UNIVERSITY OF TORONTO
Department of Electrical and Computer Engineering
ECE320H1F – Fields and Waves
Course Outline 2006

	LEC 01	LEC 02
Name	Professor M. Mojahedi	Professor M. Mojahedi
Office Room	BA5124	BA5124
Email Address	mojahedi@waves.utoronto.ca	mojahedi@waves.utoronto.ca
Lecture Times	Mondays 1-2 P.M. GB119 Wednesdays 9-10 A.M. GB248 Thursdays 10-11 A.M. GB119	Mondays 10-11 A.M. GB221 Tuesdays 1-2 P.M. GB220 Fridays 1-2 P.M. GB119

TUTORIAL SCHEDULE

TUT01:	Thursdays	1:00 P.M. - 3:00 P.M.	GB304 (Alternates starting Sept. 21)
TUT02:	Thursdays	4:00 P.M. -6:00 P.M.	BA2185 (Alternates starting Sept. 21)
TUT03:	Tuesday	3:00 P.M. - 5:00 P.M.	HA401 (Alternates starting Sept. 12)
TUT04:	Tuesday	10:00 A.M. - 12:00 P.M.	HA401 (Alternates starting Sept. 12)

LABORATORY SCHEDULE

PRA01:	Thursdays	3 P.M.-6 P.M.	GB450	(Alternates starting Oct. 19)
PRA02:	Fridays	3 P.M.-6 P.M.	GB450	(Alternates starting Oct. 13)
PRA03:	Fridays	9 A.M.-12 P.M.	GB450	(Alternates starting Oct. 20)
PRA04:	Tuesdays	4 P.M.-7 P.M.	GB450	(Alternates starting Oct. 17)
PRA05:	Tuesdays	9 A.M.-12 P.M.	GB450	(Alternates starting Oct. 17)
PRA06:	Fridays	9 A.M.-12 P.M.	GB450	(Alternates starting Oct. 13)
PRA07:	Monday	3 P.M.-6 P.M.	GB450	(Alternates starting Oct. 9)*
PRA08:	Wednesday	3 P.M.-6 P.M.	GB450	(Alternates starting Oct. 11)

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

	Weight
First Exam: **Thursday October 19**, from 6:00-7:30	20 %
Rooms: BA 2145, BA 2155, BA 2165, BA 2175, HA 401, HA 410	
Second Exam: **Monday November 20**, from 6:00-7:30	20 %
Rooms: GB 404, GB 405, GB 412	
Laboratory Work	20 %
Final Exam	40 %

COURSE WEBSITE

http://courses.ece.utoronto.ca/20069/ece320h1f/

* For PRA07, on Monday October 9 (Thanksgiving) see the web site under LABORATORIES.

ECE320H1F – Fields and Waves
Course Timetable 2005

Week	Lectures	Tutorials	Labs
Sept. 7 – 8	L1: Course introduction	–	–
Sept. 11 – 15	L2: TL circuit model L3: Wave chars. on infinite lines L4: TL wave equations solutions	TUT: 03, 04 Phasor	–
Sept. 18 – 22	L5: Forward and backward waves L6: TL examples L7: Wave char. on finite lines	TUT: 01, 02 Phasor	–
Sept. 25 – 29	L8: Matched TL L9: TLs as circuit elements L10: Lines with resistive terms.	TUT: 03, 04 Lines with arbitrary Z_L	–
Oct. 2 – 6	L11: Max/Min voltage along TLs L12: TL circuits L13: Transients on TLs	TUT: 01, 02 Lines with arbitrary Z_L	–
Oct. 9 – 13	*Oct. 9: Thanksgiving (no lecture)* L14: Reflection diagrams L15: Smith chart derivation	TUT: 03, 04 Impedance Matching	Lab #1 (PRA: 02, 06, 07, 08) Waves on Transmission Lines
Oct. 16 – 20	L16: Smith chart applications L17: Electromagnetic fields L18: Div theorem, curl, etc. **(Week of Exam-1)**	TUT: 01, 02 Impedance Matching	Lab #1 (PRA: 01, 03, 04, 05) Waves on Transmission Lines
Oct. 23 – 27	L19: Maxwell's equations L20: Potential functions L21: Solutions of wave equations	TUT: 03, 04 Vector Calculus Review	Lab #2 (PRA: 02, 06, 07, 08) Design of a Double-Stub Matching Network
Oct. 30 – Nov. 3	L22: Source-free wave equations L23: EM boundary conditions L24: Plane waves in lossless media	TUT: 01, 02 Vector Calculus Review	Lab #2 (PRA: 01, 03, 04, 05) Design of a Double-Stub Matching Network
Nov. 6 – 10	L25: TEM waves L26: Polarization of plane waves L27: Plane waves in lossy media	TUT: 03, 04 Waveguides	Lab #3 (PRA: 02, 06, 07, 08) Resonant Cavity

