

# ELEN426 16

**STUDENT WARNING:** This course syllabus is from a previous semester archive and serves only as a preparatory reference. Please use this syllabus as a reference only until the professor opens the classroom and you have access to the updated course syllabus. Please do NOT purchase any books or start any work based on this syllabus; this syllabus may NOT be the one that your individual instructor uses for a course that has not yet started. If you need to verify course textbooks, please refer to the online course description through your student portal. This syllabus is proprietary material of APUS.

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## Course Summary

**Course :** ELEN426 **Title :** Antennas-Theory and Applications

**Length of Course :** 16

**Prerequisites :** ELEN420 **Credit Hours :** 3

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## Description

**Course Description:** This course is an in-depth coverage of the basic properties of antenna theory, analysis, and design. Topics covered include radiation patterns; antenna gain and directivity; antenna main lobe and side lobe levels and shaping; system losses; and antenna impedances. Different types of antennas including linear dipoles; horns; slot antennas; and linear and planar array antennas will be examined. Students will be introduced to numerical methods for analysis and modeling as well as the effects of RF frequency on antenna design. NOTE: This course requires the student to purchase additional materials that are not covered by the book grant. Please refer to the Course Materials section for additional details. (Prerequisite: ELEN420)

### Course Scope:

At the end of this course you will have an understanding of the basic properties and fundamentals of antenna theory and design.

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## Objectives

After completing the course, the student should be able to accomplish these Learning Objectives (LO):

1. Demonstrate an understanding of antenna theory.
  2. Compare and contrast the radiation patterns of dipoles, loops, helices, horns, slots, and patch antennas.
  3. Explain the operational concepts of both linear and planar array antennas.
  4. Assess various antenna structures and components and be able to isolate individual blocks.
  5. Given a series of key parameters, choose the correct type of antenna for a specific requirement.
  6. Design an antenna circuit to solve a specific problem or requirement.
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## Outline

**Week 1: Introductions, Far-Field Integrals, Reciprocity, Directivity**

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Learning Objective(s)

Electrostatics and Magnetostatics in Free Space,  
Dielectric, Magnetic, and Conductive Materials,  
Time-Varying Fields,  
Retarded Potential Functions,  
Poynting's Theorem,  
Stratton-Chu Solution,  
Conditions at Infinity,  
Field Values in the Excluded Regions,  
Type I Antennas,  
The Schelkunoff Equivalence Principle,  
Type II Antennas,  
The Reciprocity Theorem,  
Equivalence of the Transmitting and Receiving Patterns,  
Directivity and Gain,  
Receiving Cross Section,  
Polarization of the Electric Field.

(LO-1)

Readings

Chapter 1

Assignment(s)

Homework assignment due end of week

**Week 2: Radiation Patterns of Dipoles, Loops, and Helices**

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Learning Objective(s)

Center-Fed Dipole,  
Images in a Ground Plane,  
Monopole Above a Ground Plane,  
A Dipole in Front of a Ground Plane,  
Small Current Loop,  
Traveling Wave Current on a Loop,

End-Fire Helix.

(LO-1, LO-2)

Readings

Chapter 2

Assignment(s)

Homework assignment due end of week

### **Week 3: Radiation Patterns of Horns, Slots and Patch Antennas**

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Learning Objective(s)

Open-Ended Waveguide,

Radiation from Horns,

Center-Fed Slot in Large Ground Plane,

Waveguide-Fed Slots,

Theory of Waveguide-Fed Slot Radiators,

Patch Antennas

(LO-1, LO-2, LO-4)

Readings

Chapter 3

Assignment(s)

Homework assignment due end of week

### **Week 4: Linear Arrays: Analysis.**

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Learning Objective(s)

Pattern Formulas for Arrays with Arbitrary Element Positions,

Linear Arrays: Preliminaries,

Schelkunoff's Unit Circle Representation.

(LO-1, LO-4)

Readings

Chapter 4

Assignment(s)

Homework assignment due end of week

### **Week 5: Exam review, catch-up, Exam 1**

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Learning Objective(s)

None

Readings

None

Assignment(s)

Exam 1

### **Week 6: Review Exam, Linear Arrays: Synthesis**

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Learning Objective(s)

Sum and Difference Patterns,

Dolph-Chebyshev Synthesis of Sum Patterns,

Sum Pattern Beamwidth of Linear Arrays,

Peak Directivity of the Sum Pattern of a Linear Array,

Relation Between Beamwidth and Peak Directivity for Linear Arrays.

(LO-1, LO-3)

Readings

Chapter 5

Assignment(s)

Homework assignment due end of week

### **Week 7: Linear Arrays: Synthesis (cont.)**

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Learning Objective(s)

Taylor Synthesis of Sum Patterns,

Modified Taylor Patterns,

Sum Patterns with Arbitrary Side Lobe Topography,

Discretization of a Continuous Line Source Distribution,

Bayliss Synthesis of Difference Patterns,

Difference Patterns with Arbitrary Side Lobe Topography,

Discretization Applied to Difference Patterns,

Design of Linear Arrays to Produce Null-Free Patterns.

