EELE482 INTRODUCTION TO ELECTRO-OPTICAL SYSTEMS

Fall 2016
3 credits

Class meetings: Lecture *section 01* Mon, Wed 10:00-10:50 am in BARNAH 110
Lab *section 02* Tuesday 9:00-11:00 am in BARNAH 110
Lab *section 03* Tuesday 1:10-3:00 am in BARNAH 110

Instructor: David Dickensheets
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Office Hours: Mon 4:00-5:30pm, Th 4:00-5:30pm

TA: TBD
Office Hours: TBD

Course webpage: http://www.montana.edu/ddickensheets/courses/eele482/eele482.html

Text: *Fundamentals of Photonics* 2nd ed. by Saleh and Teich, (John Wiley & Sons, inc., 2007).

Other References: *Building Electro-Optical Systems – Making it all work*, by Philip C.D. Hobbs (John Wiley and Sons, 2000). *Optoelectronics, An Introduction,* 3rd Edition, by Wilson and Hawkes (Prentice Hall Europe, 1998).

Course Description:

This course will provide an introduction to electro-optical systems and components. Roughly half of the course is devoted to optical theory, with the remainder devoted to devices and systems. Topics will include scalar wave optics, laser and Gaussian beam optics, photon-matter interactions, light sources, detectors, and electro-optic and acousto-optic photonic devices. We will examine several case studies of electro-optical systems.

Prerequisites:

EM Theory including wave equation, plane wave propagation, reflection and refraction (EELE334 or equivalent, or consent of instructor).

Course Goals:

This is an introductory course in applied optics and electro-optical systems. It is intended to provide considerable breadth of coverage of both optical theory and optical devices. It is the goal of this course to provide a "big picture" of the principles and devices that are commonly used in optical communication systems, scientific and medical instruments, sensors, commercial electronics and experimental optics. After completing this course, you should be able to analyze a typical electro-optical system in order to:

1. Identify the primary optical components and their function within the system.
2. Understand how the components work together to produce the desired system behavior.
3. Estimate system performance parameters, such as optical power, frequency and bandwidth, electronic bandwidth, minimum detectable signal, dynamic range, modulation depth, and spatial, spectral or temporal resolution.
4. Effectively communicate the results of your analysis in the form of a written report or an oral presentation.

This course will also emphasize problem solving skills through weekly homework assignments. After completing this course you should be able to

5. Analyze and effectively communicate quantitative written analyses of problems in optical wave and beam propagation, light polarization, light sources, light detectors and light modulators.

In this course there is NOT time to cover in-depth fundamental optical theory or physical theory for each device. This course WILL provide an introduction to important underlying physical concepts and operational parameters of the devices that are covered, as well as an introduction to the "lingo" and a roadmap to guide further in-depth study.

Course Organization and Grading:

The course will consist of two lectures and a lab each week. Grading will be based on homework assignments, lab notebooks and reports, two examinations and a final paper, with the following relative weights:

Weekly homework	20%
Midterm	20%
Final exam	20%
Final paper	15%
Lab Grade	25%

The laboratory grade will be composed of several parts as follows:

Attendance	≤ 2 unexcused absences for passing course grade
Notebooks	25%
Formal reports	75%

Important Dates:

Aug. 29	First day of instruction
Nov. 2	Midterm examination
November 28 (Monday)	(optional) preliminary draft of design review paper due
December 7 (Wednesday)	Design review oral presentations
December 9 (Friday)	Design review papers due
Dec. 12 (Monday) 8:00am	Final examination

Lab Modules

There will be eight lab modules during the course. Two of those are two-week modules. You will work in small groups of 2-3 individuals. The work in the lab will be performed as a group, and data generated will be common to all members of a given group. However, each member of the group is expected to keep a lab notebook and to generate an individual lab report.

You will keep a laboratory notebook documenting all of your experiments and calculations in the lab. This notebook should be bound, with numbered pages. Notebooks will be handed in for grading on the following dates:

September 21
December 5

The notebook grade will be awarded based on completeness of recorded data, including diagrams of experiments, complete description of signal sources and measurement techniques, tabular data and graphical data, along with enough narrative to describe the experiments. Neatness counts.

You will be required to hand in three formal lab reports. These will be due according to the following schedule:

First report on or before	October 11
Second report on or before	November 1
Third report on or before	November 29

Lab reports will be prepared in a professional manner. Data will be plotted using spreadsheet or graphing software such as Excel or Matlab. Wherever possible, include both measured data and theoretical predictions on the same graph. Use error bars to show measurement uncertainty, and discuss major sources of error in the text of the report. Extensive theoretical developments requiring lots of equations may be neatly hand lettered and included as an appendix to the lab report.

Other Optics Courses at MSU:

EELE482	Electro-Optical Systems (Lab)
EELE432	Applied Electromagnetics
EELE538	Advanced Topics in Optics and Electromagnetics
EELE563	Remote Sensing & Image Processing
EELE581	Fourier Optics and Imaging Theory
EELE582	Optical Design
PHSX 253	Physics of Photography
PHSX 305	Holography
PHSX427	Advanced Optics
PHSX 437	Laser Applications
PHSX 531	Nonlinear Optics and Laser Spectroscopy