UNIVERSITY OF TORONTO
Department of Electrical and Computer Engineering
ECE357H1 S – Electromagnetic Fields
Course Outline 2006

	LEC 01
Name	Professor M. Mojahedi (coordinator)
Office Room	BA5124
Email Address	mojahedi@waves.utoronto.ca
Lecture Times	Mondays 9:00-10:00 am BA1240 Tuesdays 4:00-5:00 pm RS208 Fridays 2:00-3:00 pm BA2135

TUTORIAL SCHEDULE

TUT01:	Thursdays	4:00 pm-5:00 pm	SF2202 (Starting Jan. 19)
TUT02:	Thursdays	3:00 pm-4:00 pm	BA3116 (Starting Jan. 19)

LABORATORY SCHEDULE

Description	**Time**	**Place**
PRA 01: Starts on *Friday, February 17* and alternates	9:00 am-12:00 pm	GB450
PRA 02: Starts on *Monday, February 27* and alternates	12:00 pm-3:00 pm	GB450

TEXTBOOK

Required

David K. Cheng, *Field and Wave Electromagnetics*, 2nd Ed., Addison-Wesley, 1992

Recommended

1) R. Feynman, R. Leighton, and M. Sands, *The Feynman Lectures on Physics Vol. 2*, Addison-Wesley, 1970
2) M. N.O. Sadiku, *Elements of Electromagnetics*, Oxford, 2001

COURSE GRADING

First Exam (Thursday, February 16h; 6:15 pm – 7:30 pm at GB304)	20 %
Second Exam (Monday, March 27; 6:15 pm – 7:30 pm at GB304)	20 %
Laboratory Work	20 %
Final Exam	40 %

COURSE WEBSITE

http://ecnet.utoronto.ca/20061/ece357h1s/

ECE357H1F – Electromagnetic Fields
Course Timetable 2006

Week	Lectures	Tutorials	Labs
Jan. 9-Jan. 13 (Week 1)	L1. Course introduction L2. TL circuit model L3. Wave chars. on infinite lines		
Jan. 16-Jan. 20 (Week 2)	L4. TL wave equations solutions L5. Forward and backward waves L6. TL examples	Phasors	
Jan.23-Jan. 27 (Week 3)	L7. Wave char. on finite lines L8. Matched TL L9. TLs as circuit elements	Homework and Review	
Jan.30-Feb. 3 (Week 4)	L10. Lines with resistive terms L11. Max/Min voltage along TLs L12. TL circuits	Lines with Short, open, and arbitrary termination	
Feb. 6-Feb.10 (Week 5)	L13. Transients on TLs L14. Reflection diagrams L15. Smith chart derivation	Lines with Short, open, and arbitrary termination	
Feb. 13-Feb.17 (Week 6)	L16. Smith chart applications L17. Matching Circuits L18. Electromagnetic fields	Midterm 1 Review	Lab #1 (PRA01) Waves on Transmission Lines
Feb. 27-March 3 (Week 7)	L19. Div theorem, curl, etc L20. Maxwell's equations L21. Potential functions	Impedance Matching	Lab #1 (PRA02) Waves on Transmission Lines
March 6-March 10 (Week 8)	L22. Solutions of wave equations L23. Source-free wave equations L24. EM boundary conditions	Impedance Matching	Lab #2 (PRA01) Double-Stub Matching Network
March 13-March 17 (Week 9)	L25. Plane waves in lossless media L26. TEM waves L27. Polarization of plane waves	Vector Calculus Review	Lab #2 (PRA02) Double-Stub Matching
March 20-March 24 (Week 10)	L28. Plane waves in lossy media L29. Group velocity L30. Dispersion	Midterm 2 Review	Lab #3 (PRA01) Resonant Cavity
March 27-March 31 (Week 11)	L31. Flow of EM power L32. Normal inc. at conductor L33. Normal inc. at dielectric	Waveguides	Lab #3 (PRA02) Resonant Cavity
April 3-April 7 (Week 12)	L34. Normal inc. at mult. diels. L35. Oblique inc. at dielectric L36. Snell's law, total ref., etc.	Waveguides	Lab #4 (PRA01) Coaxial Photonic Crystal
April 10-April 14 (Week 13)	L37. Radiation fields of el. Dipoles L38. Review	Final Exam Review	Lab #4 (PRA02) Coaxial Photonic Crystal

