LBST => 04/21/10

| LSC Use Only No: LSC Action-Date: | UWUCC USE Only No. | UWUCC Action-Date: | Senate Action Date: |
| --- | --- | --- | --- |
| | 10-25a. | AP-10/12/10 | App 11/2/10 |

## Curriculum Proposal Cover Sheet - University-Wide Undergraduate Curriculum Committee

| Contact Person | Email Address |
| --- | --- |
| Feng Zhou | fzhou@iup.edu |
| Proposing Department/Unit | Phone |
| Physics/Electro-Optics | 724-294-3300 (ext: 27) |

**Check all appropriate lines and complete information as requested. Use a separate cover sheet for each course proposal and for each program proposal.**

**1. Course Proposals (check all that apply)**

__X__ New Course  _____ Course Prefix Change  _____ Course Deletion

_____ Course Revision  _____ Course Number and/or Title Change  _____ Catalog Description Change

| | EOPT 150 Fundamentals of Photonics and Laser Safety |
| --- | --- |
| *Current Course prefix, number and full title* | *Proposed course prefix, number and full title, if changing* |

**2. Additional Course Designations: check if appropriate**

_____ This course is also proposed as a Liberal Studies Course.

_____ This course is also proposed as an Honors College Course.

_____ Other: (e.g., Women's Studies, Pan-African)

**3. Program Proposals**

_____ Catalog Description Change  _____ Program Revision

_____ New Degree Program  _____ Program Title Change  _____ Other

_____ New Minor Program  _____ New Track

| | |
| --- | --- |
| *Current program name* | *Proposed program name, if changing* |

**4. Approvals**

| | | Date |
| --- | --- | --- |
| Department Curriculum Committee Chair(s) | [signature] | 4/20/10 |
| Department Chair(s) | [signature] | 4/20/10 |
| College Curriculum Committee Chair | Anne Kado | 4/21/10 |
| College Dean | Mary Ann Zonick | 4/21/10 |
| Director of Liberal Studies * | | |
| Director of Honors College * | | |
| Provost * | | |
| **Additional signatures as appropriate:** (include title) | | |
| UWUCC Co-Chairs | Gail S Sechrist | 10/28/10 |

* where applicable

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# Syllabus of Record

## I. Catalog Description.

**EOPT 150 Fundamentals of Photonics and Laser Safety** **(2c-1l-3cr)**

**Prerequisites:** PHYS 100 or Placement Test

Introduces the field of photonics. Designed to acquaint the student with the various concepts associated with the nature of light and lasers. Explores the nature of light and lasers using hands-on explorations, problem solving techniques, and practical current applications. Topics covered include: nature and property of light, optical handling and positioning, basic geometrical optics, basic physical optics and principles of lasers.

## II. Course Outcomes

After successfully completing the course, the student will be able to:

1. Demonstrate the nature and properties of light
2. Handle and position optical systems
3. Demonstrate an understanding of various light sources and safety issues related to these light sources.
4. Describe the basic optics principles of reflection, refraction, interference, diffraction and polarization.
5. Describe the working principles of lasers.

## III. Detailed Course Outline (28 academic hours plus 3 lab hours/week for 14 weeks)

1. Nature of Light (4 academic hours + 2 labs)

    a. Define the following properties of light: speed, frequency, wavelength and energy and describe the dual nature of light.
    b. Describe Huygens' principle and the superposition principle.
    c. Define the terms *reflection*, *refraction*, and *index of refraction* and explain how they are related.
    d. Explain diffraction and interference in terms of Huygens' principle.
    e. List the three types of emission and identify the material properties that control the emission type.
    f. Describe in a short paragraph the electromagnetic spectrum and sketch a diagram of the key optical regions and uses.
    g. Give a basic explanation of atoms and molecules and their ability to absorb, store, and emit quanta of energy.
    h. Define the primary equations describing the relationships between temperature of, wavelength of, and energy emitted by a blackbody and a gray body.

2. Optics Handling and Positioning (4 academic hours + 2 labs)

a. Bulk optical materials and their properties.
b. Optical coatings
c. Surface quality of optical components and inspection methods
d. Care and cleaning of optics
e. Lab mountings and positioning equipment

3. Light Sources and Laser Safety (4 academic hours + 2 labs)

   a. Define the following properties of laser light such as monochromaticity, directionality and coherence
   b. Distinguish between the different types of nonlaser light sources and identify their characteristics.
   c. Recognize and avoid various nonbeam hazards, such as electrical and chemical hazards.
   d. Label a diagram of the human eye. Given the basic information required, calculate retinal spot size and retinal irradiance.
   e. Describe three general types of laser hazard controls, and list five laser safety precautions applicable to all types of lasers.

