



# INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad -500 043

## ELECTRONICS AND COMMUNICATION ENGINEERING

### COURSE DESCRIPTOR

Course Title	<b>MICROWAVE ENGINEERING LABORATORY</b>				
Course Code	AEC110				
Programme	B.Tech				
Semester	VII	ECE			
Course Type	Core				
Regulation	IARE - R16				
Course Structure	Theory			Practical	
	Lectures	Tutorials	Credits	Laboratory	Credits
	-	-	-	3	2
Chief Coordinator	Mrs. P. Annapurna, Assistant Professor				
Course Faculty	Dr. V Siva Nagaraju, Professor, Ms. P Saritha, Assistant Professor Mr. U Somanaidu, Assistant Professor				

#### I. COURSE OVERVIEW:

This laboratory course builds on the lecture course " Microwave Engineering " which is mandatory for all students of electronics and communication engineering. The course aims at practical experience with the characteristics and theoretical principles of microwave devices and their applications.

#### II. COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites	Credits
UG	AEC007	IV	Electromagnetic theory and transmission lines	4
UG	AEC011	V	Antennas and propagation	4

#### III. MARKS DISTRIBUTION:

Subject	SEE Examination	CIA Examination	Total Marks
Microwave Engineering Laboratory	70 Marks	30 Marks	100

#### IV. DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✗	Chalk & Talk	✗	Quiz	✗	Assignments	✗	MOOCs
✓	LCD / PPT	✗	Seminars	✗	Mini Project	✗	Videos
✗	Open Ended Experiments						

#### V. EVALUATION METHODOLOGY:

Each laboratory will be evaluated for a total of 100 marks consisting of 30 marks for internal assessment and 70 marks for semester end lab examination. Out of 30 marks of internal assessment, continuous lab assessment will be done for 20 marks for the day to day performance and 10 marks for the final internal lab assessment.

**Semester End Examination (SEE):** The semester end lab examination for 70 marks shall be conducted by two examiners, one of them being Internal Examiner and the other being External Examiner, both nominated by the Principal from the panel of experts recommended by Chairman, BOS.

The emphasis on the experiments is broadly based on the following criteria:

20 %	To test the preparedness for the experiment.
20 %	To test the performance in the laboratory.
20 %	To test the calculations and graphs related to the concern experiment.
20 %	To test the results and the error analysis of the experiment.
20 %	To test the subject knowledge through viva – voce.

#### Continuous Internal Assessment (CIA):

CIA is conducted for a total of 30 marks (Table 1), with 20 marks for continuous lab assessment during day to day performance, 10 marks for final internal lab assessment.

Table 1: Assessment pattern for CIA

Component	Laboratory		Total Marks
	Day to day performance	Final internal lab assessment	
CIA Marks	20	10	30

#### Continuous Internal Examination (CIE):

One CIE exams shall be conducted at the end of the 16<sup>th</sup> week of the semester. The CIE exam is conducted for 10 marks of 3 hours duration.

Preparation	Performance	Calculations and Graph	Results and Error Analysis	Viva	Total
2	2	2	2	2	10

## VI. HOW PROGRAM OUTCOMES ARE ASSESSED:

Program Outcomes (POs)		Strength	Proficiency assessed by
PO 1	<b>Engineering knowledge:</b> Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	3	Calculations of the observations
PO 2	<b>Problem analysis:</b> Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.	2	Lab related Exercises
PO 4	<b>Conduct investigations of complex problems:</b> Use research- based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.	3	Lab experiments
PO12	<b>Life long learning:</b> Recognize the need for, and have the preparation and ability to engage in independent and life e- long learning in the broadest context of technological change.	2	Mini Projects

**3 = High; 2 = Medium; 1 = Low**

## VII. HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program Specific Outcomes (PSOs)		Strength	Proficiency assessed by
PSO 1	<b>Professional Skills:</b> An ability to understand the basic concepts in Electronics & Communication Engineering and to apply them to various areas, like Electronics, Communications, Signal processing, VLSI, Embedded systems etc., in the design and implementation of complex systems.	2	Lab related Exercises
PSO 2	<b>Problem-Solving Skills:</b> An ability to solve complex Electronics and communication Engineering problems, using latest hardware and software tools, along with analytical skills to arrive cost effective and appropriate solutions.	-	-
PSO 3	<b>Successful Career and Entrepreneurship:</b> An understanding of social-awareness & environmental-wisdom along with ethical responsibility to have a successful career and to sustain passion and zeal for real-world applications using optimal resources as an Entrepreneur.	-	-

**3 = High; 2 = Medium; 1 = Low**

## VIII. COURSE OBJECTIVES( Cos):

The course should enable the students to:	
I	Measure the parameters using microwave components.
II	Analyze the generation and propagation of microwaves in waveguides
III	Evaluate scattering parameters of different microwave junctions.
IV	Determine characteristic parameters of waveguides.

