EP 225.3: Waves, Fields and Optics
Term II 2010-2011 Academic Year

COURSE OUTLINE

Instructor: Prof. Alexander Moewes, Ph.D.
Office: Room 154 Physics Building
Phone: 306-966-6431
email: alex.moewes@usask.ca

Course Website: http://physics.usask.ca/~alex/ep225/

This course will use the above Course Website for distribution of assignments and posting of solutions and grades.

Course Objectives:

An introduction to mechanical and electromagnetic wave phenomena including derivation of wave equations and wave velocities, energy and momentum carried by waves, wave reflection in terms of impedance mismatch, standing waves, and radiation of electromagnetic waves. This is followed by geometrical and physical optics.

Prerequisites:

(1) (MATH 223 or MATH 225 or MATH 276) and (PHYS 125 or PHYS 117 or (GE 125 and PHYS 155)).
(2) MATH 224 or MATH 226 or MATH 238.

Lectures:

This class will take place MWF from 9:30 – 10:20 a.m. in Physics 103.

Tutorials:

There will be one tutorial before the midterm exam and one tutorial before the final exam. Time and location will be determined (in class).

Office Hours:

I will hold office hours from Monday and Friday 1:30-3:30 p.m.

Topics to be covered in EP 225 (see also detailed schedule):

- Mechanical & electromagnetic oscillations (3 lectures) [chapter 1 in textbook]
  - Mass-spring oscillator
  - Simple and physical pendulums
  - LC oscillator
  - Damping (due to finite resistance - LCR circuit)

- Forced oscillations (in LCR circuit)

- Basic properties of waves (3 lectures) [chapter 2]
  - Sinusoidal (harmonic) waves, wavenumber *k*
  - Simple nondispersive wave differential equation
  - Beat phenomenon; phase and group velocities
  - Dispersive waves

- Mechanical waves (5 lectures) [chapter 4, 5 6, & 7]
  - Longitudinal waves in mass-spring transmission line
  - Transverse waves in string
  - Energy and momentum carried by waves
  - Concept of characteristic impedance, wave reflection in terms of impedance mismatch
  - Sound waves in solid, liquid, and gas
  - Doppler effect and shock waves

- Electromagnetic waves (8 lectures) [chapters 9 & 10]
  - Waves in LC transmission line, impedance
  - Waves in free space
  - Energy, momentum and angular momentum carried by E & M waves, Poynting vector
  - Wave reflection at impedance discontinuity, impedance matching by quarter wavelength transformer
  - E & M waves in a plasma, reflection by the ionospheric plasma, global waveguide
  - Radiation of E & M waves by accelerated charges, radiation from antennas

- Physical optics (8 lectures) [chapter 11]
  - Interference: Young's double slit experiment, multiple slits, grating interferometer, thin film interference
  - Diffraction: Fraunhofer and Fresnel diffraction, resolving power of optical devices

- Geometrical optics (9 lectures) [chapter 12]
  - Concave and convex mirrors
  - Snell's law, total reflection, refraction at a spherical dielectric boundary
  - Lens maker's formula, compound lens, matrix method, and optical devices
  - Achromatic lens
  - Optical waveguide

- Particle Nature of Light (2 lectures) [chapter 13]
  - Einstein’s photoeffect & theory
  - De Broglie wave & hydrogen atom

Academic Honesty (see http://www.usask.ca/honesty/):

Students are expected to understand and abide by the principles of academic honesty and to realize that there are potentially serious consequences for dishonest behaviour. It is your duty to educate yourself on academic honesty.

Composition of Grade:

Homework assignments	15%
Laboratories	15%
Midterm (to be announced)	20%
Final Examination (t.b.a)	50%
Total:	100%

Required Textbook:

• Hirose & Lonnegren, Fundamentals of Wave Phenomena, SciTech Publishing, 2nd edition, 2010.

Possibly supplementary reading:

• Serway and Jewett, "Physics for Scientists and Engineers", Publishers: Brooks Cole, 7th edition (new). You should have this book from PHYS 121 or 128.

Homework Assignments

• Written assignments will be a key part of this class. You cannot learn physics without doing a lot of problems; these written assignments will give you the opportunity to do this!
• **There will be a weekly written assignment.** Solve each problem with a complete written solution, following the methods outlined in the lectures.
• Late assignments can not be accepted.
• Assignments not submitted will receive a mark of zero.
• The assignment solutions will be posted to the course web site and will remain posted for the duration of the course.
• The marks for each assignment will be posted by your instructor (with your student number only).

Exam Rules:

• Turn off cell phones before entering the examination room.
• Only Texas Instruments TI-30X series or Hewlett-Packard HP-30S calculators may be used.
No other electronic device is allowed at your desk (e.g. cell phone, pager, PDA, iPod, MP3 player, electronic dictionary…).
• No written material is allowed at your desk other than the test paper, formulae sheet and OpScan sheet.
• Bring your student card, a pen, two soft-lead (HB) pencils, eraser, and straightedge.

Laboratories:

Lab-schedule EP 225 for 2010: All labs in Room 113 Physics

Lab Sec\Expt	L11	L13	L16	W2	L12	Make-up Labs
L2A & B (Mon)	Jan 17	Jan 31	Feb 14	Mar 7	Mar 21	by appt.
L4A & B (Wed)	Jan 19	Feb 2	Feb 16	Mar 9	Mar 23	by appt.

Lab Introductions:

L2A & B, 1:30 p.m., Monday, January 10th – Rm 128 Physics
L4A & B, 1:30 p.m., Wednesday, January 12th – Rm 127 Physics

Lab Material:

Students should bring a copy of "A Laboratory Manual for Engineering Physics 225.3, REVISED 1997". These are available at the Book Store.

Lab Titles:

L11 Prism Spectrometer
L13 Geometric Optics
L16 Optical Instruments
W2 Microwave Optics
L12 Interference and Diffraction Patterns

For any questions regarding the labs please contact:

Brian Zulkoskey, Lab Instructor, Room 115 Physics, ph. 6439
Email: brian.zulkoskey@usask.ca

EP 225 Laboratory Policy

1. Laboratory work is an integral part of the course. A student will not receive a passing grade for the course unless **all** of the experiments have been completed. Failure to complete the laboratory work will result in failure in the course.
2. Withdrawing from EP 225 implies withdrawing from the laboratory work in the course as well. You may not continue laboratory work after withdrawing from the course, even if you decide to continue to attend the lectures.
3. If you complete EP 225 with a final grade of 40% or higher and complete the laboratory work with an average laboratory mark of at least 70%, and you then repeat the course in a later session but within three years, you may request exemption from all of the labs. Your laboratory mark for the year will be the average mark you received for the experiments already performed.