LSC

CURRICULUM PROPOSAL COVER SHEET

University Wide Undergraduate Curriculum Committee

Course Number and Full Title

Course Revision

for New or Existing Course

Course Number and Full Title

Course Deletion

Department Chair

Department Curriculum Committee

Provost (where applicable)

Director of Liberal Studies (where applicable)

Syllabus of Record for EOPT 260

EOPT 260 Industrial Applications of Lasers

2 lecture hours
3 lab hours
3 credits
(2c-3l-3sh)

Prerequisite: EOPT 220

Laser power and energy measurements will be made. The theory and applications of industrial lasers will be covered. Material processing such as welding, cutting, and hole drilling will be discussed, implemented, and analyzed. The role of optics in laser machining will be covered. Laser safety will be emphasized throughout the course. This course includes a lab component.

II. Course Objectives

Upon successful completion of this course, the student will be able to:

D. Materials Processing (4 hrs)
1. Heat Treating
2. Welding (lap and butt)
3. Cutting and Material Removal
4. Hole Drilling.
   a. Process parameters and their effect on:
      i Hole taper
      ii Hole diameter
      iii Hole entrance features (geometries of entrance)

[redacted]

5. Electronic Material Processing
   a. Direct write of electrical connections.
   b. Drilling of via holes.
6. Marking and Scribing Experiments
7. Metallurgical Effects due to Laser Processing

[redacted]

E. Flashlamp Pumped Nd:YAG Lasers (2 hrs)

III-B. Course Outline for Labs (14 labs, 3 hours per lab)

A. Introduction (1 lab)
   1. Lab Safety
   2. Laser Safety: ANSI (American National Standards Institute) Standard
   3. Technical Writing
      a. Notebooks
      b. Lab Reports
   4. Rules and Regulations

B. CO_2 1.5kWatt CW (Continuous Wave) Laser (3 labs)
   1. Cutting Metal.
      a. Write and debug workstation operation program
      b. Develop process parameters (speed, power, spot size)
      c. Produce cut geometric shapes with laser under computer control
   2. Welding Metal.
      a. Produce lap welds.
      b. Produce butt welds.

C. Ultrashort Pulsed Laser Precision Machining. (3 labs)
   1. Hole Drilling.
      a. Process parameters and their effect on:
         i Hole taper
         ii Hole diameter
         iii Hole entrance features (prevention of cratering)

[redacted]

      a. Direct write of electrical connections.
      b. Drilling of via holes.

D. Sealed CO_2 100 Watt Laser (3 labs)
   1. Emphasis on Modern Approach to Controlling Laser Processing.
   2. Marking and Scribing Experiments
   3. Light Metal Cutting.

For the above 3 lasers (sections A, B, and C above) the following will be done for each laser.
   1. The metals to be used for the following sections 2 and 3 are: Stainless Steel, Low Carbon Steel, and Aluminum Alloy.
   2. Power and Energy Measurements
      a. Effects of spot size.
      b. Losses in transmission through optical paths

E. Flashlamp Pumped Nd:YAG Laser (2 labs)
   1. Modulators
   2. Q-Switching
   3. Mode-Locking

F. Nonlinear Generation of Frequencies (1 lab)

   1. Observe the second harmonic radiation coming from a nonlinear crystal that is excited by a laser, e.g. focusing the beam from a 1.06 mm Nd:YAG laser onto certain crystals will produce a second harmonic at 530 nm.

G. Lab Practical: Students will be required to take and analyze some data from set-ups that are similar to those they worked with during the semester. (1 lab)

IV. Evaluation Methods

50% Tests Three tests (two during the semester and the final) consisting of solving word problems and writing short essays.

35% Laboratory assignments

VII. Bibliography

Diels, J., *Ultrashort Laser Pulse Phenomena*, Academic Press, 1996

Duley, W., *Laser Welding*, John Wiley and Sons, 1998

Hecht, J. *Understanding Lasers, an Entry Level Guide, 2nd Ed.*, IEEE Press, 1992

Iga, K.; Miles, R., *Fundamentals of Laser Optics (Lasers, Photonics, and Electro-Optics),* Plenum, 1994

Introduction to Lasers (Modules 1-1 → 1-11), Laser Electro-Optics Technology Series, Center for Occupational Research and Development (CORD) Communications, 1987

Petruzzellis, T., *Optoelectronics, Fiber Optics, and Laser Cookbook*, McGraw Hill, 1997

A3 This course has not been offered on a trial basis at IUP.

A4 This course is not intended to be dual level.

A5 This course is not to be taken for variable credit.

A6 Similar courses are offered at these institutions:

1. Camden County College; Blackwood, New Jersey
   LFO-212 Pulsed & CW Lasers & their Applications
2. Cincinnati Technical College; Cincinnati, Ohio
   LOT 6735 Industrial Laser Systems
   LOT 6740 Applications of Lasers
3. Indian Hills Community College; Ottumwa, Iowa
   LE 263V Laser Technology
4. Northcentral Technical College; Wausau, Wisconsin
   622-131 High Power Lasers and Accessories
5. Pueblo Community College; Pueblo, Colorado
   PHV 133 Pulsed Laser Systems
6. Springfield Technical Community College; Springfield, Massachusetts

Section C: Implementation

[redacted]

0.208 FTE additional faculty. (For the source of this faculty resource see pg. 23 of "SSHE Requirements for New Programs".)

C2 Other Resources

a. Space

Most of this course will be taught using space belonging to the Electro-Optics Center (EOC). For the part in the IUP space it is anticipated that a new building will be constructed at the North Pointe (Slate Lick) site before this program starts