### IX. COURSE LEARNING OUTCOMES (CLOs):

CLO Code	CLO's	At the end of the course, the student will have the ability to:	PO's Mapped	Strength of Mapping
AEC110.01	CLO 1	Understand the Working of different wave guide components in microwave bench setup.	PO 1, PO 2, PO4 , PO12	3
AEC110.02	CLO 2	Measure the frequency of microwave source and obtain te relation between different wave lengths.	PO 1, PO 2, PO4 , PO12	3
AEC110.03	CLO 3	Calculate the different modes and efficiency of a reflex klystron and Verify With Theoretical Efficiency	PO 1, PO 2, PO4, PO12	3
AEC110.04	CLO 4	Measure the V-I Characteristics of Gunn diode.	PO 1, PO 2, PO4, PO12	2
AEC110.05	CLO 5	Measure the Attenuation and insertion loss of fixed and variable attenuator	PO 1, PO 2, PO4, PO12	2
AEC110.06	CLO 6	Measure the different parameters of directional coupler	PO 1, PO 2, PO4, PO12	3
AEC110.07	CLO 7	Determine the impedance by using microwave bench set-up	PO 1, PO 2, PO4, PO12	2
AEC110.08	CLO 8	Calculate the scattering parameters of E-Plane and H-Plane TEE Junction	PO 1, PO 2, PO4, PO12	3
AEC110.09	CLO 9	Measure the low and high V.S.W.R.	PO 1, PO 2, PO4, PO12	2
AEC110.10	CLO 10	Calculate the scattering parameters Magic TEE	PO 1, PO 2, PO4, PO12	2
AEC110.11	CLO 11	Determine the gain and radiation pattern of horn antenna	PO 1, PO 2, PO4, PO12	3
AEC110.12	CLO 12	Measure the insertion and isolation losses	PO 1, PO 2, PO4, PO12	2
AEC110.13	CLO13	Measure the phase shift with the help of microwave bench	PO 1, PO 2, PO4, PO12	3
AEC110.14	CLO14	Measure the insertion and isolation losses of three port circulator	PO 1, PO 2, PO4, PO12	2

3= High; 2 = Medium; 1 = Low

### X. MAPPING COURSE LEARNING OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

Course Learning Outcomes (CLOs)	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CLO 1	3	2		3								3	2		
CLO 2	3	2		3								3	2		
CLO 3	3	2		3								3	2		
CLO 4	2	2		3								2	2		
CLO 5	2	2		3								2	2		
CLO 6	2	3		3								3	2		

Course Learning Outcomes (CLOs)	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CLO 7	2	2		3								2			
CLO 8	3	2		3								3	2		
CLO 9	3	2		3								2	2		
CLO 10	2	2		3								2			
CLO 11	2	3		3								3	2		
CLO 12	2	2		3								3	2		
CLO 13	2	3		3								3	2		
CLO 14	3	2		3								2	2		

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#### IX. ASSESSMENT METHODOLOGIES – DIRECT

CIE Exams	PO1, PO2, PO4, PO12, PSO1	SEE Exams	PO1, PO2, PO4, PO12, PSO1	Assignments	-	Seminars	-
Laboratory Practices	PO1, PO2, PO4, PO12, PSO1	Student Viva	PO1, PO2, PO4, PO12, PSO1	Mini Project	-	Certification	-

#### X. ASSESSMENT METHODOLOGIES - INDIRECT

✓	Early Semester Feedback	✓	End Semester OBE Feedback
✗	Assessment of Mini Projects by Experts		

#### XI. SYLLABUS

LIST OF EXPERIMENTS	
<b>Week-1</b>	<b>STUDY OF MICROWAVE COMPONENTS</b>
To study the different wave guide components in the microwave bench setup.	
<b>Week-2</b>	<b>MEASUREMENT OF FREQUENCY AND GUIDE WAVE LENGTH</b>
To measure the frequency of a microwave source and demonstrate relationship among guide dimensions, free space wavelength and guide wave length	
<b>Week-3</b>	<b>MODE CHARACTERISTICS OF REFLEX KLYSTRON</b>
To study the characteristics of Reflex Klystron oscillator, finding the mode numbers and efficiencies of different modes	
<b>Week-4</b>	<b>GUNN DIODE CHARACTERISTICS</b>

