BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE, PILANI (Rajasthan)
FIRST SEMESTER 2015-2016
Course Handout (Part II)

Date: 02/08/2016

In addition to Part-I (General Handout for all courses appended to the time table) this portion gives further specific details regarding the course.

Course No.	**:**	**EEE F474**
Course Title	**:**	**Antenna Theory and Design**
Instructor-in-charge	**:**	**NAVNEET GUPTA (Chamber No. 2210-H)** (email: ngupta@pilani.bits-pilani.ac.in)

1. 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.

2. Text Book :

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

3. Reference Books :

(i) J. D. Kraus and R. J. Marhefka, *Antennas*, 3rd ed. McGraw-Hill, 2002.
(ii) W. L. Stutzman and G. A. Thiele, *Antenna Theory and Design*, 2nd ed. Wiley, 1998.
(iii) S.J.Orfanidis, *Electromagnetic Waves and Antennas*; Online Book by Reuters Univ., 2005.

4. Course Plan :

Lec. No.	Topic	Learning Objective	Reference
1-2	Introduction to antenna theory, review of Maxwell's equations and electromagnetic wave theory, Smith Chart and impedance matching	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
5-6	Antenna Polarization, Antenna Equivalent circuit, Friis transmission and Radar range equation	To derive polarization and Friis transmission equation	2.12-2.17

7-8	Demonstration of Commercial Software Packages for antenna design; CST and HFSS software tools.	To demonstrate the antenna design software tools	Software Tools
9	Radiation integrals and auxiliary potential functions	To derive potential functions	3.1-3.6
10-12	Basic radiator; short dipoles, half wave dipoles, loop antennas	To explain the analysis and parameters of basic radiators	4.1-4.3; 4.6 and 5
13-17	Antenna Arrays; linear arrays, planar arrays. *N*-Element Linear Array	To describe the various linear antenna arrays	6.1-6.5; 6.8
18-20	Traveling wave and Broadband Antennas (Helical and Yagi-Uda antennas)	To discuss important broadband antennas	10.2-10.3
21-23	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
24-25	Aperture antennas: Huygen's principle, rectangular apertures	To explain the Huygen's principle for aperture antennas	12.2, 12.5
26-28	Horn Antennas: E-Plane, H-Plane, Pyramidal and conical corrugated horn	To analyze the performances of horn antennas	Ch 13
29-32	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
33	Q-factor, bandwidth and Efficiency.	To evaluate the performance of patch antenna on the basis of three figure of merits	14.4
34-35	Antenna Measurement techniques	To measure various antenna properties	Chapter 17
36-40	Overview of advanced antennas structures	To describe the antennas used in latest technologies	Research art./papers

5. Learning outcomes:

After completing this course student shall be able to:

1. Understand important and fundamental antenna engineering parameters and terminology,
2. Learn the basic concepts of electromagnetic wave radiation and reception,
3. Develop the basic skills necessary for designing a wide variety of practical antennas and antenna arrays.
4. Learn and analyze design issues and the necessary trade-offs that are required in complex systems with antenna design as a significant aspect of the overall system design and development.

6. Evaluation Scheme:

Component	Duration	Marks (200)	Weightage	Date & Time	Evaluation type
Mid-Sem Test	90 min	60	30%		Closed Book
Literature Surveys / Research Summaries	--	20	10%	One before & second after mid-sem test	Open Book
Quizzes	10 min	10	5%	Surprize	Closed Book
Seminars/Design Experiments	30 min	30	15%	During Nov. (17^{th} -30^{th})	Open Book
Comprehensive Examination	3 hours	80	40%	12/12/2016 (FN)	(25%) Open + (15%) Closed Book

7. Chamber Consultation Hour: Mon 4:50-5:50 pm

8. Notices: All notices will be put up on EEE Notice Board and on NALANDA.

9. Make-up Examination: Make-up will be given **ONLY** in cases of **sickness (hospitalization)** or **urgency** for going out of station.

Instructor-in-charge
EEE F474