INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)
Dundigal - 500 043, Hyderabad, Telangana

COURSE CONTENT

RF and MICROWAVE ANTENNA DESIGN LABORATORY								
VII Semester: ECE								
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
AECD60	**Core**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		0	0	2	1	40	60	100
Contact Classes: Nil	**Tutorial Classes: Nil**	**Practical Classes:45**				**Total Classes:45**		
Prerequisites: Microwave and Radar Engineering								

I. COURSE OVERVIEW:
This course introduces basics of microwaves devices, circuits and passive devices. These are used in the front-end of all telecommunication transmitters and receivers and thus are extensively used in the industry. It involves measurement of frequency, wave length, VSWR, impedance and scattering parameters of various micro wave devices like circulator, directional coupler, and magic-tee. Microwave devices support larger bandwidth and hence higher data rates are transmitted. There are many applications where microwave components function as couplers, filters, power dividers, attenuators, terminators, and more. Also HFSS tool is used to measure the parameters of the antenna like radiation pattern, return loss, gain and VSWR.

II. COURSE OBJECTIVES:
The students will try to learn:

I. The experiments on microwave test equipment to make measurements of microwave parameters and devices.
II. The measurement of S-Parameters of microwave components to gain the practical hands on experience on the microwave test bench.
III. The simulation to plot the radiation pattern for an antenna using High Frequency Software Simulator.

III. COURSE OUTCOMES:
At the end of the course students should be able to:

CO1 Summarize the waveguide components and their specifications using microwave test bench set-up.
CO2 Sketch the characteristics of reflex klystron to obtain the electronic tuning range using klystron bench set up.
CO3 Analyze the characteristics of directional coupler, circulator and magic tee using microwave test bench setup.
CO4 Distinguish the low and high voltage standing wave ratio of unknown load to find out the reflection coefficient using slotted line section.
CO5 Identify fundamental parameters of the antenna to measure far-field radiation pattern using High frequency Structure Simulator.
CO6 Design and measure antenna parameters of modern antenna using software tools.

LIST OF EXPERIMENTS:

WEEK-1: INTRODUCTION TO MICROWAVE BENCH SETUP
To study the different wave guide components in the microwave bench setup.

WEEK-2: REFLEX KLYSTRON CHARACTERISTICS
Plot frequency characteristics of reflex klystron and identify the modes of reflex klystron.

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WEEK-3: DIRECTIONAL COUPLER CHARACTERISTICS
To measure coupling factor, insertion loss, isolation and directivity of a directional coupler.

WEEK-4: MEASUREMENT OF VSWR, FREQUENCY AND UNKNOWN LOAD IMPEDANCE
To measure the incident and reflected power and impedance of unknown load by measuring VSWR.

WEEK-5:MEASUREMENT OF POWER DIVISION IN MAGIC TEE
To measure the isolation coefficient, coupling coefficient and determine the S – matrix of a magic – Tee.

WEEK-6: INTRODUCTION TO HFSS
Introduction to HFSS tool.

WEEK-7: MONOPOLE ANTENNA DESIGN
To create a monopole antenna geometry and analyze the radiation pattern for simple monopole.

WEEK-8: DIPOLE ANTENNA DESIGN
To create dipole antenna geometry, analyze the radiation pattern and measure the gain, impedance and half-power beam width of dipole antenna.

WEEK-9: LOOP ANTENNA DESIGN
To design a loop antenna and analyze the antenna's radiation pattern, gain and bandwidth

WEEK-10: MICROSTRIP FEED ANTENNA DESIGN
To analyze the radiation pattern and measure the gain, impedance and half-power beam width of microstrip feed antenna.

WEEK-11: PROBE FEED PATCH ANTENNA DESIGN
To design a rectangular patch and a probe-fed structure and analyze the antenna's impedance matching, radiation pattern, and bandwidth.

WEEK-12: SLOT COUPLED PATCH ANTENNA
To design a rectangular patch with a slot and analyze the effects of slot dimensions on the antenna's performance.

WEEK-13: RECTANGULAR MICROSTRIP PATCH ANTENNA USING STRIPLINE FEED
To design and simulate rectangular microstrip patch antenna for the frequency 3GHz using stripline feed.

WEEK-14: IMPEDANCE MATCHING FEEDING TECHNIQUES OF PATCH ANTENNA
To design a square patch antenna with a coaxial feed and perform the parametric sweep to find the optimum position of it.

IV. TEXT BOOKS:

1. Samuel Y. Liao, “Microwave Devices and Circuits”, Pearson, 3rd Edition, 2003.
2. Herbert J.Reich, J.G.Skalnik, P.F.Ordungand H.L.Krauss, “Microwave Principles”, CBS Publishers and Distributors, New Delhi, 1st Edition, 2004.
3. M. Kulkarni, “Microwave and radar engineering “, Umesh Publications,5th Edition,2016.
4. Liu xing Nanjing JiangSu, “Ansoft HFSS basic and applied”, 2nd edition, 2009.

V. REFERENCE BOOKS:

1. F.E. Terman, “Electronic and Radio Engineering”, Tata McGraw-Hill Publications, 4th Edition, 1955.
2. John D. Kraus, Ronald J. Marhefka, Ahmad S. Khan, “Antennas and Wave Propagation”, TMH, 4th Edition, 2010.

VI. ELECTRONICS RESOURCES:

1. http://www.ansys.com
2. https://athena.ecs.csus.edu/~milica/EEE212/HAND/HFSSintro.pdf

VII. MATERIALS ONLINE:

1. Course template
2. Lab Manual