BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE, PILANI,
HYDERABAD CAMPUS
Second Semester 2022-2023

Course Handout (Part - II)

Date: 16/01/2023

Course Number : EEE F474
Course Title : Antenna Theory and Design
Instructor-in-Charge : Dr. Harish V. Dixit and Dr. Sourav Nandi

Course Description:

Introduction of Antenna theory; Antenna parameters: Radiation pattern, power density, radiation intensity, beamwidth, Directivity, Antenna Efficiency and Gain etc; Antenna Polarization, Antenna Equivalent circuit, Friis transmission and Radar range equation; Radiation integrals and auxiliary potential functions; Basic radiator; short dipoles, half wave dipoles, Monopole antenna, loop antennas; Antenna Arrays; linear arrays, planar arrays. N-Element Linear Array; Antenna Synthesis: Schelkunoff Polynomial Method, Fourier Transform Method; Traveling wave and Broadband Antennas (Helical and Yagi-Uda antennas); Frequency Independent Antennas (FIA): Spiral antennas and Log-periodic antenna Fractal antennas; Aperture antennas: Huygen's principle, rectangular apertures; Horn Antennas: E-Plane, H-Plane, Pyramidal and conical horn; Microstrip antennas analysis and design; general characteristics, radiation mechanism feeding techniques, rectangular patch.; Q-factor, bandwidth and Efficiency. Input impedance & circular polarization techniques. Patch Antenna arrays; Parabolic Reflector antennas.

Scope and Objective of the Course:

To provide the fundamental knowledge about the antenna design which is the key subject of radar, wireless communication and mobile communication. The main objective of this course is to introduce theory, analysis, design and measurements of antennas. First, the electromagnetic theory is introduced and the fundamental antenna parameters are explained. Classical radiating elements; dipoles/monopoles, loops, apertures, horns, reflectors and modern antennas like microstrip patch antennas (MPAs) and fractal antennas are included to meet the cutting-edge requirement of this field. Considerable special attention is also planned to antennas popular in mobile telecommunications. Antenna simulations through professional software will be taken through seminars.

1. Text Books:

C.A. Balanis, Antenna Theory, Analysis and Design, 3rd ed., John Wiley and Sons 2005.

2. Reference Books:

a) J. D. Kraus and R. J. Marhefka, Antennas, 3rd ed. McGraw-Hill, 2002.

4. Course Plan:

Lec. No.	Topic	Learning Objective	Reference
1 – 2	Introduction to antenna theory	To recall the basics of EM theory to useful to discuss antenna theory	Chapter 1
3 – 4	Antenna parameters: Radiation pattern, power density, radiation intensity, beamwidth, Directivity, Antenna Efficiency and Gain etc.	To describe parameters used to evaluate the properties of antenna.	2.1 – 2.11/Class notes
5 – 6	Antenna Polarization, Antenna Equivalent circuit, Friis transmission and Radar range equation	To derive polarization and Friis transmission equation	2.12 – 2.17/Class notes
7 — 8	Radiation integrals and auxiliary potential functions	To derive potential functions	3.1 – 3.6/Class notes

9 – 13	Basic radiator; short dipoles, half wave dipoles, Monopole antenna, loop antennas	To explain the analysis and parameters of basic radiators	4.1 – 4.3; 4.6 & 5/Class notes
14 – 19	Antenna Arrays; linear arrays, planar arrays. N-Element Linear Array	To describe the various linear antenna arrays	6.1 – 6.5; 6.8/Class notes
20 – 23	Antenna Synthesis: Schelkunoff Polynomial Method, Fourier Transform Method	To learn the conventional antenna synthesis processes	7.1 – 7.4 /Class notes
24 – 26	Traveling wave and Broadband Antennas (Helical and Yagi-Uda antennas)	To discuss important broadband antennas	10.2 – 10.3/Class notes
27 – 29	Frequency Independent Antennas (FIA): Spiral antennas and Log-periodic antenna Fractal antennas	To learn some important types of FIA	11.3 – 11.4, 11.6/Class notes
30 – 31	Aperture antennas: Huygen's principle, rectangular apertures	To explain the Huygen's principle for aperture antennas	12.2, 12.5/Class notes
32 – 34	Horn Antennas: E-Plane, H-Plane, Pyramidal and conical horn	To analyze the performances of horn antennas	Ch 13/Class notes
35 – 37	Microstrip antennas analysis and design; general characteristics, radiation mechanism feeding techniques, rectangular patch.	To explain the theory and radiation mechanism of patch antennas	14.1 – 14.2/Class notes
38 – 40	Q-factor, bandwidth and Efficiency. Input impedance & circular polarization techniques. Patch Antenna arrays	To evaluate the performance of patch antenna on the basis of Q-factor, BW & eff.	14.3 – 14.8/Class notes
41 – 42	Parabolic Reflector antennas	To describe various reflector antennas and their applications	15.4 & 16/Class notes
		Total no. of classes planned	42

***The primary reference for the coverage (breadth and depth)/nomenclature/notations for a particular topic would be as per the lectures. Students are strongly advised to take class notes during the lectures.**

5. Evaluation Scheme :

Component	Duration	Weightage	Marks (200)	Date & Time	Remarks
Mid Term Test	90 min	20%	40	17/03 4.00 - 5.30PM	Closed Book
Assignment		15%	30		Open Book
Regular Lab		25%	50	Regular Lab Performance	Open Book
Comprehensive	3 Hrs	40%	80	18/05 AN	Closed Book

6. Chamber Consultation Hour: To be announced in Class

7. Make-up Policy: Make-up will be given on extremely genuine grounds only. Prior application should be made for seeking the make-up examination. For quizzes and assignments, make-up will not be permitted.

8. Notices: Notices, if any, concerning the course will be put up on CMS only.

9. Academic Honesty and Integrity Policy:

Academic honesty and integrity are to be maintained by all the students throughout the semester and no type of academic dishonesty is acceptable.

Dr. Harish V. Dixit

Dr. Sourav Nandi
Instructor-in-Charge
EEE F474