

**Department of Electrical Engineering**  
**College of Engineering and Applied Sciences**  
**Arizona State University**

**EEE 443/591 Antennas for Wireless Communications 3 hours rec.**

Prerequisites: **EEE 341 or equivalent**

Text: **Antenna Theory: Analysis and Design** (3<sup>rd</sup> Edition, 2005) by C. A. Balanis

Reference **Microwave Antenna Theory and Design** by S. Silver  
Books: **Antennas** by J. D. Kraus and R. J. Marhefka  
**Antenna Theory and Design** by W. L. Stutzman and G. A. Thiele  
**Antenna Theory and Design** by R. S. Elliott

**Syllabus:**

The course introduces the fundamental principles of antenna theory and applies them to particular antennas for *wireless* communications systems and other *advanced antenna systems*. In addition, the course develops appreciation for research issues of antennas for mobile wireless and advanced communications systems.

Particular topics covered are: Introduction and examples of wireless communications; overview of wireless communications systems; antenna types; fundamental parameters of antennas; engineering principles; radiation integrals; linear wire antennas; loops; arrays; smart/intelligent/adaptive antennas; numerical computations; measurements.

**OUTLINE**

<b>TOPIC</b>	<b>Approximate number of 75-minute periods</b>
<b>I. Introduction to Antennas for Wireless Communications</b>	<b>1</b>
<b>II. Overview of Wireless Communications Systems</b>	
a. Basic communication system	
b. Propagation channel	
c. Wired vs. wireless	
d. Basic components	
e. Information transfer	
f. Modulation and demodulation	
g. Spectrum sharing schemes (FDMA, TDMA, CDMA, SDMA)	
h. Impediments of high-performance (path loss, shadowing, multipath)	
i. Smart antennas	

(continued)

<b>III. Antennas</b>	<b>1</b>
a. Types of antennas	
b. Radiation mechanism	
c. Current distribution	
d. Historical advancement	
<b>IV. Fundamental Parameters of Antennas</b>	<b>6</b>
a. Antenna	
b. Radiation mechanism	
c. Radiation pattern	
d. Radiation intensity	
e. Directivity	
f. Gain	
g. Efficiency, beamwidth, and bandwidth	
h. Polarization	
i. Impedance	
j. Antenna as an aperture	
<b>Test 1</b>	<b>1</b>
<b>V. Radiation Integrals</b>	<b>1</b>
a. Vector potential <b>A</b>	
b. Vector potential <b>F</b>	
c. Far-field radiation	
d. Duality, reciprocity, and reaction theorem	
<b>VI. Wire Antennas</b>	<b>5</b>
a. Short wire	
b. Finite length dipole	
c. Ground effects	
<b>VII. Loop Antennas</b>	<b>2</b>
a. Small circular loop	
b. Large circular loop	
c. Ground effects	
d. Polygonal loops	
<b>Test 2</b>	<b>1</b>
<b>VIII. Arrays</b>	<b>6</b>
a. Linear array	
1. Broadside	
2. Endfire	
3. Scanning	
4. Binomial	
5. Dolph-Tchebyscheff	
b. Planar array	
c. Circular array	

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d. Designs	
1. Dolph-Tschebyscheff	
2. Yagi-Uda	
3. Log-Periodic	
d. Smart/Intelligent/Adaptive Antennas	
<b>IX. Synthesis Methods-Overview</b>	<b>1</b>
<b>X. Microstrip Antennas</b>	<b>2</b>
<b>XI. Smart Antennas/Adaptive Arrays</b>	<b>1</b>
<b>XII. Measurements</b>	<b>1</b>
a. Antenna ranges	
b. Radiation patterns	
c. Gain measurements	
d. Directivity	
e. Polarization measurements	

### **Final Exam**

*University Academic Integrity Policy (AIP)* refers to each student's obligation to act with honesty and integrity and to respect the rights of others in carrying out all academic assignments. Violations of the University AIP will not be ignored. Penalties include reduced or no credit for submitted work, a failing grade in the class, a note on your official transcript that shows you were punished for cheating, suspension, expulsion and revocation of already awarded degrees. The University requires that should I implement any penalty for violations of the academic integrity policy, I must report the matter to the Dean's office. The University has a Student Academic Integrity Policy, which will be followed in EEE 443/591.

*January 10, 2009*