## Wave Propagation and Antennas

| Code | Credit Hours |
|---|---|
| EE- 344 | 3-1 |

### Course Description

The course introduces the propagation of electromagnetic waves through different media as well as reflection & transmission at normal incidence on an interface between different mediums. Transmission line theory and its applications, Smith Chart. Wave propagation in guided wave structure such as waveguides of rectangular geometries. The course also covers antenna characteristics & its various types.

### Text Book:

Elements of Electromagnetism by Mathew N. O. Sadiku, 7th th Edition, Oxford University Press.

### Reference Books:

1. Fields and Waves in Communication Electronics by Simon Ramo, John R, Whinnery, Theodore Van Duzer, 3rd Ed. John Wiley and Sons Inc.
2. Field and Wave Electromagnetics by David K. Cheng
3. Engineering Electromagnetics by William H. Hayt, Jr. John A. Buck, 6th Ed. McGraw Hill.
4. Antenna Theory Analysis and Design by Constantine A. Balanis, 4th Ed. John Wiley & Sons

### Prerequisites

EE-241 Electromagnetic Field Theory

### ASSESSMENT SYSTEM FOR THEORY

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|---|---|
| Quizzes | 10% |
| Assignments | 10% |
| Mid Terms | 30% |
| ESE | 50% |

### ASSESSMENT SYSTEM FOR LAB

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|---|---|
| **Quizzes** | 10%-15% |
| **Assignments** | 5% - 10% |
| **Lab Work and Report** | 70-80% |
| **Lab ESE/Viva** | 20-30% |

**Teaching Plan**

| Week No | Topics | Learning Outcomes |
|---|---|---|
| 1-5 | Maxwell's Equations and Electromagnetic Wave Propagation | Wave equation and Time harmonic fields, Electromagnetic wave propagation, Plane wave propagation in different media: lossy dielectrics, lossless dielectrics, free space and good conductors, polarization of plane waves, Poynting vector, reflection of a plane wave. |
| 6-8, 10 | Transmission Lines | General transmission line equations, wave characteristics on an infinite transmission line, transmission line parameters, wave characteristics on finite transmission lines, input impedance and SWR, Smith Chart, transmission line impedance matching, quarter wave transformer , single stub matching |
| 9 | **MID TERM EXAM** | |
| 11-13 | Waveguides | Wave propagation in rectangular waveguides, TE and TM modes of rectangular waveguides, cut off frequency, power transmission |
| 14-17 | Antennas | Types of antennas, radiation mechanism, fundamental parameters of antennas, radiation from wire antennas: various forms of dipole and small loop, array antennas |
| 18 | **End Semester Exams** | |

## Practical:

| Experiment No | Description |
|---|---|
| 1 | Familiarization with antenna trainer |
| 2 | Study of antenna polarization, axial ratio and tilt angle of a circularly polarized antenna. |
| 3 | Study of dipole antenna and its radiation pattern. |
| 4 | Study of horn antenna and its radiation pattern. |
| 5 | Study of slotted line and measurement of wavelength and frequency. |
| 6 | Measurement of VSWR using slotted line. |
| 7 | Measurement of the gain of horn antenna using method of two antennas. |
| 8 | Introduction to Ansys HFSS: Coaxial Cable |
| 9 | HFSS Simulation: Coaxial Tee |
| 10 | HFSS Simulation: Basics of Waveguide |
| 11 | HFSS Simulation: Waveguide Tee |
| 12 | HFSS Simulation: Dipole Antenna |
| 13 | OEL1 |
| 14 | OEL2 |