



# WISCONSIN

## UNIVERSITY OF WISCONSIN-MADISON

University of Wisconsin - Madison  
College of Engineering [EGR]  
Last Offered: 2015 Spring [1154]  
Direct Link to this Syllabus :

<http://aefis.engr.wisc.edu/index.cfm/page/CourseAdmin.ViewABET?coursecatalogid=20&pdf=True>

1. **E C E 420, Electromagnetic Wave Transmission**

2. **Credits :** 3    **Contact Hours :** 3.5

3. **Textbook and Materials :** Field and wave electromagnetics; Cheng, David K; second; 1989

a. **Other Supplemental Materials :** None

- **Specific Course Information :**

- a. **Brief description of the content of the course (Course Catalog Description) :** Transmission lines: frequency domain analysis of radio frequency and microwave transmission circuits including power relations and graphical and computer methods. Electromagnetic waves: planar optical components, pulse dispersion, phase front considerations for optical components, conducting waveguides, dielectric waveguides. Radiation: retarded potentials, elemental dipoles, radiating antenna characterization, receiving mode.
- b. **Pre-requisites or Co-requisites :** ECE 320
- c. **This is a Selected Elective course.**

- **Specific Goals for the Course :**

a. **Course Outcomes :**

1. Knowledge of methods of guided (transmission lines and waveguides) and unguided (antennas and free-space links) electromagnetic wave transmission in communications and sensing systems
2. Analytical tools used in the design of such systems. Students will be able to use different strategies to achieve impedance matching in microwave networks; students will understand wave reflection and transmission in one-dimensional structures like waveguides
3. Dimensional space at dielectric and conducting boundaries.

- **ABET Student Learning Outcomes :**

- (a) Ability to apply mathematics, science and engineering principles.
- (k) Ability to use the techniques, skills and modern engineering tools necessary for engineering practice.

- **Brief List of Topics to be Covered :**

1. review of Maxwell's equations and plane wave propagation
2. TEM transmission lines, including parallel-plate, coaxial, and two-wire lines
3. quasi-TEM transmission lines, including microstrips
4. time-harmonic analysis of the transmission line equations
5. impedance transformations and reflection coefficients for terminated transmission lines
6. Smith Chart
7. impedance matching networks, including quarter-wave transformers, single-stub tuners, and double-stub tuners

9. higher-order modes on parallel-plate waveguides
10. rectangular waveguides
11. dielectric slab waveguides
12. review of magnetic vector potential
13. elemental antennas (infinitesimal dipoles and small loops)
14. finite-length dipole antennas
15. transmitting and receiving properties of antennas
16. gain, directivity, radiation patterns, beamwidth, radiation resistance, input impedance, radiation efficiency
17. antenna arrays
18. communications links