Nov. 13 – 17	L28: Group velocity L29: Dispersion L30: Flow of EM power	TUT: 01, 02 Waveguides	Lab #3 (PRA: 01, 03, 04, 05) Resonant Cavity
Nov. 20 – 24	L31: Normal inc. at conductor L32: Normal inc. at dielectric L33: Normal inc. at mult. diels. **(Week of Exam-2)**	TUT: 03, 04 Homework and Review	Lab #4 (PRA: 02, 06, 07, 08) Coaxial Photonic Crystal
Nov. 27 – Dec. 1	L34: Oblique inc. at dielectric L35: Snell's law, total ref., etc. L36: Radiation fields of el. dipoles	TUT: 01, 02 Homework and Review	Lab #4 (PRA: 01, 03, 04, 05) Coaxial Photonic Crystal

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

Lecture Number	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 &Class Notes
3	Wave characteristics on an infinite transmission line Time-harmonic transmission-line equations Propagation constant	7-7.1 9-3.1 & Class Notes
4	Transmission line wave equation solutions Characteristic impedance	9-3.1 & Class Notes
5	Forward and backward traveling waves Phase velocity	9-3.1 and Class Notes
6	Transmission line examples (lossless, low-loss, distortionless) Attenuation constant from power relations	9-3.1 9-3.3
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
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
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 (introduction and derivation)	9-6 introduction
16	Smith chart applications (plotting Γ, Z_{in}, Y_{in}, standing wave ratio)	9-6 introduction

Lecture Number	Lecture Content	Textbook Sections
17	Electromagnetic fields (vector and scalar fields) Coordinate systems, gradient, divergence	2-4, 2-5, 2-6, 2-7
18	Divergence theorem, curl, Stokes's theorem Helmholtz's theorem	2-8, 2-9, 2-10, 2-11, 2-12
19	Maxwell's equations for time-varying fields (differential and integral forms)	7-3
20	Potential functions (nonhomogeneous wave equations for $\boldsymbol{A}$ and V)	7-4
21	Solutions of wave equations for potentials	7-6.1
22	Source-free wave equations Time-harmonic fields and wave equations	7-6.2 7-7.2
23	Electromagnetic boundary conditions	7-5
24	Plane waves in lossless media	8-1, 8-2 intro.
25	Transverse electromagnetic (TEM) wave Polarization of plane waves (introduction)	8-2.2 8-2.3
26	Polarization of plane waves (linear, circular, elliptical)	8-2.3
27	Plane waves in lossy media (propagation constant, low-loss dielectrics)	8-3 intro. 8-3.1
28	Plane waves in lossy media (good conductors) Group velocity	8-3.2 8-4
29	Dispersion	8-4
30	Flow of electromagnetic power and the Poynting vector Instantaneous and average power densities	8-5
31	Normal incidence at a plane conducting boundary	8-6
32	Normal incidence at a plane dielectric boundary	8-8
33	Normal incidence at multiple dielectric interfaces Wave impedance of the total field Impedance transformation with multiple dielectrics	8-9
34	Oblique incidence at a plane dielectric boundary Example of perpendicular (E) polarization	8-10.2
35	Oblique incidence at a plane dielectric boundary Snell's law, total reflection, Brewster's angle	8-10 int. 8-10.1
36	Radiation fields of elemental dipoles	11-2.1