



Wardha Road, Nagpur - 441108 Accredited with NAAC **A+** Grade Approved by AICTE, New Delhi, Govt. of Maharashtra (**An Autonomous Institution Affiliated to RTM Nagpur University**)



Department of Electronics and Communication Engineering

Name of Course-Microwave and Radar Engineering Sem/Year-VII SEM/4th Year

Name of Course Coordinator-Prof. Rahul Dhuture

Title of Innovative practices for learning teaching process

Online Collaboration Tools: Virtual Lab Tools

Objective:- Platform that facilitate group work, discussions and information sharing among the students

For Students:-

1. *Interactive Learning:-* Virtual labs offer hands-on experience in a controlled environment, enabling students to interact with equipment, settings, and parameters to observe real-time outcomes.

2.*Concept Reinforcement*: Students can apply theoretical concepts learned in lectures to practical scenarios, reinforcing their understanding of microwave and radar engineering principles.

3. *Risk-Free Experimentation*: Virtual labs eliminate risks associated with real-world equipment handling, allowing students to experiment freely without the fear of damaging expensive equipment.

4. Visual and Spatial Understanding: Complex microwave and radar concepts, such as wave propagation and antenna radiation patterns, can be better understood through visualizations in a virtual lab.

5. *Self-Paced Learning:* Students can repeat experiments as many times as needed, enabling self-paced learning and facilitating a deeper understanding of concepts.





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6. *Exploration of Scenarios:* Virtual labs can simulate scenarios that might be impractical or dangerous in a physical lab setting, enabling students to explore a wider range of conditions.

7. *Instant Feedback:* Virtual labs often provide immediate feedback on students' actions and outcomes, helping them identify and correct mistakes in real-time.

8. *Preparation for Industry:* Familiarity with virtual labs can prepare students for using simulation tools commonly employed in industry for microwave and radar system design and analysis.

9. Collaborative Learning: Virtual labs can support collaborative learning, allowing students to work together on experiments and share insights.

10. *Inclusive Learning:* Virtual labs can cater to diverse learning styles and abilities, ensuring that all students have the opportunity to engage with and understand the subject matter.

For Educators:

- 1. Enhanced Teaching Effectiveness: Virtual labs provide educators with a platform to demonstrate complex microwave and radar concepts more effectively, making it easier to explain abstract theories through interactive simulations.
- **2.** *Scalability*: Virtual labs can accommodate a larger number of students compared to traditional physical labs, allowing educators to reach more learners without concerns about space or equipment limitations.
- 3. *Reduced Costs:* Setting up and maintaining physical labs with expensive microwave and radar equipment can be costly. Virtual labs eliminate the need for purchasing and maintaining physical equipment, thus reducing costs.





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- 4. *Flexibility:* Educators can design and modify virtual lab experiments to suit different learning objectives and adapt to changing curriculum requirements.
- **5.** *Data Collection and Analysis*: Virtual labs often provide tools for data collection and analysis, allowing educators to demonstrate data processing techniques that might be challenging to conduct in a physical lab.
- 6. *Remote Learning:* Virtual labs enable remote access, allowing students to perform experiments from anywhere with an internet connection, even outside traditional classroom hours.

Incorporating virtual labs into microwave and radar engineering education can significantly enrich the learning experience by bridging the gap between theoretical knowledge and practical application.

Program: B.Tech (Microwave and Radar Engineering) Course Name: Microwav e and Radar Engineerin g Course Cordinat or: Prof. Rahul

Dhuture

Course Code: BEETC702PE-T

РО	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	PSO3
CO	Engineering Knowledge	Problem Analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Lifelong learning	To achieve competence in designing, analyzing and testing electronic systems for social, industrial and research application in communication, signal processing and embedded system.	An ability to independently carry out research/investigation and development work to solve practical problems.	To inculcate research attributes and approach through industry oriented internships and projects.
CO 1	1	1	0	1	2	1	0	2	2	3	2	3	2	0	0
CO 2	1	1	0	2	2	2	0	2	3	3	2	3	2	0	0
CO 3	1	1	0	0	3	0	0	3	3	2	3	3	2	0	0
CO 4	2	2	0	3	1	1	0	0	3	3	2	3	2	0	0
CO 5	1	0	0	3	1	0	0	0	2	2	3	3	2	0	0

