

BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE, PILANI, HYDERABAD CAMPUS
INSTRUCTION DIVISION, FIRST SEMESTER 2016-2017
Course Handout (Part-II)

Date: 01/08/2016

Course No. : ECE F314

Course Title : Electromagnetic Fields and Microwave Engineering

Instructor-in-charge : Dr. Prasant Kumar Pattnaik

Course Description:

Electromagnetic waves; Maxwell's equations; Poynting theorem and wave equations; propagation of EM waves; transmission lines; microstrip lines; wave guides; cavities and antennas; microwave generators, microwave amplifiers; measurement at microwave frequencies.

Scope and objective of the course:

Electromagnetics is one of the most fundamental topics in Electrical Engineering. Maxwell's four simple equations form the basis for almost all phenomena in Electrical and Communication Engineering. Thorough understanding of many areas such as VLSI, PCBs operating at GHz clocks, rotating machines, microwaves and antennas depends upon electromagnetics. The emphasis will be placed on both physical concepts and mathematical equations. An effort will be made to show that electromagnetic is not a dull and dry area with lot of mathematics but something beyond it. The objective of this course is to provide the students with the basic understanding of electromagnetic fields and microwaves. The material covered in this course is basic to the training of electrical engineers.

1. Text Book :

John D. Kraus and Daniel A. Fleisch, "Electromagnetics", 5th ed., McGraw-Hill, New York, 1999.

2. Reference Books :

- i) RB1: Samuel Y. Liao, "Microwave devices and circuits" 3rd ed., PHI 2008.
- ii) RB2: Annapurna Das and Sisir Das, "Microwave Engineering", TMH 2009.
- iii) RB3: David Pozar, "Microwave Engineering", 4th edition, John Wiley & Sons, 2012.
- iv) RB4: J.D Krauss et.al., "Antennas and Wave Propagation", 4th edition, TMH 2010.
- v) RB5: Matthew N.O.Sadiku, "Principles of Electromagnetics" 4th ed. Oxford University Press, New Delhi, 2009.
- vi) RB6: David K.Cheng, "Field and Wave Electromagnetics" 2nd ed. Pearson Education, New Delhi, 2009.
- vii) RB7: EDD Notes: "Smith Chart and its Applications", BITS, Pilani, 2009.

3. Course Plan:

Lec. No.	Topic to be covered	Learning Objective	Ref. To Text Book and Reference Book
1-2	Maxwell's equations, Plane wave propagation in conducting and dielectric	Understand the propagation of waves through space and various kinds of media	4.2-4.6 (TB)

	media		
3-4	Energy relations and Poynting Vector & Wave polarisation	How energy is stored and transmitted by EM wave	4.10-4.12 (TB)
5-6	Reflection & refraction of plane waves	Behaviour of plane waves at the interface between two media	4.7-4.9, 4.14 (TB)
7-8	Transmission lines	Analysis of transmission lines and their circuit behaviour	3.1-3.4 (TB)
9-10	Impedance matching	How to solve transmission line problems using Smith Chart	3.4-3.5 (TB)
11-12	Waveguides	General Wave behaviour along uniform guiding structures, TEM waves, TM waves, TE waves	8.1-8.3 (TB)
13-15	Waveguides	Parallel-plate, Rectangular & Circular waveguides	8.4 (TB) and 4.1-4.2 (RB1)
16	Cavity Resonator	Rectangular cavity resonator and quality factor	8.12 (TB) and 4.3 (RB1)
17-18	Microwave Network theory and Passive Devices	Microwave hybrid circuits, Directional couplers, Circulators and Isolators.	Class notes and 4.4-4.6 (RB1)
19-20	Microstrip Lines & MMIC	Study of microstrip lines	11.1 (RB1)
21-22	Microwave Generators	Introduce the microwave generation concepts with Gunn diode and Klystron tubes	7.1-7.3, 9.1-9.2, 9.4 (RB1) & 9.2, 10.2-10.3 (RB2)
23-25	Microwave amplifiers, Microwave measurements	Types of amplifiers, classes based on operating point, measurements	Class Notes & 13.2-13.17 (RB2)
26-28	Antennas and Antennas Arrays	Antenna parameters, basic antenna elements, Antenna Equivalent circuit, Antenna arrays, Antenna patterns, Tapering etc	5.2-5.3 (TB)
29-30	Dipole antennas	Retarded Potential, Hertzian dipole, Half wave dipole,	5.4-5.9 (TB)
31-32	Different types of Antennas	Small loop antenna, Slot antenna, Horn antenna, Helical antenna and Log periodic antenna	5.4-5.9 (TB)
33-35	Radio wave propagation	Radio link and Friis formula, radar equation, etc.	5.10-5.12 (TB)
36-37	Antenna measurements	To measure antenna ranges, gain, directivity and radiation efficiency of an antenna	19.1-19.6 (RB4)
38-40	Special Topics	RF MEMS, Computational Electromagnetics	Class notes

4. Evaluation Scheme:

Component	Duration	Percentage	Marks	Date & Time	Evaluation type
Test-I	60 min	25 %	75	13/09 & 10:00 to 11:00 A.M	Open Book
Test-II	60 min	25 %	75	21/10 & 10:00 to 11:00 A.M	Closed Book
Assignments	---	10%	30	Take home	Open Book
Compre. Exam.	3 hours	40 %	120	14/12/2016 AN	Closed Book
Total			300		

5. Chamber Consultation Hour: To be announced in the class
email: pkpattnaik@hyderabad.bits-pilani.ac.in

6. Notices: EEE Notice Board and CMS.

7. Make-up Examination:

Makeup for Tests and Comprehensive Examination will be given only in **extremely genuine cases** for which prior permission of the instructor-in-charge is required.

Instructor-in-charge
ECE F314