SARVAJANIK UNIVERSITY
Sarvajanik College of Engineering and Technology
Bachelor of Technology

B. Tech. Semester VI

Subject Name: **Antenna and Microwave Engineering** **Subject Code: BTEC13601**
Type of course: PCC
Prerequisite: Basic Knowledge of wave propagation, Maxwell equation.
Rationale: This course introduces the principles of Antenna, microwave engineering and the devices, circuits and systems used at microwave frequencies. The course also introduces the design principles and measurement techniques for antenna and microwave circuits.

Teaching and Examination Scheme:

Teaching Scheme				Theory Marks			Practical Marks		Total
L	T	P	C	TEE	CA1	CA2	TEP	CA3	150
3	0	2	4	60	25	15	30	20	

CA1: Continuous Assessment (assignments/projects/open book tests/closed book tests **CA2:** Sincerity in attending classes/class tests/ timely submissions of assignments/self-learning attitude/solving advanced problems **TEE:** Term End Examination **TEP:** Term End Practical Exam (Performance and viva on practical skills learned in course) **CA3:** Regular submission of Lab work/Quality of work submitted/Active participation in lab sessions/viva on practical skills learned in course

Content:

Sr. no.	Topics	Teaching Hrs.	Module % Weightage
1.	**Basic antenna concepts**: Definition and functions of an antenna, radiation patterns of antennas-field and power patterns. **Radiation of Electric dipole**: Potential functions and the electromagnetic field, Oscillating electric dipole, derivations for E and H field components in spherical coordinate systems, Power Radiated by a current element, Radiation from quarter wave monopole and half wave dipoles, radiation resistance, reciprocity theorem , equality of directional patterns, effective lengths of antennas.	6	10
2.	**Antenna parameters and definitions:** Beam area, beam width- Half-Power Beam width (HPBW) and First Null Beam width (FNBW), Polarization, Radiation Intensity, Beam Efficiency, Directivity and directive gain, radiation resistance, radiation efficiency, resolution, Antenna aperture-physical and effective apertures, transmission formula, antenna field zones, Transmission loss as a function of frequency. Antenna temperature and signal to noise ratio.	6	10
3.	**Types of antennas:** Loop Antenna, Helical antenna, Yagi uda antenna, Reflector	6	20

	antennas, Slot patch & Horn antennas, Micro strip (patch) antennas, Lens antennas, Broadband & Freq. Independent antennas.		
4.	**Introduction to microwave:** Microwave history, Band Designation. Advantages of Microwave. Application of Microwave. Propagation modes: TEM/TE/TM/HE.	3	10
5.	**Transmission line:** Voltage and Current relationship on transmission line, Characteristic impedance, reflection coefficient, input impedance, standing wave, VSWR, losses due to mismatch in transmission line, impedance matching, travelling wave in lossless medium, Types of transmission line , micro strip line, micro strip line advantage and disadvantage. Waveguide Vs transmission line types of waveguide. Smith Chart.	10	20
6.	**Microwave Components:** **Active Components:** Oscillators, Mixers. Microwave Semiconductor Devices: Gunn Diodes, diodes, PIN diodes. Klystron, TWT, Magnetron. **Passive Components:** Directional Coupler, Power Divider, Magic Tee, Attenuator, ferrite devices, bend, twister, Resonator. Scattering parameter.	7	15
7.	**Microwave Integrated Circuits (MIC):** Introduction, Types of MICs and Their Technology, Hybrid MIC (HMIC) Technology, Monolithic Technology, MIC Lumped and Distributed Elements**.** **Microwave Systems:** Radar, Terrestrial and Satellite Communication, Radio Aids to Navigation, RFID, GPS. Modern Trends in Microwaves Engineering. Monolithic Microwave ICs, RF-MEMS for microwave components, Microwave Imaging.	7	15

Suggested Specification table with Marks (Theory):

% Distribution of Marks					
R Level	**U Level**	**A Level**	**N Level**	**E Level**	**C Level**
15	15	30	40	0	0

