the start of the semester. Every student or a group of students shall critically study 2 papers, integrate the details and make presentation in the last two weeks of the semester. The GTU marks entry portal will allow entry of marks only after uploading of the best 3 presentations. A unique id number will be generated only after uploading the presentations. Thereafter the entry of marks will be allowed. The best 3 presentations of each college will be uploaded on GTU website