4. Basic Geometrical Optics (6 academic hours + 3 labs)

   a. State the *law of reflection* and show with appropriate drawings how it applies to light rays at plane and spherical surfaces.
   b. State *Snell's law of refraction* and show with appropriate drawings how it applies to light rays at plane and spherical surfaces.
   c. Define *index of refraction* and give typical values for glass, water, and air. Calculate the *critical angle* of incidence for the interface between two optical media and describe the process of *total internal reflection*.
   d. Describe *dispersion* of light and show how a prism disperses white light. Calculate the *minimum angle of deviation* for a prism and show how this angle can be used to determine the refractive index of a prism material.
   e. Use *ray-tracing techniques* to locate the images formed by plane and spherical mirrors. Use the *mirror equations* to determine location, size, orientation, and nature of images formed with spherical mirrors.
   f. Use *ray-tracing techniques* to locate images formed by *thin lenses.*
   g. Use the *lensmaker's equation* to determine the focal length of a thin lens. Use the *thin-lens equations* to determine location, size, orientation, and nature of the images formed by simple lenses.

5. Basic Wave Optics (6 academic hours + 3 labs)
   a. Describe the relationship between *light rays* and *wave fronts*, and define *phase angle* and its relationship to a *wave front.*
   b. State the *conditions required* for producing *interference patterns* and define *constructive* and *destructive* interference.
   c. *Calculate the* thickness of *thin films* designed to *enhance* or *suppress* reflected light.
   d. Describe *single-slit diffraction* and *calculate positions of the minima* in the diffraction pattern.

e. Distinguish between *Fraunhofer* and *Fresnel* diffraction.
f. Sketch typical Fraunhofer *diffraction patterns* for a *single slit, circular aperture,* and *rectangular aperture*, and use equations to calculate *beam spread* and *fringe locations.*
g. *Describe* a transmission grating *and calculate positions of different orders of diffraction.*
h. Describe what is meant by *diffraction-limited optics* and describe the difference between a *focal point in geometrical optics* and a *focal-point diffraction pattern in wave optics.*
i. Describe how *polarizers/analyzers* are used with polarized light.
j. State the *Law of Malus* and explain how it is used to calculate intensity of polarized light passing through a polarizer with a tilted transmission axis.
k. Calculate *Brewster's angle of incidence* for a given interface between two optical media.

6. Principles of Lasers (4 academic hours + 2 labs)

a. Understand how laser operates, how gain or amplification is produced
b. Know how various beam characteristics occur
c. Know about longitudinal and transverse modes
d. Design laser cavities or resonators understand unstable resonators
e. Be familiar with Q-switching, mode locking
f. Be familiar with how a variety of laser types work and be familiar with their wavelengths, power capabilities, and beam properties

**Final Exam** (to be held during the finals week)

**List of lab experiments**

Lab 1 Measurement of wavelength, frequency and speed
Lab 2 Black body emission
Lab 3 Optical lapping and polish
Lab 4 Optical component handling, cleaning and positioning
Lab 5 Coherent length measurement and monochormaticity
Lab 6 Laser hazard controls and safety precautions
Lab 7 Law of reflection
Lab 8 Law of refraction
Lab 9 Dispersion measurement
Lab 10 Interference measurement
Lab 11 Diffraction measurement
Lab 12 Polarization measurement
Lab 13 Laser longitudinal and transverse mode characterization
Lab 14 Laser output characterization

IV. <u>**Evaluation Methods.**</u>

The final grade will be determined as follows:

Exams (25%): 25% for both midterm exam and final exam. Each exam will consist of multiple-choice questions, circuit sketches and calculations, and a circuit design and construction problem. The final exam will be cumulative and require the student to integrate knowledge acquired throughout the course.

Quizzes (25%): Two quizzes will be administered during the semester.

Lab Reports (25%): Students will turn in lab reports weekly (due one week after the laboratory exercise). Grading will be based on quality of laboratory participation, quality and completeness of report, and neatness.

Homework (25%) Students will be assigned approximately 10 homework problem sets, entailing basic design and calculations, internet searches and reports, and questions based on chapter reading material.

V. **Example Grading Scale.**

Grading Scale: A: ≥90% B: 80-89% C: 70-79% D: 60-69% F: <60%

VI. **Undergraduate Course Attendance Policy.**

Formal attendance and participation in class discussions are required. Attendance policy will follow those as proscribed in the Undergraduate Catalog

VII. **Required Textbook(s), Supplemental Books and Readings.**

1. *Fundamentals of Light and Lasers,* CORD Communications, ISBN PHO337-8
2. *Fundamentals of Photonics* by B. E. A. Saleh and M. C. Teich (2nd Edition), Wiley-Interscience, ISBN: 978-0-471-35832-9 (2007)
3. *Laser Safety: Tools and Training*, by Ken Barat, CRC Press, ISBN-13: 978-1420068542 (2008)

VIII. **Special Resource Requirements.** None

IX. **Bibliography.**


- Fundamentals of Photonics (Wiley Series in Pure and Applied Optics) by Bahaa E. A. Saleh and Malvin Carl Teich, 2nd edition (2007), ISBN: 978-0-471-35832-9
- Fundamentals of Light Sources and Lasers by Mark Csele, 2004, John Wiley & Sons, ISBN 0-471-47660-9
- A Guide to Laser Safety, by R Henderson; Chapman & Hall; 1st edition (January 15, 1997) , ISBN: 0412729407
- LIA Laser Safety Guide, by Wesley Marshall and David H. Sliney, Laser Institute of America; 10th edition (August 2000), ISBN: 0912035064

- Laser Safety, by R Henderson, Bioptica Ltd; K Schulmeister, ARC Seibersdorf Research ; IOP Publishing 1st edition (Dec 2003); ISBN : 0750308591

**Course Analysis Questionnaire**

**Section A: Details of the Course**

A1 How does this course fit into the programs of the department? For what students is the course designed? (majors, students in other majors, liberal studies). Explain why this content cannot be incorporated into an existing course.