Legends: R: Remembrance, **U:** Understanding; **A:** Application, **N:** Analyze, **E:** Evaluate **C:** Create and above Levels **(Revised Bloom's Taxonomy)**

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Reference Text Books:

Sr. No.	Title of book /article	Author(s)	Publisher and details like ISBN	Year of publication	Publication Edition
1.	Microwave and Radar Engineering	M.Kulkarni	Umesh	2009	Latest
2.	Antenna Theory: Analysis and design	C. Balanis	Prentice Hall	2007	Latest
3.	Microwave Engineering	A. Das and S. K. Das	McGraw-Hill	2009	2nd
4.	Antennas for all applications	J.D. Krauss	TMH	2008	4th

Course Outcome:

Sr. No.	CO Statement After learning this subject students will be able to	Marks % weightage
CO-1	Describe and Compare radiation patterns and parameters associated with various antennas.	30
CO-2	Apply various antennas for application specific systems and scenarios.	20
CO-3	Describe RF fundamentals for Microwave Systems and integrated circuits.	10
CO-4	Define parameters of transmission line and apply the knowledge for computation of transmission line system.	20
CO-5	Summarize microwave active sources and microwave passive components.	20

Mapping with POs:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO-1	3	3	2	2	2	3	2	2	3	3	2	2	2	2	2
CO-2	3	3	2	2	2	2	1	2	3	3	2	2	2	2	2
CO-3	3	2	1	-	2	2	-	2	3	3	-	2	2	-	2
CO-4	3	2	2	2	2	2	-	2	2	3	-	2	2	-	-
CO-5	3	3	1	-	2	3	1	2	2	3	2	2	2	-	-

List of Practical:

1. A. Design a dipole antenna for given frequency on simulation software and generate, 2D, 3D radiation pattern for given variation of phi and theta.
B. Analyze the radiation pattern of Dipole antenna using experiment kit-setup.

2. A. Design 3 and 5 element Yagi-Uda antenna for given frequency on simulation software and generate, 2D, 3D radiation pattern for given variation of phi and theta.
B. Analyze the radiation pattern of 3 element Yagi-Uda antenna using experiment kit-setup.

3. A. Design loop antenna for given frequency on simulation software and generate, 2D, 3D radiation pattern for given variation of phi and theta.
B. Analyze the radiation pattern of loop antenna using experiment kit-setup.

4 A. Design a broadside array antenna for given frequency on simulation software and generate, 2D, 3D radiation pattern for given variation of phi and theta.
B. Design end fire array antenna for given frequency on simulation software and generate, 2D, 3D radiation pattern for given variation of phi and theta.

5 To Identify Microwave Components, devices for preparation microwave bench and utilization of Instruments for measurement purpose.

6 A. To measure the voltage and current of microwave source Gunn Diode and plot the VI characteristics.
B. Identify the negative resistance region by graphical method.

7 Generate power at different repellor voltages using reflex klystron for various microwave benches and experiment set-up.

8 A. To measure the insertion and isolation loss of microwave component - isolator and circulator.
B. To compare the insertion and isolation loss at all ports of microwave component - isolator and circulator.

9 To measure the insertion, isolation loss and return loss of microwave component – coupler and magic tee.

10. A. To compute the frequency and wavelength of rectangular wave –guide (TE10 mode) using slotted line.
B. To measure the frequency and wavelength of rectangular wave –guide (TE10 mode) using frequency meter.

11. To plot Standing Wave pattern for: i) Matched load ii) Open circuit load iii) Short circuit load.

12. Poster presentation, Mini Project (Antenna Design), ALA.

Major Equipment:

- Microwave test bench, klystron and gunn power supply, SWR meter, Frequency meter, Microwave spectrum analyzer, Antenna kit

List of Open Source/learning website:

- https://nptel.ac.in/courses/108101112 - Microwave Theory and Techniques

List of Open Source Software:

- ANSOFT