

SAULT COLLEGE OF APPLIED ARTS & TECHNOLOGY

SAULT STE. MARIE, ONTARIO

COURSE OUTLINE

COURSE TITLE: FIBER OPTIC COMMUNICATIONS

CODE NO.: ELN 318 - 3

PROGRAM: ELECTRONIC TECHNOLOGY SEMESTER: FIVE

AUTHOR: DOUG FAGGETTER

DATE: SEPT 1993 PREVIOUS OUTLINE DATED: MAY 1991

APPROVED:

W. Filipowich
COORDINATOR

Sep 2/93
DATE

D. McConnel
DEAN

93 09 02
DATE

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TOTAL CREDIT HOURS: 48

PREREQUISITE(S): ELN 245

I. PHILOSOPHY/GOALS:

A THIRD YEAR COURSE AT THE TECHNOLOGY LEVEL IN THE NEWLY DEVELOPED HIGH TECHNOLOGY FIELD OF ELECTRONIC COMMUNICATIONS.

THE CONCEPTS OF ANALOG AND DIGITAL MODULATION OF LIGHT-WAVES, THE APPLICATION AND FUNCTIONING OF LASER DIODES, LIGHT EMITTING DIODES AND VARIOUS PHOTO DETECTORS ARE STUDIED. THE ANALYSIS OF THE PROPAGATION MODES OF LIGHT IN OPTICAL FIBERS, SPLICING AND CONNECTING FIBERS, TRANSMITTING AND RECEIVER CIRCUITS ARE ALSO INCLUDED. LABORATORY PROJECTS AND EXPERIMENTS SUPPORT THE THEORY.

II. STUDENT PERFORMANCE OBJECTIVES:

UPON SUCCESSFUL COMPLETION OF THIS COURSE THE STUDENT WILL:

1. UNDERSTAND THE PHYSICS OF LIGHT AS IT APPLIES TO OPTICAL FIBERS;
2. BE FAMILIAR WITH THE CONSTRUCTION OF OPTICAL FIBERS AND OPTICAL FIBER CABLES;
3. UNDERSTAND THE OPERATION OF OPTICAL FIBER LIGHT SOURCES AND DETECTORS AND ASSOCIATED CIRCUITS;
4. BE FAMILIAR WITH OPTICAL FIBER COUPLERS AND CONNECTORS;
5. BE FAMILIAR WITH FIBER OPTIC DISTRIBUTION SYSTEMS.

III. TOPICS TO BE COVERED:

1. FIBER OPTIC COMMUNICATION SYSTEMS;
2. OPTICS;
3. OPTIC FIBER WAVEGUIDES;
4. LIGHT SOURCES;
5. LIGHT DETECTORS;
6. COUPLERS AND CONNECTORS;
7. DISTRIBUTION SYSTEMS;
8. MODULATION.

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IV. LEARNING ACTIVITIES

REQUIRED RESOURCES

1. FIBER OPTIC COMMUNICATIONS SYS.
 - DEFINE FIBER OPTICS
 - BLOCK DIAGRAM OF A FIBER OPTIC SYSTEM
 - ADVANTAGES AND DISADVANTAGES
 - APPLICATIONS

2. OPTICS
 - QUANTUM MECHANICS
 - THE ELECTROMAGNETIC SPECTRUM
 - RAY THEORY AND APPLICATIONS, FOUR RULES OF RAY THEORY
 - LENSES
 - NUMERICAL APERTURE
 - SOLID ANGLE
 - PHYSICAL OPTICS
 - RADIOMETRIC AND PHOTOMETRIC UNITS
 - DISPERSION, PULSE DISTORTION, AND INFORMATION RATE
 - POLARIZATION
 - REFLECTION AT A PLANE BOUNDARY

3. OPTIC FIBER WAVEGUIDES
 - STEP-INDEX FIBER
 - GRADED-INDEX FIBER
 - MODES AND MODAL DISTORTION
 - ATTENUATION
 - CONSTRUCTION OF OPTIC FIBERS

4. LIGHT SOURCES
 - LIGHT-EMITTING DIODES (LED)
 - HOMOJUNCTION LEDs
 - HETEROJUNCTION LEDs
 - LED OPERATING CHARACTERISTICS
 - LASER PRINCIPLES
 - LASER DIODES (LD)
 - LD OPERATING PRINCIPLES

TEXT: FIBER OPTIC COMMUNICATIONS, 2nd. ed., J. C. PALAIS.