	To study the characteristics of Gunn diode oscillator
<b>Week-5</b>	<b>ATTENUATION MEASUREMENT</b>
	To measure attenuation and insertion loss of a fixed and variable attenuator.
<b>Week-6</b>	<b>DIRECTIONAL COUPLER CHARACTERISTICS</b>
	To measure coupling factor, insertion loss, isolation and directivity of a Directional coupler.
<b>Week-7</b>	<b>MEASUREMENT OF IMPEDANCE OF GIVEN LOAD</b>
	To measure the unknown impedance of given load using bench set up.
<b>Week-8</b>	<b>SCATTERING PARAMETERS OF H-PLANE TEE AND E-PLANE TEE</b>
	To find the scattering parameters of a three port H-Plane Tee And E-PlaneTEE
<b>Week-9</b>	<b>MEASUREMENT OF VSWR</b>
	To measure the low and high VSWR's of matched terminals
<b>Week-10</b>	<b>MEASUREMENT OF SCATTERING PARAMETERS OF MAGIC TEE</b>
	To find the scattering parameters of a four port Magic Tee.
<b>Week-11</b>	<b>CIRCULATOR CHARACTERISTICS</b>
	To measure the isolation and insertion loss of a three port circulator.
<b>Week-12</b>	<b>GAIN AND RADIATION PATTERN OF HORN ANTENNA</b>
	Develop a Hello World application using Google App Engine.
<b>Week-13</b>	<b>MEASUREMENT OF PHASE SHIFT</b>
	To measure the Phase shift between two components in the microwave bench set up.
<b>Week-14</b>	<b>ISOLATOR CHARACTERISTICS</b>
	To measure the isolation and insertion loss of a three port circulator.
<b>Reference Books:</b>	
<ol style="list-style-type: none"> <li>1. Samuel Y. Liao, "Microwave Devices and Circuits", Pearson, 3<sup>rd</sup> Edition, 2003.</li> <li>2. Herbert J. Reich, J.G. Skalnik, P.F. Ordung and H.L.Krauss, "Microwave Principles" , CBS Publishers and Distributors, New Delhi, 1<sup>st</sup> Edition, 2004.</li> <li>3. F.E. Terman, "Electronic and Radio Engineering", Tata McGraw-Hill Publications, 4<sup>th</sup> Edition, 1955.</li> <li>4. Microwave and Radar Engineering – M. Kulkarni, Umesh Publications, 1998.</li> </ol>	
<b>Web References:</b>	
<ol style="list-style-type: none"> <li>1. <a href="http://www.ee.iitkgp.ac.in">http://www.ee.iitkgp.ac.in</a></li> <li>2. <a href="http://www.citchennai.edu.in">http://www.citchennai.edu.in</a></li> </ol>	

## XII. COURSE PLAN:

The course plan is meant as a guideline. Probably there may be changes.

Week No.	Topics to be covered	Course Learning Outcomes (CLOs)	Reference
1	Understand the Working of different wave guide components in microwave bench setup.	CLO 1	R4-7.2
2	Measure the frequency of microwave source and obtain the relation between different wave lengths.	CLO 2	R1-4.1.6-4.1.7
3	Calculate the different modes and efficiency of a reflex klystron and Verify With Theoretical Efficiency	CLO 3	R1-9.4.1
4	Measure the V-I Characteristics of Gunn diode.	CLO 4	R1-7.1-7.3
5	Measure the Attenuation and insertion loss of fixed and variable attenuator	CLO 5	R4-6.4-6.14
6	Measure the different parameters of directional coupler	CLO 6	R4 6.10
7	Determine the impedance by using microwave bench set-up	CLO 7	R4-7.5,7.9
8	Calculate the scattering parameters of E-Plane and H-Plane TEE Junction	CLO 8	R1-4.4,4.5
9	Measure the low and high V.S.W.R.	CLO 9	R4-7.5,7.9
10	Calculate the scattering parameters Magic TEE	CLO 10	R1-4.4,4.5
11	Determine the gain and radiation pattern of horn antenna	CLO 11	R1-2.5
12	Measure the insertion and isolation losses of isolator	CLO 12	R1 4.6
13	Measure the phase shift with the help of microwave bench	CLO 13	R4-7.5,7.9
14	Measure the insertion and isolation losses of three port circulator	CLO 14	R1 4.6

## XIII. GAPS IN THE SYLLABUS - TO MEET INDUSTRY / PROFESSION REQUIREMENTS:

S. No	Description	Proposed actions	Relevance with POs	Relevance with PSOs
1	Study the function of Attenuator (Fixed and Variable type) by measuring the following parameters (a) Input VSWR measurement. (b) Measurement of insertion loss and attenuation.	Seminars / NPTEL	PO 1, PO4, PO12	PSO 1
2	Encourage students to solve real time applications and prepare towards competitive examinations.	NPTEL	PO 1, PO2, PO12	PSO 1

Prepared by:  
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HOD, ECE