
1. Course Profile:

Course Syllabus for ETE-317

1. Title: Antenna and Propagation

2. Credits: 3 (3 lectures of 50 minutes per week)

Session: 2018-19

3. Course Teacher: Dr. Md Azad Hossain, Associate Professor, Dept. of ETE, CUET
and Eftekhar Hossain, Lecturer, Dept. of ETE, CUET.

4. Learning Resources:

Textbook Reference:

1. Constantine A. Balanis, -- Antenna Theory Analysis and Design, Second Edition

2. K.D Prasad,-- Antenna and Wave Propagation

5. Course Syllabus: Fundamental of Antennas: Radiation Mechanism, Radiation Patterns, Lobes, Power Density and Intensity, Directive Gain and Directivity, Power Gain, Bandwidths, Radiation Efficiency, Input Impedance, Effective Aperture and Antenna Temperature. Vector Potential Functions, Electric and Magnetic Fields for Electric and Magnetic Current Sources, Solution of Vector Potential Wave Equation, Duality, Reciprocity and Reaction Theorems.

Linear Wire and Loop Antennas: Infinitesimal, Small, Finite Length and Half-wave Length Dipoles, Determination of Radiation Fields, Radiation Patterns, Radiation Resistance, Directivity and Input Impedance of Dipoles, Mutual Impedance Between Linear Elements Near Infinite Planes Conductors and Ground Effects. Circular, Square, Triangular, Rectangular, Rhombic and Ferrite Loop Antennas. Cylindrical Dipole, Folded Dipole, Matching Techniques, Balun Transformers.

Antenna Arrays: Two-Element Array, N-element Linear Arrays; Broad-side, End-fire, Phased, Binomial, Dolph-Tchebyschef and Super-directive Arrays, Determination of Array Factor and Patterns, Planar and Circular Arrays.

Planner Antenna: Types of planner antenna, microstrip patch antenna, FIFA, FILA.

Travelling-Wave and Broad-band Antennas: Long wire, V, Rhombic and Helical Antennas, Yagi, Uda array, Frequency Independent and Log-periodic Antennas.

Aperture, Reflector and Lens antenna: Huygen's principle, rectangular and circular apertures, micro strip antennas.

Babinet's Principle, Sectoral, Pyramidal and Conical Horns, Parabolic and Cassegrain Reflector Antennas, Lens Antennas.

6. Prerequisite(s): Electromagnetic Waves, Microwave Engineering

7. Course Designation as Elective or Required: Required

8. Course Objectives:

- (a) Introduce with the fundamentals of antenna theory, covering their principles of radiation, their basic parameters, their general types, and those commonly used in wireless systems.
- (b) Provide a profound knowledge about the procedures of link budget analysis and propagation calculations.
- (c) Acquainted with various types of antennas designing procedures and their characteristics.
- (d) Comprehend and apply different methods of analysis on different categories of antennas.

9. Student Learning Outcomes: After successfully completing the course with a grade of D (2.0/4.0) or better, the student should be able to do the following

No.	Course Learning Outcomes (CLOs)	POs#
1	Identify basic antenna parameters and apply the fundamentals of antenna theory in wireless system design.	1
2	Perform link budget calculations to analyze wireless transmit-receive systems	3
3	Design and analyze various types antennas including wire, aperture, array antennas, frequency independent antennas and so on.	2

10. Program Outcomes Addressed: 1, 2 and 3.

CLO#	Program Outcome (PO)	PO#
1	Apply knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems	1
2	Identify, formulate, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences	2
3	Design solutions for complex engineering problems and design systems, components or processes that meet specified needs with appropriate consideration for public health and safety, cultural, societal, and environmental considerations	3

11. Assessment Strategy: According to the Undergraduate Academic Rule of the University

Class Tests/Assignments/ Projects:	20%
Attendance:	10 %
Term final :	70%

Lesson Plan

with

Lesson Learning Outcomes (LLOs)

	Topic	Lesson Learning Outcomes (at the end of the lesson students will be able to ...)	Teaching-Learning Methodology	Assessment Method
Lesson-01	Overview of the course	<ul style="list-style-type: none"> Summarize the objectives and outcomes of the course 	Lecture with whiteboard	Not applicable
Lesson-02	An Overview of the Electromagnetics Theory	<ul style="list-style-type: none"> Describe the core concepts and theories of Electromagnetics i.e. Maxwell equations, Poynting Theorem and so on. 	Lecture with whiteboard	Test, exams, quiz, etc
Lesson-03	An Overview of the Microwave Theory	<ul style="list-style-type: none"> Describe the core concepts of transmission line i.e. reflection and transmission coefficients, standing wave, VSWR and so on. 	Lecture with whiteboard	Test, exams, quiz, etc
Lesson-04	Introduction to Antenna [1]	<ul style="list-style-type: none"> Describe the Principles of and Antenna Explain the impact of an Antenna Impedance 	Lecture with whiteboard	Test, exams, quiz, etc
Lesson-05	Single Wire Antenna [1]	<ul style="list-style-type: none"> Describe the working principle of a single wire antenna Explain mathematical expression of a single wire antenna 	Lecture with whiteboard	Test, exams, quiz, etc
Lesson-06	Two Wire Antenna [1]	<ul style="list-style-type: none"> Explain the principles of two wire antenna. Describe different types of antenna. 	Lecture with whiteboard	Assignment
Lesson-07	Dipole Antenna and current distribution [1]	<ul style="list-style-type: none"> Describe Dipole Antenna Describe about the current distribution on a thin wire. 	Lecture with whiteboard	Test, exams, quiz, etc

