

# Arizona State University

## School of Electrical, Computer and Energy Engineering

### EEE 541

#### Electromagnetic Fields and Guided Waves - 3 hour rec.

<http://balanis.faculty.asu.edu/EEE541>

**Prerequisites:** EEE 341 or equivalent

**Text:** Advanced Engineering Electromagnetics (2<sup>nd</sup> edition, 2012) by C. A. Balanis

**Reference Books:** Time-Harmonic Electromagnetic Fields by R. F. Harrington  
Fields and Waves in Communication Electronics by S. Ramo,  
J.R. Whinnery, and T. Van Duzer  
Field and Wave Electromagnetics by D. K. Cheng  
Electromagnetics by J. D. Kraus

**Course Syllabus:** Polarization and magnetization; dielectric, conducting, anisotropic, and semiconducting media, duality, uniqueness and image theory; plane wave functions, waveguides, resonators, and surface guided waves.

	Approximate Number of 75-Minute Periods	
I.	<b>Fundamental Concepts</b>	2
	a. Maxwell's Equations	
	b. Constitutive Parameters and Relations	
	c. Circuit-Field Relations	
	d. Boundary Conditions	
	e. Power and Energy	
	f. Time-Harmonic EM Fields	
II.	<b>Electrical Properties of Matter</b>	4
	a. Dielectrics, Polarization, and Permittivity	
	b. Magnetics, Magnetization, and Permeability	
	c. Current, Conductors, and Conductivity	
	d. Semiconductors	
	e. Superconductors	
	f. Metamaterials	
	g. A.C. Variations in Materials	
III.	<b>Wave Equation and Its Solution</b>	1
	a. Wave Equation	
	b. Solution of Wave Equation	
	1. Rectangular	
	2. Cylindrical	
	3. Spherical	

<b>IV. Wave Propagation and Polarization</b>	<b>10</b>
a. Transverse ElectroMagnetic Modes (TEM)	
b. Polarization	
c. Reflection and Transmission	
1. Normal Incidence	
2. Oblique Incidence	
d. Polarization Characteristics on Reflection	
e. Metamaterials	
<b>V. Auxiliary Vector Potentials and Construction of Solutions</b>	<b>3</b>
a. Vector Potentials <b>A</b> and <b>F</b>	
b. Construction of Solutions	
1. Transverse ElectroMagnetic (TEM)	
2. Transverse Magnetic (TM)	
3. Transverse Electric (TE)	
<b>VI. Electromagnetic Theorems and Principles</b>	<b>4</b>
a. Duality	
b. Uniqueness	
c. Image	
d. Reciprocity and Reaction	
e. Volume and Surface Equivalences	
f. Induction and Physical Equivalents	
<b>VII. Rectangular Waveguides and Cavities</b>	<b>3</b>
a. Rectangular Waveguide	
b. Rectangular Cavity	
c. Hybrid ( <b>LSE</b> and <b>LSM</b> ) Modes	

**Grading:**

Final Grade will be determined as follows:

- Homework     20%
- Tests (2)     50%
- Final Exam   30%
- Total       100%

**Academic integrity** 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 Academic integrity policy 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 541.

August 15, 2017