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CURRICULUM PROPOSAL COVER SHEET
University-Wide Undergraduate Curriculum Committee

I. CONTACT

Contact Person Dennis Whitson and W. Larry Freeman Phone 7-4593/4592

Department Physics

II. PROPOSAL TYPE (Check All Appropriate Lines)

X **COURSE** Fiber Optics
Suggested 20 character title

X New Course* EOPT 240 Fiber Optics
Course Number and Full Title

____ Course Revision _____
Course Number and Full Title

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____ Liberal Studies Approval+ for new or existing course _____
Course Number and Full Title

____ Course Deletion _____
Course Number and Full Title

____ Number and/or Title Change _____
Old Number and/or Full Old Title

_____
New Number and/or Full New Title

____ Course or Catalog Description Change _____
Course Number and Full Title

PROGRAM: _____ Major _____ Minor _____ Track

____ New Program* _____
Program Name

____ Program Revision* _____
Program Name

____ Program Deletion* _____
Program Name

____ Title Change _____
Old Program Name

_____
New Program Name

III. Approvals (signatures and date)

Kenneth E. Hershman 11/16/00
Department Curriculum Committee

Richard D. Roberts 11/16/00
Department Chair

College Curriculum Committee 12/6/00

John D. Ed 1/12/01
College Dean

_____

+Director of Liberal Studies (where applicable)

1/15/01
*Provost (where applicable)

Syllabus of Record for EOPT 240

I. Catalog Description

EOPT 240 Fiber Optics

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

Prerequisite: EOPT 120

This course covers basic concepts in fiber optics such as dispersion, attenuation, single-mode and multimode propagation. Fiber optic test equipment such as optical time domain reflectometers and optical power meters will be discussed and investigated. Sources, detectors, and optical amplifiers will be covered. A lab component is included with this course.

II. Course Objectives

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

1. Explain and apply some of the basic concepts of the optical fiber.
2. Describe and operate fiber optic test equipment.
3. Explain and employ the optical components.
4. Discuss the optical cables and their properties.
5. Explain and use fiber optic networks.
6. Discuss and employ fiber optic sensors.

III-A. Course Outline for Lectures (28 hrs)

A. Basic Concepts (5 hrs)
   1. Wavelength and Bandwidth
   2. Modal and Chromatic Dispersion
   3. Attenuation and Return Loss
   4. Spectral Width, FWHM, Center & Peak Wavelength
   5. Basic System Components
   6. Single-mode and Multi-mode Systems

B. Fiber Optic Testing (3 hrs)
   1. Optical Time Domain Reflectometer (OTDR)
   2. Optical Power Meter

C. Sources (3.5 hrs)
   1. Lasers and diodes
   2. Transmitters Characteristics
   3. Output Power
   4. Data Rate

5. Output Spectrum
6. Rise/Fall Times

D. Detectors (3.5 hrs)
1. Avalanche Photodiodes (APD'S)
2. Pin Photodiodes
3. Receivers
4. Data Rate
5. Bit Error Rate (BER)
6. Rise/Fall Times

E. Amplifiers (2 hrs)
1. Erbium doped fiber amplifiers (EDFA)

F. Optical Cable (4 hrs)
1. Fiber Cable Types and Applications
2. Cable Construction: Core/Cladding/Buffer
3. Jacket Types and Strength Members
4. Optical Cable Specifications
5. Bend Radius and Tensile Strength
6. Micro and Macro Bends
7. Fiber Joints
   a. Splices and Connectors
   b. Optical Backplanes

G. Fiber Optic Applications (5 hrs)
1. Fiber Optic Networks
   a. topology
   b. designs
   c. specifications
   d. applications
2. Fiber Optic Sensors
   a. design
   b. applications
3. Future Fiber Optic Applications

Testing (2 hrs)

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

A. Introduction (1 lab)
1. Lab Safety
2. Lab Practice
3. Technical Writing
   a. Notebooks
   b. Lab Reports
4. Rules and Regulations

B. Fiber Preparation and Light Coupling (1 lab)
   1. Stripping and cleaving fibers
   2. Coupling laser beam to fiber

C. Optical Measurements (1.5 lab)
   1. Demonstrate and measure total internal reflection using a semi-circular transparent material.
   2. Demonstrate light guidance through an optical fiber.
   3. Using a coherent bundle observe image transfer.
   4. Differentiate between a multimode and a single-mode optical fiber.
   5. Demonstrate Rayleigh scattering in an optical fiber.

D. More Optical Measurements (1 lab)
   1. Measure the numerical aperture (NA) of a multimode optical fiber.
   2. Determine the mode-field diameter (MFD) of a single-mode fiber.

E. Some Applications to Investigate (1.5 lab)
   1. Liquid Monitor Switch
   2. Vibration Detector
   3. Fiber-Optic Voice-Communication System
   4. Fiber-Optic Data-Transmission System

F. Measure the Attenuation Coefficient of a Multimode Optical Fiber. (1 lab)

G. Fiber Optic Interferometry (1 lab)

H. Fiber Optic Coupler (1 lab)
   1. Using materials provided make a Fiber Optic Coupler
   2. Wavelength Division Multiplexing Using the Fiber Optic Coupler
   3. Measure the Coupler Loss

I. Fiber Optic Splicing (1 lab)
   1. Splice Two Cables Together
   2. Determine the Splice Loss Across a Multimode Fiber Joint.