*This course is a comprehensive study of photonics specifically designed for the EO students who are looking for technician jobs.*

A2 Does this course require changes in the content of existing courses or requirements for a program? If catalog descriptions of other courses or department programs must be changed as a result of the adoption of this course, please submit as separate proposals all other changes in courses and/or program requirements.

*The course will be added to the list of courses leading to AAS-Electro-Optics degree.*

A3 Has this course ever been offered at IUP on a trial basis (e.g. as a special topic) If so, explain the details of the offering (semester/year and number of students).

*The course has not been offered at IUP.*

A4 Is this course to be a dual-level course? If so, please note that the graduate approval occurs after the undergraduate.

*The course will not be a dual-level course.*

A5 If this course may be taken for variable credit, what criteria will be used to relate the credits to the learning experience of each student? Who will make this determination and by what procedures?

*The course is a fixed credit course.*

A6 Do other higher education institutions currently offer this course? If so, please list examples (institution, course title).

*Several other universities and community colleges offer the course. Examples of community colleges include*

- *Camden Community college*
- *Texas State Technical College.*

A7 Is the content, or are the skills, of the proposed course recommended or required by a professional society, accrediting authority, law or other external agency? If so, please provide documentation.

*The skills emphasized in the proposed course are included in the Photonics Skills standard for technicians, developed by CORD (Center for Occupational Research and Development). This standard was compiled by industry to meet the needs of the 21st century photonics workplace.*

**Section B: Interdisciplinary Implications**

B1 Will this course be taught by instructors from more than one department? If so, explain the teaching plan, its rationale, and how the team will adhere to the syllabus of record.

*The course will be taught by physics/electro-optics faculty only.*

B2 What is the relationship between the content of this course and the content of courses offered by other departments? Summarize your discussions (with other departments) concerning the proposed changes and indicate how any conflicts have been resolved. Please attach relevant memoranda from these departments that clarify their attitudes toward the proposed change(s).

*No equivalent courses are taught by other departments. Some of the content of this class is similar to that of EOPT 220. This is by design. A student may enter the program at any time during the rotation. The student might take EOPT 220 first or EOPT 150 first. This way, the students will be introduced to these important key Electro Optics concepts early in their academic career.*

B3 Will this course be cross-listed with other departments? If so, please summarize the department representatives' discussions concerning the course and indicate how consistency will be maintained across departments.

*The course will not be cross-listed with other departments.*

**Section C: Implementation**

C1 Are faculty resources adequate? If you are not requesting or have not been authorized to hire additional faculty, demonstrate how this course will fit into the schedule(s) of current faculty. What will be taught less frequently or in fewer sections to make this possible? Please specify how preparation and equated workload will be assigned for this course.

*An additional faculty member will not be needed when the course is added, and no additional faculties are needed from the main campus. The enrollment patterns for the EOPT classes have been adequate. The pattern has been to offer five classes per semester. However, If additional faculty resources are necessary, they will be provided by the Physics Department.*

C2 What other resources will be needed to teach this course and how adequate are the current resources? If not adequate, what plans exist for achieving adequacy? Reply in terms of the following:

*Space
*Equipment
*Laboratory Supplies and other Consumable Goods
*Library Materials
*Travel Funds

*Existing facilities are adequate. There is no need for other resource necessary for course implementation. No library and travel funds will be required for course implementation.*

C3 Are any of the resources for this course funded by a grant? If so, what provisions have been made to continue support for this course once the grant has expired? (Attach letters of support from Dean, Provost, etc.)

*No resources are funded by a grant.*

C4 How frequently do you expect this course to be offered? Is this course particularly designed for or restricted to certain seasonal semesters?

*This course will be offered once a year to the electro-optics students.*

C5 How many sections of this course do you anticipate offering in any single semester?

*One section of the course will be offered.*

C6 How many students do you plan to accommodate in a section of this course? What is the justification for this planned number of students?

*Approximately 10 - 20 students in a course.*

C7 Does any professional society recommend enrollment limits or parameters for a course of this nature? If they do, please quote from the appropriate documents.

*No recommended enrollment limits exist for courses of this nature.*

C8 If this course is a distance education course, see the Implementation of Distance Education Agreement and the Undergraduate Distance Education Review Form in Appendix D and respond to the questions listed.

*The proposed course is not a distance education course.*

**<u>Section D: Miscellaneous</u>**

Include any additional information valuable to those reviewing this new course proposal.

*Experience obtained during five years of instruction in the new IUP Electro-Optics* *program has been used to identify curriculum changes necessary for EO graduates to succeed in the workplace. This training provided by this course is necessary for the students to work with optics and lasers.*