Lesson-09	Antenna Radiation Pattern [1]	<ul style="list-style-type: none"> Describe antenna radiation pattern and various types antenna beamwidth. 	Lecture with whiteboard	Test, exams, quiz etc.
Lesson-10 & 11	Radiation density, Field Regions and Radiation Intensity [1]	<ul style="list-style-type: none"> Mathematically explain radiation density and radiation intensity Describe different antenna field regions and their implications 	Lecture with whiteboard	Test, exams, quiz, etc
Lesson-12	Antenna Directivity [1]	<ul style="list-style-type: none"> Explain the relation between directivity and radiation intensity 	Lecture with whiteboard	Test, exams, quiz, etc
Lesson-13	Beam Solid Angle and Beam Efficiency [1]	<ul style="list-style-type: none"> Describe directivity in terms of beam solid angle Problem solving 	Lecture with whiteboard	Test, exams, quiz, etc
Lesson-14 & 15	Antenna Gain and Efficiency [1]	<ul style="list-style-type: none"> Explain the interpretation of antenna efficiency Describe the relation between gain, absolute gain, directivity Problem solving 	Lecture with whiteboard	Test, exams, quiz, etc
Lesson-16	Polarization [1]	<ul style="list-style-type: none"> Describe different types of antenna polarization 	Lecture with whiteboard	Test, exams, quiz, etc
Lesson-17 & 18	Polarization Loss Factor, Scattering Parameter, Axial Ratio [1]	<ul style="list-style-type: none"> Explain the importance of PLF Define Axial Ratio Describe the relation between bandwidth, VSWR, axial ratio. 	Lecture with whiteboard	Test, exams, quiz, etc
Lesson-19	Antenna Impedance [1]	<ul style="list-style-type: none"> Describe the relation between transferred power and antenna impedance in both transmitting and receiving mode. 	Lecture with whiteboard	Assignment
Lesson-20	Antenna Radiation Efficiency and Vector Effective Length [1]	<ul style="list-style-type: none"> Explain antenna radiation efficiency Describe the relation between vector effective area and impinges electric field 	Lecture with whiteboard	Assignment
Lesson-21	Antenna Equivalent Area [1]	<ul style="list-style-type: none"> Explain different antenna equivalent areas 	Lecture with whiteboard	Test, exams, quiz, etc
Lesson-22 & 23	Directivity and Effective area [1]	<ul style="list-style-type: none"> Describe the relation between maximum directivity and maximum effective area Describe duality principle 	Lecture with whiteboard	Test, exams, quiz, etc
Lesson-24	Fries Transmission Formula [1]	<ul style="list-style-type: none"> Explain the relation between two antennas using Fries transmission line equation Problem Solving 	Lecture with whiteboard	Test, exams, quiz, assignments, etc

Lesson-25	Antenna Temperature [1]	<ul style="list-style-type: none"> Describe the relation between antenna received power and antenna temperature. 	Lecture with whiteboard	Test, exams, quiz, etc
Lesson-26	Radiation Integrals [1]	<ul style="list-style-type: none"> Explain the way of computing radiated fields from electric and magnetic sources. 	Lecture with whiteboard	Test, exams, quiz, etc
Lesson-27	Vector Potential for Current Source and Magnetic Source [1]	<ul style="list-style-type: none"> Describe the relation of vector potential for a current source J and a magnetic source M. 	Lecture with whiteboard	Test, exams, quiz, etc
Lesson-28	Inhomogeneous Vector Potential Wave Equation [1]	<ul style="list-style-type: none"> Explain the solution of the inhomogeneous vector potential wave equation 	Lecture with whiteboard	Test, exams, quiz, etc
Lesson-29 & 30	Reciprocity and Reaction Theorems [1]	<ul style="list-style-type: none"> Describe Reciprocity and Reaction theorem. Explain Reciprocity for two antennas 	Lecture with whiteboard	Test, exams, quiz, etc
Lesson-31	Antenna Array [2]	<ul style="list-style-type: none"> Explain the design procedures of an array antenna Compare broadside, end fire and colinear array antenna 	Lecture with whiteboard	Test, exams, quiz, etc
Lesson-32	Microstrip Antenna [2]	<ul style="list-style-type: none"> Describe design procedures of microstrip patch antennas Explain Feeding methods patch antenna 	Lecture with whiteboard	Test, exams, quiz, etc
Lesson-33	Yagi Uda Antenna [2]	<ul style="list-style-type: none"> Design procedures of Yagi Uda Antenna 	Lecture with whiteboard	Test, exams, quiz, etc
Lesson-34	V Antenna and Rhombic Antenna [2]	<ul style="list-style-type: none"> Describe the design of a V and Rhombic Antenna 	Lecture with whiteboard	Test, exams, quiz, etc
Lesson-35 & 36	Loop Antenna and Folded Dipole Antenna [2]	<ul style="list-style-type: none"> Explain the designing steps of a loop and folded dipole antenna. 	Lecture with whiteboard	Test, exams, quiz, etc
Lesson-37	Slot Antenna and Horn Antenna [2]	<ul style="list-style-type: none"> Design of a slot antenna Explain the construction of a horn antenna 	Lecture with whiteboard	Test, exams, quiz, etc
Lesson-38	Log Periodic Antenna [2]	<ul style="list-style-type: none"> Explain the construction of a log periodic antenna 	Lecture with whiteboard	Assignment
Lesson-39	Makeup classes	<ul style="list-style-type: none"> Review of the course 		Test, exams, quiz, etc