CMPE 330 (WAVES AND TRANSMISSION) SYLLABUS

I. Introduction (4 lectures)
1. Why study waves and electromagnetics?
   — Why circuit analysis is not enough (wireless transmissions, delays)
   — Applications (Taflove): military, computer interconnects, communications, photonics, medicine
   — WRITING ASSIGNMENT: Applications of waves and electromagnets to future careers (two page essay)
2. Course philosophy and background
   — The professor
   — Courses it uses: ENEE 206, MATH 225, MATH 251
   — Courses it complements: PHYS 122, CMPE 314, CMPE 323
   — Courses that require it: All communications track electives
   — ABET, IEEE Required outcomes
3. Textbook:
   — F. T. Ulaby, FUNDAMENTALS OF APPLIED ELECTROMAGNETICS [required]
      - Advantages: begins with transmission lines, useful software, simple mathematics
      - NOTE: 2010 Media Edition preferred; CD is required
4. Waves and complex numbers
   — Basic wave parameters
      - Amplitude, wavelength, frequency, wavenumber, phase offset
   — Dispersion relations: Relations between wavelength, loss, and frequency
   — Electromagnetic spectrum
   — Spectral analysis
   — Review of complex numbers
   — Phasors
5. ASSIGNMENT: Problem Set

II. Transmission Lines (6 lectures)
1. Basics
   — Lumped Model
   — Types of lines
   — Propagation equations
2. Time Domain
   — Current and voltage evolution
   — SPICE calculations
3. Frequency Domain (Phasors)
   — Current and voltage transmission
   — Voltage standing wave ratio
   — Power flow
4. Smith Chart
   — Parametric equations
   — Impedance matching
5. Lossy Lines
6. Applications
7. ASSIGNMENT: Problem Set
8. MID-TERM 1

III. Vector Analysis (3 lectures)
1. Motivation
   — Charges + currents → Fields → Forces + measurable effects
   — Electric and magnetic fields are described by vectors

2. Laws of vector algebra
   — Addition, subtraction, dot product, cross product
   — Position vectors
3. Coordinate systems
   — rectangular, cylindrical, spherical
4. Line and surface integrals
5. ASSIGNMENT: Problem Set

IV. Classic E&M Experiments (1 lecture)
1. Historical Perspectives
   — Electrostatics: Franklin, Coulomb, Galvani, Volta
   — Magnetostatics: Oersted, Ampere
   — Dynamics: Faraday, Henry, Lenz
   — Maxwell's Equations: MAXWELL
   — Waves: Hertz, Marconi
2. Historical Electronics Museum Experiments
   — Oersted's Experiment
   — Faraday's Experiment
   — A motor: (a) a moving wire, (b) a complete motor
   — A generator
3. Experimental demonstrations
4. PROJECT/WRITING ASSIGNMENT: Build an electrical motor-generator set; Write a 5–10 page description

V. Static Fields (6 lectures)
1. Electrostatics
   — Charge and Coulomb's law
   — Electric field
   — Dielectric materials
   — Gauss's law
2. Voltage and capacitance
   — Charge distributions
   — Capacitance calculations
3. Magnetostatics
   — Current and Biot-Savart law
   — Magnetic field
   — Magnetic materials
   — Ampere's law
   — Gauss's law
4. Applications
5. ASSIGNMENT: Problem Set
6. MID-TERM 2

VI. Time-Varying Fields (4 lectures)
1. Faraday's Law
   — Physical expression
   — Differential form
2. Ampere's Law
   — Physical Expression
   — Differential Form
3. Gauss's Law: Differential Form
4. MAXWELL'S EQUATIONS
   — Comparison of integral and differential forms

— Power Density: Poynting Vector
— Boundary conditions
— Phasor form: sinusoidally varying fields

5. ASSIGNMENT: Problem Set

VII. Wave Propagation (5 lectures)

1. Uniform plane waves
   — Lossless and lossy media
   — Power flow
   — Skin Depth
2. Reflection and transmission
   — Normal incidence
   — Snell's laws
3. Applications
4. ASSIGNMENT: Problem Set
5. COURSE REVIEW

COURSE ASSESSMENTS:

2 writing/project assignments — 20%
8 problems sets + 10 math/physics quizzes — 40%
2 mid-term exams + 7 review quizzes — 20%
1 final exam — 20%

By enrolling in this course, each student assumes the responsibilities of an active participant in UMBC's scholarly community in which everyone's academic work and behavior are held to the highest standards of honesty. Cheating, fabrication, plagiarism, and helping others to commit these acts are all forms of academic dishonesty, and they are wrong. Academic misconduct could result in disciplinary action that may include, but is not limited to dismissal. To read the full Student Academic Conduct Policy, consult the UMBC Student Handbook, the Faculty Handbook, or the UMBC Policies section of the UMBC directory.