EECS 311-Electromagnetic Field Theory II

Prof. Frank Merat

Spring 2003 Semester

Textbook:

John Kraus and Daniel Fleisch
Electromagnetics with Applications, Fifth Edition
McGraw-Hill
Copyright1999
ISBN:0-07-289969-7.

Web page: http://vorlon.cwru.edu/~flm/eecs311/home.html

Supplemental References (requested to be placed on 3 day library reserve)

Umran S. Inan and Aziz S. Inan
Engineering Electromagnetics
Addison-Wesley
Copyright1999
ISBN:0-8053-4423-3

Reinhold Ludwig and Pavel Bretchko
RF Circuit Design: Theory and Applications
Prentice-Hall
Copyright2000
ISBN:0-13-095323-7

Nannapaneni Narayana Rao
Elements of Engineering Electromagnetics, 5th Edition
Prentice-Hall
Copyright2000
ISBN:0-13-013201-2

GRADING:

Mid-term exam	25%
Final exam	25%
Homework	50%

TENTATIVE SYLLABUS

Transient Transmission Lines (11 lectures)

- Transmission line equation
- Bounce diagrams, pulses and transients
- Open and short circuited lines, reactive and non-linear terminations
- Time-domain reflectometry
- Lossy transmission lines
- Pulses in digital systems, printed circuit board lines

Sinusoidal Steady State Transmission Lines (11 lectures)

- Wave equation, phasors
- Standing waves, VSWR
- Open and shorted lines, resistive and reactive terminations
- Reflection coefficient, input impedance
- Impedance matching, quarter- and half-wavelength transformers
- Single- and double-stub tuners
- Smith Chart
- Transmission line matching networks

MID-TERM EXAM

Transmission Line Applications (7 lectures)

- Interconnection networks, network parameters, two-port networks
- Scattering parameters
- Signal-flow charts
- Impedance matching using discrete networks
- Microstrip line matching networks

Antennas (11 lectures)

- Fundamental antenna concepts: directivity, effective aperture
- Arrays of point sources
- Retarded potential, dipole antennas, radiation resistance, $\lambda/2$ and $3\lambda/2$ dipoles
- Types of antennas: endside and broadside arrays
- Basic radio link calculations
- Near-field and Far-field antenna patterns

EM Computational Methods (5 lectures)

- Finite difference techniques, relaxation
- Method of Moments
- Finite Element Methods (FEM)

FINAL EXAM (Monday, May 5th, 8:00-11:00 a.m.)

READING LIST

Topic	Kraus and Fleisch	Inan & Inan	Rao	Ludwig & Bretchko
Review of circuit theory, the transmission line equation	119-123	17-32	333-346 (Maxwell's Eqn)	
Coaxial, two-conductor, conductor over ground plane, microstrip transmission lines	127-133			
Pulses and transients	162-166	32-34		
Bounce diagrams, open and short circuited lines, resistive terminations		34-58	347-364	
Reactive and non-linear terminations		59-74	369-376	
Time domain reflectometry		75-82	365-368	
Transients on lossy transmission lines, characteristic impedance		83-88		
Initial conditions and transmission lines, logic gates			376-386	
EM Effects in digital systems: pulses, PC boards, and terminations	521-539			
Crosstalk on transmission lines			386-393	
The wave equation	124-126			
Waves and phasors		108-114		
Open and short circuited lines, , standing waves, input impedance		114-126	415-425	
Terminated uniform transmission line, VSWR, reflection coefficient	137-144	126-148	425-436	
Power transfer using transmission lines		148-158		
Impedance matching: quarter and half wavelength transformers, single and double stub	150-161	159-176	436-445	

tuning, bandwidth				
Smith Chart	145-150	176-192	445-460	
Transmission line matching networks		193-199		
Sinusoidal steady state lossy transmission lines		199-216	460-469	
Transmission line resonators, bandwidth, Q		216-222		
Interconnecting networks, seri/parallel and cascade connections				143-167
Scattering parameters				168-178
Signal flow charts				178-184
Generalized s-parameters, measuring s-parameters				184-194
Impedance matching using discrete components, T and π matching networks, forbidden regions				405-421
Microstrip line matching networks				431-444
Basic antenna parameters: radiation, beam area, directivity, effective aperture	247-260			
Arrays of point sources	260-275			
Retarded potential, radiation resistance,	275-287		656-668	
Dipole antennas, $\lambda/2$ and $3\lambda/2$ dipoles			668-674	
Arrays of dipoles	287-291		674-685	
Types of antennas: loops, dipoles, horns, Yagi, patch and many others	292-308		685-690	
Basic radio links: Friis equation, noise	308-328			
Near field and far-field radiation patterns	329-332			
EM Interference	539-542			
Biological transmission lines and fields	501-512			

EM Hazards and the environment	512-518			
Laplace's Equation, separation of variables, boundary conditions	547-552			
Finite difference techniques, relaxation	552-558		704-710, 716-718	
Method of Moments	558-560		711-716	
Finite Difference Time Domain	560-563			
Finite Element Methods (FEM)	563-565		719-726	