

EE 372L Engineering Electromagnetics Laboratory

Credits: 1

Categorization of credits: engineering topic

Instructors or course coordinator: Zhengqing Yun

Textbook and Other Required Materials:

Laboratory manual designed for lab

Designation: Elective (required for EP Track students)

Catalog Description: Engineering Electromagnetics Lab (1) (1 3-hr Lab) Virtual and lab experiments illustrating the basic principles of electromagnetics. Pre: 371 and PHYS 274 (or concurrent); or consent. Co-requisite: 372.

Pre-and Co-requisites: EE 371 (Engineering Electromagnetics I) and PHYS 274 (General Physics III). Co-requisite: 372 (Engineering Electromagnetics II)

Class/Lab Schedule: 3 lab hours every other week (9 experiments)

Topics Covered:

- Computer usage and equipment safety education (3 hours)
- Wave fundamentals: transverse, longitudinal, and circular waves (3 hours)
- Plane waves and plane electromagnetic (EM) waves: orthogonality of electric field, magnetic field and the propagation directions (3 hours)
- Polarization of EM waves: linear, circular, and elliptical polarizations (3 hours)
- Phasors (3 hours)
- Plane wave reflection by a PEC plane (3 hours)
- Build a rainbow: Wave reflection and transmission for a spherical water drop. A comprehensive understanding for dispersion, polarization by reflection (Brewster angle), and total reflection (critical angles) (3 consecutive experiments, 9 hours)
- Waves in waveguide and along transmission lines: modes, cut-off frequency (2 consecutive experiments, 6 hours)
- Phase velocity and group velocity (3 hours)
- Wave propagation in urban and indoor environments: application of ray-tracing method in the prediction of path loss; optimization of base station locations to get maximum coverage of wireless communication systems (2 consecutive experiments, 6 hours)

Course Objectives and Their Relationship to Program Objectives:

The student should understand (i) properties of electromagnetic (plane) waves, (ii) the propagation of EM waves in free space and waveguide, (iii) boundary conditions, (iv) the reflection and transmission of EM waves, (v) Brewster and critical angles, (vi) dispersion, and (vii) wave propagation prediction for wireless communication system design. The student should also be able to determine base station locations to obtain best wireless coverage using ray-tracing software. [Program Objectives this course addresses: 1, 2, and 4.]

Course Outcomes and Their Relationship to Program Outcomes:

The following are the course outcomes and the subset of Program Outcomes (numbered 1-7 in square braces "[]") they address:

- Understand different types of waves and the characteristics of EM waves [1]
- Understand the propagation of EM wave in waveguides and urban and indoor environments [1]
- Understand the interference of EM waves and fading effect on wireless communications systems [1, 5]
- Be able to determine locations of base stations to achieve best coverage of wireless communication systems [1, 2, 4]
- Complete laboratory assignments in teams of three students [3, 5]

Contribution of Course to Meeting the Professional Component

Engineering Topics: 100%

Computer Usage:

The course has virtual labs that require use of computers. Students are encouraged to use the Internet for reference searching. Word processing programs are also needed for writing summaries and lab reports. The course has a web site with downloadable course materials and reference links. All lab reports must be typed and data plotted by computer programs such as MS Word, MS Excel, MatLab, etc.

Design Credits and Features:

EE 372L has 0.5 design credits.

Person Preparing Syllabus and Date: Zhengqing Yun, Sept. 29, 2014. Modified by A. Ohta, Jan. 18, 2021.