ECE320H1F – Fields and Waves
Detailed Lecture Schedule 2005
(subject to change)

Lecture #	Lecture Content	Textbook Sections
1.	Course introduction, overview, and motivation	9-1
2.	Introduction to transmission lines Distributed transmission-line circuit model General transmission-line equations in time	9-3 introduction
3.	Wave characteristics on an infinite transmission line Time-harmonic transmission-line equations Propagation constant	7-7.1 9-3.1 (End of week 1)
4.	Transmission line wave equation solutions Characteristic impedance	9-3.1
5.	Forward and backward traveling waves Phase velocity	
6.	Transmission line examples (lossless, low-loss, distortionless) Attenuation constant from power relations	9-3.1 9-3.3 (End of week 2)
7.	Wave characteristics on finite transmission lines Input impedance	9-4 introduction
8.	Matched transmission line Transmission line as circuit elements (introduction)	9-4.1
9.	Transmission line as circuit elements (open, short, quarter-wavelength, half-wavelength)	9-4.1 (End of week 3)
10.	Lines with resistive termination (reflection coefficient, standing wave ratio)	9-4.2
11.	Maximum and minimum voltage locations along a line	9-4.2
12.	Transmission-line circuits (reflection coefficient at the source, multiple reflections)	9-4.4 (End of week 4)
13.	Transients on transmission lines	9-5 intro.
14.	Reflection diagrams Pulse excitation	9-5.1 9-5.2
15.	Smith chart for lossless lines	9-6 introduction (End of week 5)

Lecture #	Lecture Content	Textbook Sections
	(introduction and derivation)	
16.	Smith chart applications (plotting Γ, Z_{in}, Y_{in}, standing wave ratio)	9-6 introduction
17.	TL Impedance Matching	9-7, 9-7.1, 9.7.2
18.	Electromagnetic fields (vector and scalar fields) Coordinate systems, gradient, divergence	2-4, 2-5, 2-6, 2-7 (End of week 6)
19.	Divergence theorem, curl, Stokes's theorem Helmholtz's theorem	2-8, 2-9, 2-10, 2-11, 2-12
20.	Maxwell's equations for time-varying fields (differential and integral forms)	7-3
21.	Potential functions (nonhomogeneous wave equations for $\boldsymbol{A}$ and V)	7-4 (End of week 7)
22.	Solutions of wave equations for potentials	7-6.1
23.	Source-free wave equations Time-harmonic fields and wave equations	7-6.2 7-7.2
24.	Electromagnetic boundary conditions	7-5 (End of week 8)
25.	Plane waves in lossless media	8-1, 8-2 intro.
26.	Transverse electromagnetic (TEM) wave Polarization of plane waves (introduction)	8-2.2 8-2.3
27.	Polarization of plane waves (linear, circular, elliptical)	8-2.3 (End of week 9)
28.	Plane waves in lossy media (propagation constant, low-loss dielectrics)	8-3 intro. 8-3.1
29.	Plane waves in lossy media (good conductors) Group velocity	8-3.2 8-4
30.	Dispersion	8-4 (End of week 10)
31.	Flow of electromagnetic power and the Poynting vector Instantaneous and average power densities	8-5
32.	Normal incidence at a plane conducting boundary	8-6
33.	Normal incidence at a plane dielectric boundary	8-8 (End of week 11)
34.	Normal incidence at multiple dielectric	8-9

Lecture #	Lecture Content	Textbook Sections
	interfaces Wave impedance of the total field Impedance transformation with multiple dielectrics	
35.	Oblique incidence at a plane dielectric boundary Example of perpendicular (E) polarization	8-10.2
36.	Oblique incidence at a plane dielectric boundary Snell's law, total reflection, Brewster's angle	8-10 int. 8-10.1 (End of week 12)
37.	Radiation fields of elemental dipoles	11-2.1
38.	Review	(End of week 13)