EE 422 – Optical Engineering Laboratory

Designation: Elective course for electrical engineering majors.

University Bulletin Description: EE 422: (3) Hands-on experience covering areas of geometric optics, physical optics, electrooptic devices, lasers, holography, fiber optic communications, and advanced optical sensors.
Prerequisite: EE 320.

Prerequisites by Topics:
1. Understanding of basic principles of geometric optics, including transmission, reflection, refraction, and imaging by lenses. (EE 320)
2. Understanding of basic principles of physical optics, including interference, diffraction, and polarization. (EE 320)
3. Proficiency in the use of basic optical components (lens, laser, camera, fiber, digital oscilloscope, function generator, photodetector) (EE 320)
4. Familiarity with basic working principle of semiconductor p-n junctions, forward and inverse bias, and light emitting process (EE 210)

Textbook/Required Materials:
Eugene Hecht, Optics, 4th ed., Addison Wesley, San Francisco, 2002.

Experimental Manual: EE 422 Experimental Manual (Edited by the instructor Shizhuo Yin).

Learning Outcomes:
EE 422 is a laboratory-oriented technical elective course. Through lecture, laboratory, and class assignments, students are provided learning experiences that enable them to:
1. Analyze and design simple optical processor, particularly with hand-on exposure to lenses, lasers, diffraction, holograms, optical fibers, fiber optic communications, fiber optic sensors, modern displays, and electro-optic devices.
2. Develop technical writing skills important for effective communication
3. Acquire teamwork skills for working effective in groups

Topics:
Introduction; Lab group organization and EO Lab Orientation Tour (1 lecture and one lab period)
1. Basic film and digital photography and dark room processing (1 lecture and one lab period)
2. Basic optical laboratory, beam collimating and optical imaging (1 lecture and one lab period)
3. Optical interference (1 lecture and one lab period)
4. Diffraction theory (1 lecture and one lab period)
5. Fraunhofer diffraction and Optical Fourier transform (1 lecture and one lab period)
6. 4-f Optical processing system (1 lecture and one lab period)
7. Midterm Review (1 lecture) and Midterm Exam (1hr 30 min)
8. Light propagation in optical fiber (1 lecture and one lab period)
9. Voice link fiber optic communication system (1 lecture and one lab period)
10. Fiber optic sensors (1 lecture and one lab period)
11. Holography (1 lecture and one lab period)
12. Fast speed electro-optic modulators (1 lecture and one lab period)
13. LED and diode lasers (1 lecture and one lab period)
14. Semester Review (1 lecture) and Final exam (1hr 50 min)

Class/laboratory schedule: One 75-minute lecture and one 2-hour laboratory per week

Computer usage:
All the experiments require the use of word processing, excel analysis and graphics software for their formal laboratory report writing.

Computer is used to control the optical processing system in the laboratory

Laboratory Projects/Assignments:
A total of twelve experiments are required for the laboratory part of this course. Technical writing skills, maintaining a laboratory notebook, working in teams, development of good optical system setup, and understanding the contents through observation and analysis are emphasized during the laboratories. Lab reports are submitted by each group and checked weekly with feedback to students for improvement.

A total of twelve homework assignments are required to enhance the lab experience and lecture comprehension by individual students. Homeworks are graded weekly.

In class quizzes were given weekly during lecture period following each week's laboratory.

Contribution to Meeting the Requirements of Criterion 5. Curriculum:
This course contributes to both the engineering topics and design components.
The course provides the theory on principles of optical components and devices and hands-on experiments in the area of optical engineering. It is a prerequisite to the high-level electro-optics courses in EE department, such as EE 522, EE 520, and EE 524. The graduates may look for co-op, internship or permanent jobs in industries that would benefit from their hand-on experiences. Topics pertaining the health and safety are considered in the development of the optical engineering design in the laboratory.

Relationship to Program Outcomes:
O.1.1. Graduates will possess mathematics skills necessary for electrical engineering.
O.1.2. Graduates will have a theoretical and practical background in both physics and chemistry.
O.1.3. Graduates will have attained computer proficiency.
O.2.4. Graduates will understand fundamental electricity and magnetism concepts and be able to use them in applications.
O.3.1. Graduates will have in-depth technical knowledge in one or more areas of specialization.
O.3.2. Graduates will have practical understanding of the major electrical engineering concepts and demonstrate application of their theoretical knowledge of the concepts.
O.4.1. Graduates will interact with industry both within and outside of a classroom setting.
O.4.2. Graduates will develop an appreciation of continuing educational and professional development.
O.5.1. Graduates will have good teamwork skills.
O.5.2. Graduates will possess good oral and written communication skills.

Prepared by: Shizhuo Yin **Date:** 4-25-08