(LO-1, LO-2, LO-3)

Readings

Chapter 5 (cont.)

Assignment(s)

Homework assignment due end of week

### **Week 8: Planar Arrays: Analysis and Synthesis**

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Learning Objective(s)

Rectangular Grid Arrays,

Circular Taylor Patterns,

Modified Circular Taylor Patterns,

Sampling Generalized Taylor Distributions,

Improved Discretizing Technique.

(LO-2, LO-3, LO-5)

Readings

Chapter 6

Assignment(s)

Homework assignment due end of week

### **Week 9: Planar Arrays: Analysis and Synthesis (cont.)**

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Learning Objective(s)

Rectangular Grid Arrays,

Circular Bayliss Patterns,

Discretizing Technique Applied to Planar Arrays,

Separable and Nonseparable Excitations,

Fourier Integral Representation.

(LO-3, LO-4, LO-5)

Readings

Chapter 6 (cont.)

Assignment(s)

Homework assignment due end of week

### **Week 10: Self-Impedance and Mutual Impedance of Antenna Elements**

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Learning Objective(s)

Current Distribution on an Antenna,  
Cylindrical Dipole,  
Method of Moments,  
Solution of Hallén's Integral Equation.

(LO-1, LO-3, LO-4)

Readings

Chapter 7

Assignment(s)

Homework assignment due end of week

### **Week 11: Homework assignment due end of week**

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Learning Objective(s)

Self-Impedance of Center-Fed Cylindrical Dipoles,

Self-Impedance of Center-Fed Strip Dipoles,

The Exact Field of a Dipole,

Mutual Impedance,

Center-Fed Slots in a Large Ground Plane,

Self-Impedance of a Patch Antenna.

(LO-3)

Readings

Chapter 7 (cont.)

Assignment(s)

Homework assignment due end of week

### **Week 12: Exam Review, Review Exam**

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Learning Objective(s)

None

Readings

None

Assignment(s)

### **Exam 2**

### **Week 13: Design of Feeding Structures for Antenna Elements and Arrays**

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Learning Objective(s)

Coaxially Fed Monopole,

Balun-Fed Dipole,

Two-Wire-Fed Slots,

Coaxially Fed Helix,

Endfire Dipole Array,

Yagi-Uda Type Dipole Arrays,

Frequency-Independent Antennas,

Ground Plane Backed Dipole Arrays,

Scanning Array,

Waveguide-Fed Slot Arrays.

(LO-2, LO-3, LO-5, LO-6)

Readings

Chapter 8

Assignment(s)

Homework assignment due end of week

### **Week 14: Traveling Wave Antennas**

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Learning Objective(s)

Long Wire Antenna,

Rhombic and Vee-Antennas,

Dielectric-Clad Planar Conductors,

Corrugated Planar Conductors,

Surface Wave Excitation and Antennas,

Fast Wave Antennas,

Trough Waveguide Antennas.

(LO-2, LO-3, LO-5, LO-6)

Readings

Chapter 9

Assignment(s)

Homework assignment due end of week

## Week 15: Reflectors and Lenses

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Learning Objective(s)

Geometrical Optics,

Simple Reflectors,

Aperture Blockage,

Shaped Cylindrical Reflector,

Doubly Curved Reflector,

Radiation Patterns of Reflector Antennas,

Dual Shaped Reflector Systems,

Single Surface Dielectric Lenses,

Stepped Lenses,

Surface Mismatch, Frequency Sensitivity and Dielectric Loss.

(LO-4, LO-5, LO-6)

Readings

Chapter 10

Assignment(s)

Homework assignment due end of week

## Week 16: Catch-Up and Wrap Up

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Learning Objective(s)

None

Readings

None

Assignment(s)

Week 16 forum

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## Evaluation

**Instructor announcements:** Weekly announcements will appear on Monday of each week in the online classroom. This announcement will also be e-mailed to each student. The announcement will discuss the assignments for the week along with any other pertinent information for the week.

This is an upper-level course; all students' work is to be presented as such in terms of quality and content. The grading system will be based on your participation in the forums (20% of your total grade), twelve homework assignments (180 points or 30% of your grade), and three exams (50% of your grade).



**Reading Assignments:** Please refer to the Course Outline section of this syllabus for the weekly reading assignments.

**Week 1 Introductions:** Within 7 days of course start, each student must log into the classroom and introduce yourself to the class. This is a required assignment and your introduction is due by Sunday of Week 1. Your response must be 250-300 words (a requirement) and include the following information.