Semester: VII

CO-PO Mapping





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<u>Study of field pattern of various modes inside a rectangular</u> <u>waveguide cavity.</u>



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Feedback	ennent Freicey Procedure GAC Tutorial Mariaal Federarcais Levi Salipo
क् Aim of Experiment	Study of field pattern of various modes inside a rectangular waveguide Prof. M. J. Assess and Prof. K. V. Stransform
& Requirement	About experiment This superiment provides the field patterns of various modes inside a rectangular waveguide. The conducting walls of th waveguide confine the electromagnetic fields and thereby guide the electromagnetic wave. Hence, a number of distinct the configurations or modes can exist in waveguides. In rectangular waveguide, modes are designated as TB _{min} or TM _{min} . In the exceeded wave see exists the electromagnetization of them the field contents, wave with the parameters m and c for "Transmot
You have to install a Labytew Num lime Engine on your computer to run he following exe file in order to see olds of various modes. The Run Time ingine can be dowloaded free of cost run the following link	Electric (TE) and Transverse Magnetic (TM) modes in xy, ys and its planes for diffient frequency bands. The surface curre density plot for TE ₁₀ mode can also be observed on the walls of the rectangular waveguide. The figure below shows th planes of a rectangular waveguide.
tun time Engine क् References	
Incircul Y.Liao Incircomagnetic Waves and Radiating lystem by Keith O.Balmain	$\widehat{\uparrow} \square \longrightarrow \mathbf{y}$
	In this experiment, a restangular waveguide of dimension x=a and y=b has been considered. The dimensions of th waveguide depend on the frequency band in which we are observing the field pattern. For example, in X Band (8-12GH) the U.S. standard waveguide WH-bohas inner which of 2.286 on (%) and an inner height of 1.106 on (%).



Link for Learning topics from Virtual Lab

1. <u>Measurement of VSWR on a line: http://eem-iitd.vlabs.ac.in/exp1.html</u>



Measurement of VSWR on a line

2. <u>Relationship between guide λ_{g} and λ_{0} :- <u>http://eem-iitd.vlabs.ac.in/exp3.html</u></u>



Relationship between guide λ_g and λ_0

3. <u>Experiment of Microwave Cavity</u>:- <u>http://eem-iitd.vlabs.ac.in/exp4.html</u>



Experiment of Microwave Cavity

3. <u>Microwave Coupler</u>:- <u>http://eem-iitd.vlabs.ac.in/exp5.html</u>



Microwave Coupler

- 4. <u>Radiation Pattern of Horn Antenna</u>:- <u>http://eem-iitd.vlabs.ac.in/exp7.html</u>

Radiation Pattern of Horn Antenna

5. Experiments of Transmission Line <u>:- http://eem-iitd.vlabs.ac.in/exp1.pdf</u>



Experiments of Transmission Line

<u>Quiz</u>

	Virtual Labs - IIT Kanpur RF and Microwave Characterisation Lab
Aim of experiment About expe	ment Theory Procedure Guz Tutorial Manual References Live Support
Aim of Experiment study of field pattern of various	Study of field pattern of various modes inside a rectangular waveguide cavity.
a Requirement	Quiz This includes two sections: Quiz (Pre) and Quiz (Post). Guiz (Pre) is based on the theory of the experiment, student should have this much knowledge before performing the experiment and Quiz (Post) is based on the exe file, this will help the user to oheok the level of his understanding.
ou have to install a LabVIEW Run ime Engine on your computer to run he following exe file in order to reform the experiment. The Run Time	Section 1 : Quis (Pre) Q1. Determine the resonant frequency of an air filled rectangular cavity operating in TE101 mode with dimensions as a+4em, b+3em and d+3em.
ngine can be inventioned the of cost from the following link lun time Engine	a and uses a solution a
Download todes in rectangular waveguide avity.	TE011 TE011 TE101
	O3 Whith component of Electric field is non-zero in a restangular davity operating in TE101mode? 1 Ex Ey Ex and Ey Ex and Ex
	Q4. Consider an air filled restangular cavity with dimensions an6 cm, b=3 cm and d=1 cm. Find the dominant mode for this exercise : TE to 1 TE to 1 TAU 111 TAU 111
	O TM110