Lok Jagruti Kendra University
University with a Difference

Diploma in Electronics & Communication Engineering

LJ Polytechnic

Course Code: 025030501

Microwave & RADAR Engineering

Programme / Branch Name	Diploma in Electronics and Communication Engineering					
Course Name	Microwave & RADAR Engineering				**Course Code**	025030501
Course Type	HSSC	BSC	ESC	PCC	OEC	PEC

Legends: HSSC: Humanities and Social Sciences Courses BSC: Basic Science Courses
ESC: Engineering Science Courses PCC: Program Core Courses
OEC: Open Elective Courses PEC: Program Elective Courses

1. Teaching and Evaluation Scheme

Teaching Hours / Week / Credits				Evaluation Scheme			
L	**T**	**P**	**Total Credit**	**CCE**	**SEE (Th)**	**SEE (Pr)**	**Total Marks**
4	0	2	5	50	50	50	150

Legends:
L: Lectures T: Tutorial P: Practical
CCE: Continuous & Comprehensive Evaluation
SEE (Th): Semester End Evaluation (Theory)
SEE (Pr): Semester End Evaluation (Practical)

2. Prerequisite

- ✓ Physics and Mathematics (Pre-university level)
- ✓ Measure basic electrical quantities/parameters
- ✓ Use major electrical/electronic machines//instrument/equipment

3. Rationale

Microwave Engineering has been used extensively since World War II when the sources were based on vacuum tubes. Microwaves are playing a vital role in communication engineering such as radar system, satellite communication, TV broadcasting and mobile communication, and have wide coverage in defense, medical, domestic and industrial applications. A thorough knowledge of microwave engineering and its application is very necessary for students pursuing course in Electronics and Communication Engineering.

4. Objectives

- ✓ Analyze and understood working and construction of microwave components.
- ✓ To know the working and types of waveguides
- ✓ Know the working principle and types of RADAR
- ✓ Analyze typical microwave networks using impedance, admittance, transmission and scattering matrix representations.
- ✓ Design microwave matching networks using L section, single and double stub and quarter wave transformer.
- ✓ Explain working of microwave passive circuits such as isolator, circulator, Directional couplers, attenuators etc.
- ✓ Describe and explain working of microwave tubes and solid-state devices.

5. Contents

Unit No.	Unit Name	Topics	Learning Outcomes	% Weightage	Hours
1.	**Introduction to microwave and transmission lines**	1.1 Microwave frequency range 1.2 Characteristic features of microwaves, advantages and applications 1.3 Type of microwave transmission line 1.4 Stub matching 1.5 Mode of operation in Waveguide 1.6 Waveguide types 1.7 Comparison between TE and TM mode 1.8 Field patterns for rectangular waveguide 1.9 Comparison between waveguide and two-wire line.	• Microwave features, Vs transmission line • Operation of Waveguide and its filed pattern • Different mode of operation of waveguide	20	10
2.	**Microwave components**	2.1 Waveguide tees, waveguide bends, corners and twists 2.2 Hybrid tee (magic tee) 2.3 Directional coupler 2.4 Isolators 2.5 Circulator 2.6 Impedance matching devices 2.7 Microwave attenuators 2.8 Klystron 2.9 Two cavity klystron, multicavity klystron, reflex klystron 2.10 Comparison between TWT and klystron 2.11 Magnetron	• Types of waveguides • Microwave coupler, circulator, isolator • Klystron and its types • Magnetron	20	12
3.	**Microwave measurement**	3.1 Microwave test bench general measurement 3.2 Microwave power measurement 3.3 Low Microwave Power Measurement 3.4 Medium Power Measurement 3.5 High Power Measurement 3.6 Measurement of impedance	• Power, voltage, frequency and impedance measurement	20	12

		3.7 VSWR Measurement 3.8 Frequency Measurement			
4.	**Microwave semiconductor device**	4.1 Pin Diode 4.2 Varactor Diode 4.3 Tunnel Diode 4.4 IMPATT Diode 4.5 TRAPATT Diode 4.6 MASER	• Semiconductor devices used in microwave	20	12
5.	**RADAR**	5.1 Concept, basic system, frequencies 5.2 Advantages and limitation 5.3 Block diagram, range equation, Doppler effect 5.4 Classification of Radar 5.5 Pulse and CW Radar 5.6 FMCW Radar 5.7 MTI Radar 5.8 Blind speed 5.9 Limitation and comparison between MTI and pulsed radar 5.10 Types of radar display	• Concept and types of Radar • Limitation and blind speed • Display used in radar	20	12

6. List of Practical's / Exercises

The practical's/exercises have been properly designed and implemented in an attempt to develop different types of skills, so that students can acquire the competencies/programme outcomes. Following is the list of practical's/exercises.

Sr. No.	Practical's / Exercises	Key Competency	Hours
1	To study waveguide components.	Microwave component	
2	Study of various microwave components and instruments like frequency meter, attenuator, detector and VSWR meter.	Microwave component	
3	Measurement of guide wavelength and frequency of the signal in a rectangular waveguide.	Waveguide	
4	Measurement of VSWR (small as well as large values) and reflection coefficient.	Waveguide, VSWR	
5	Study of mode characteristics of reflex klystron and determination and mode number, transit time and electronic tuning sensitivity.	Klystron	
6	Study of characteristics of Gunn oscillator.	Gunn diode	
7	Study of Gunn diode as modulated source (PIN modulation) and determination of modulation depth.	Gunn diode	
8	Measurement of coupling coefficient and directivity of a directional coupler.	Coupler	
9	Study of insulation and coupling coefficient of a magic Tee.	Magic tee	
10	Study of waveguide horn and its radiation pattern and determination of the beam width.	Waveguide	
11	Study of a ferrite circulator and measurement of isolation, insertion loss, cross coupling and input VSWR.	Waveguide, VSWR	

12	Measurement of microwave power using power meter.	Waveguide, Power	

7. Suggested Specification Table for Evaluation Scheme

Unit No.	Unit Name	Teaching Hours	Distribution of Topics According to Bloom's Taxonomy					
			R %	U %	App %	C %	E %	An %
1	Introduction and microwave transmission lines	10	30	20	30	5	5	10
2	Microwave components	12	30	30	10	10	10	10
3	Microwave measurement	12	30	30	10	10	10	10
4	Microwave semiconductor device	12	20	30	20	5	5	20
5	RADAR	12	40	20	10	10	10	10

Legends: R - Remembering; U - Understanding; App – Applying; C – Creating; E- Evaluating; An- Analyzing

8. Textbooks

1) Microwave engineering by D M Pozar, 4th Edition, Wiley Publication
2) Microwave and Radar Engineering by Gottapu Sasibhushana Rao, Pearson Publication

9. Reference Books

1) Microwave, radar, & RF Engineering, Prakash Kumar Chaturvedi, Springer
2) Microwave Devices and Circuits, Samuel Y. Liao, PHI, 3rd Edition.

10. Open Sources (Website, Video, Movie)

1) RF Tool box: MATLAB & SIMULINK:
2) http://www.rfmw.org/transmission_lines_and_distributed_systems_transmission_lines_transmission _lines.html
3) http://www.rfmw.org/transmission_lines_and_distributed_systems_transmission_lines_transmission_lines_video_lectures.html
4) www.nptel.ac.in