- a. Your name
- b. Your university major or program
- c. Where you are in the program of study
- d. Your academic goals, to include why you are taking this class
- e. Information that you would like to share about yourself

**Weekly Forums:** The weekly discussion forum is for students to post their questions on course content for that week. This forum should not be used to discuss specific test questions prior to receiving feedback from the instructor (after the test is graded). If there is a question on a specific question, find a similar problem in the book and ask a question on that problem or concept. Asking specific questions on test questions creates an unfair advantage and defeats the purpose of the assessment tool. Specific topics will occur throughout the course and will require critical thought/research for your input – be sure to keep up with ongoing discussions! Discussion Board posting are graded at the end of the session and will constitute 20% of your final grade,

**Weekly Assignments:** There will be thirteen weekly assignments during the course worth a total of 30% of your total grade. Each weekly assignment will cover one or more chapters in the book used in this course. For all problems requiring mathematical calculations, all work must be shown.

**Exams:** There will be two exams worth 40% of your final grade. Each exam will be worth 100 points each. Exams will be open book, open note tests. Exams will be administered without a proctor. Students must complete the numbered exam by the end of the week indicated in the schedule.

**Grading:**

Name	Grade %
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## Materials

**Book Title:** Antenna Theory: Analysis and Design, 3rd ed - e-book available in the APUS Online Library

**Author:** Balanis

**Publication Info:** Wiley Lib

**ISBN:** 9780471667827

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**Book Title:** To find the library e-book(s) req'd for your course, please visit <http://apus.libguides.com/er.php> to locate the eReserve by course #.

**Author:** No Author Specified

**Publication Info:**

**ISBN:** N/A

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## Course Guidelines

## Citation and Reference Style

- Attention Please: Students will follow the APA Format as the sole citation and reference style used in written work submitted as part of coursework to the University. Assignments completed in a narrative essay or composition format must follow the citation style cited in the APA Format.

## Tutoring

- [Tutor.com](https://www.tutor.com) offers online homework help and learning resources by connecting students to certified tutors for one-on-one help. AMU and APU students are eligible for 10 free hours\* of tutoring provided by APUS. Tutors are available 24/7 unless otherwise noted. Tutor.com also has a SkillCenter Resource Library offering educational resources, worksheets, videos, websites and career help. Accessing these resources does not count against tutoring hours and is also available 24/7. Please visit the APUS Library and search for 'Tutor' to create an account.

## Late Assignments

- Students are expected to submit classroom assignments by the posted due date and to complete the course according to the published class schedule. The due date for each assignment is listed under each Assignment.
- Generally speaking, late work may result in a deduction up to 15% of the grade for each day late, not to exceed 5 days.
- As a working adult I know your time is limited and often out of your control. Faculty may be more flexible if they know ahead of time of any potential late assignments.

## Turn It In

- Faculty may require assignments be submitted to Turnitin.com. Turnitin.com will analyze a paper and report instances of potential plagiarism for the student to edit before submitting it for a grade. In some cases professors may require students to use Turnitin.com. This is automatically processed through the Assignments area of the course.

## Academic Dishonesty

- Academic Dishonesty incorporates more than plagiarism, which is using the work of others without citation. Academic dishonesty includes any use of content purchased or retrieved from web services such as CourseHero.com. Additionally, allowing your work to be placed on such web services is academic dishonesty, as it is enabling the dishonesty of others. The copy and pasting of content from any web page, without citation as a direct quote, is academic dishonesty. When in doubt, do not copy/paste, and always cite.

## Submission Guidelines

- Some assignments may have very specific requirements for formatting (such as font, margins, etc) and submission file type (such as .docx, .pdf, etc) See the assignment instructions for details. In general, standard file types such as those associated with Microsoft Office are preferred, unless otherwise specified.

## Disclaimer Statement

- Course content may vary from the outline to meet the needs of this particular group.

## Communicating on the Forum

- Forums are the heart of the interaction in this course. The more engaged and lively the exchanges, the more interesting and fun the course will be. Only substantive comments will receive credit. Although there is a final posting time after which the instructor will grade comments, it is not sufficient to wait until the last day to contribute your comments/questions on the forum. The purpose of the forums is to

actively participate in an on-going discussion about the assigned content.

- “Substantive” means comments that contribute something new and hopefully important to the discussion. Thus a message that simply says “I agree” is not substantive. A substantive comment contributes a new idea or perspective, a good follow-up question to a point made, offers a response to a question, provides an example or illustration of a key point, points out an inconsistency in an argument, etc.
- As a class, if we run into conflicting view points, we must respect each individual's own opinion. Hateful and hurtful comments towards other individuals, students, groups, peoples, and/or societies will not be tolerated.

## Identity Verification & Live Proctoring

- Faculty may require students to provide proof of identity when submitting assignments or completing assessments in this course. Verification may be in the form of a photograph and/or video of the student's face together with a valid photo ID, depending on the assignment format.
- Faculty may require live proctoring when completing assessments in this course. Proctoring may include identity verification and continuous monitoring of the student by webcam and microphone during testing.

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## University Policies

### [Student Handbook](#)

- [Drop/Withdrawal policy](#)
- [Extension Requests](#)
- [Academic Probation](#)
- [Appeals](#)
- [Disability Accommodations](#)

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