J. Optical Time Domain Reflectometer (OTDR) (1 lab)
   1. Measure the Loss Per Unit Length of a Fiber
   2. Do an Evaluation on a Splice and a Connector
   3. Locate the Fault in the Fiber Cable.

K. Optical Power Meters (1 lab)
   1. Link Certification
   2. Testing Patch Cables

L. Semiconductor Source Coupling (1 lab)

M. 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

The final grade for the course will be determined as follows:

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

35% Laboratory assignments

7.5% Quizzes in the lecture on the textbook assignments

7.5% Quizzes in the laboratory on the laboratory assignments

Grading Scale:
90-100% : A; 80-89% : B; 70-79%: C; 60-69% : D; below 60% F.

Attendance Policy: The attendance policy will conform to the University wide attendance criteria.

V. Required textbooks, supplemental books and readings

Textbook:
Hecht, Jeff, *Understanding Fiber Optics, 3rd Edition, Prentice Hall*, Upper Saddle River, New Jersey, 1999

Supplemental Readings:
1. Electro-Optics Industry Journals: e.g., *Photonics Spectra, Laser Focus World*, and *Lasers and Optronics*
2. Electro-Optics Catalogs: e.g., *Newport, Melles Griot,* and *Edmond*
3. Handouts

VI. Special resource requirements

None

VII. Bibliography

Cancelliers, G. (Editor), *Single-Mode Optical Fiber Measurement: Characterization and Sensing*, Artech House, 1993

Ghatak, Ajoy and Thyagarajan, K. *Optical Waveguides and Fibers (Module 7), Fundamentals of Photonics (Course 1),* STEP Project, Funded by NSF, 2000

Hecht, Jeff, *City of Light, the Story of Fiber Optics*, Oxford University Press, New York, 1999

Hecht, Jeff, *Understanding Fiber Optics*, Prentice Hall, 1998

Massa, Nick, *Fiber Optic Telecommunications (Module 8), Fundamentals of Photonics (Course 1),* STEP Project, Funded by NSF, 2000

Nalwa, H., *Photodetectors and Fiber Optics*, Academic Press, 2001

Palais, Joseph, *Fiber Optic Communications, 4th Edition*, Prentice Hall, Upper Saddle River, New Jersey, 1998

Pearson, Eric, *The Complete Guide to Fiber Optic Cable System Installation*, Delmar, International Thomson Publishing, 1997

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

The Photonics Design & Applications Handbook 45th Edition, Photonics Spectra, 1999

Sterling, Donald, Jr., *Technician's Guide to Fiber Optics, 3rd Edition*, Delmar, Thomson Learning, Albany, New York, 2000

Course analysis Questionnaire
EOPT 240, Fiber Optics

Section A: Details of the Course

A1 This course is a requirement for the proposed degree Associate in Applied Science in Electro-Optics (A.A.S.E.O.) and as a choice of 2 out of 3 courses for the proposed degree Associate in Science in Electro-Optics (A.S.E.O.). This course is not intended for inclusion in the Liberal Studies program.

A2 This course does not require changes in any other courses in the department. The Applied Physics program will have an additional track associated with the A.S.E.O. degree and this course will be part of the choices for that track.

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 241 Introduction to Fiber Optics
2. Central Carolina Community College; Lillington, North Carolina
   LEO 223 Fiber Optics
3. Cincinnati Technical College; Cincinnati, Ohio
   LOT 6741 Introduction to Fiber-Optics
4. Indian Hills Community College; Ottumwa, Iowa
   LE 261V Fiber Optics
5. Monroe Community College; Rochester, New York
   OPT 153 Fiber Optics
6. Pueblo Community College; Pueblo, Colorado
   PHV 231 Fiber Optics
7. Springfield Technical Community College; Springfield, Massachusetts
   EL 348 Fiber Optic Communication
8. Texas State Technical College; Waco, Texas
   LET 1003 Introduction to Fiber Optics
9. Three Rivers Community / Technical College; Norwich, Connecticut
   PHO 150 Fiber Optics

A7 As far as I know, the contents or skills of this proposed course are not recommended or required by a professional society, accrediting authority, law or other external agency. The content and/or skills of this course cannot be incorporated into an existing course. The material is not covered by any of the existing courses.

Section B: Interdisciplinary Implications

B1 This course will be taught by one instructor.

B2 This course does not overlap with any course offered by any other department at the University.

B3 Seats will be available in this course for students in the School of Continuing Education.

Section C: Implementation

C1 The faculty resources are not adequate. In order to teach this course we need 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
It is anticipated that a new building will be constructed at the North Pointe (Slate Lick) site before this program starts in the Fall of 2002. This building will house the Electro-Optics program. Since this course will be taught for the first time in the Fall of 2003 there should be no problem with space.

b. Equipment
In order to implement this course, we will need approximately $30,000 for hardware and software in the first year of the program.

c. Laboratory Supplies and other Consumable Goods
About $3,000 in the first year and about $2000 per year after that.

d. Library Materials
About $1,000 will be needed in the first year of the program and about $100 in the following years.

e. Travel Funds
None anticipated

C3 No grant funds are associated with the maintenance of this course.

C4 This course will be offered once a year, usually in the Spring semester.

C5 One section of this course will be offered at a time.

C6 Twenty-four students will be accommodated in this course. The nature of the lab activities restricts enrollment to this number.

C7 There is no professional society that recommends enrollment limits or parameters for a course of this nature.

Section D: Miscellaneous

No additional information is necessary.