CH.1

CH.2,3

CH.5

CH.6

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LEARNING ACTIVITIES

REQUIRED RESOURCES

5. LIGHT DETECTORS
 - PRINCIPLES OF PHOTODETECTION
 - PHOTOMULTIPLIERS
 - SEMICONDUCTOR PHOTODIODES
 - PIN PHOTODIODES
 - AVALANCHE PHOTODIODES

6. COUPLERS AND CONNECTORS
 - CONNECTOR PRINCIPLES
 - FIBER END PREPARATION
 - SPLICES
 - CONNECTOR TYPES
 - SOURCE COUPLING

7. DISTRIBUTION SYSTEMS
 - DISTRIBUTION NETWORKS
 - DIRECTIONAL COUPLERS
 - STAR COUPLERS
 - SWITCHES
 - WAVELENGTH-DIVISION MULTIPLEXING

8. MODULATION
 - LED MODULATION AND CIRCUITS
 - LD MODULATION AND CIRCUITS
 - ANALOG MODULATION FORMATS
 - DIGITAL MODULATION FORMATS
 - OPTIC HETERODYNE RECEIVERS

9. LAB ACTIVITIES
 - BIASING LEDs
 - FIBER OPTIC LEDs
 - PHOTODETECTORS
 - FIBER OPTIC SYSTEMS
 - INTERFACING RS-232C, TTL AND CMOS SIGNALS TO FIBER OPTIC LEDs AND DETECTORS.
 - LINK TWO PERSONAL COMPUTERS WITH OPTICAL FIBERS
 - OTHER LABS AS INTERESTS AND TIME PERMIT

CH.7

CH.8

CH.9

CH.10

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V. **EVALUATION METHODS**

TESTS	70%
LAB EXERCISES	30%
TOTAL	100%

THE GRADING SYSTEM USED WILL BE AS FOLLOWS:

A+ = 90 - 100% A = 80 - 89% B = 70 - 79% C = 55 - 69%
R REPEAT

NOTES: THE STUDENT MUST ATTAIN A 55% IN BOTH THEORY AND LAB PORTIONS TO SUCCESSFULLY COMPLETE THE COURSE.

IF A STUDENT MISSES A TEST HE/SHE MUST HAVE A VALID REASON (ie. MEDICAL OR FAMILY EMERGENCY). IN ADDITION THE SCHOOL MUST BE NOTIFIED BEFORE THE SCHEDULED TEST SITTING. THE STUDENT SHOULD CONTACT THE INSTRUCTOR INVOLVED. IF THE INSTRUCTOR CANNOT BE REACHED LEAVE A MESSAGE WITH THE DEAN'S OFFICE OR THE COLLEGE SWITCHBOARD. IF THIS PROCEDURE IS NOT FOLLOWED THE STUDENT WILL RECEIVE A MARK OF ZERO ON THE TEST WITH NO REWRITE OPTION.

VI. **REQUIRED STUDENT RESOURCES:**

TEXT BOOKS: FIBER OPTIC COMMUNICATIONS, SECOND EDITION.
J. C. PALAIS. PRENTICE HALL, 1984.

VII. **ADDITIONAL RESOURCE MATERIALS AVAILABLE IN THE COLLEGE LIBRARY BOOK SECTION:**

BAKER, D. G. FIBER OPTIC DESIGN AND APPLICATIONS. RESTON PUBLISHING COMPANY, INC., 1985. TA 1800.B35

LACY, E. A. FIBER OPTICS. PRENTICE HALL, INC., 1982.
TK 5103.5.L3

MOTOROLA. OPTOELECTRONICS DEVICE DATA, REV. 2. MOTOROLA, INC., 1988. TA 1750.M68

YEH, C. HANDBOOK OF FIBER OPTICS: THEORY AND APPLICATION. ACADEMIC PRESS, INC., 1990. TA 1800.Y44

VIII. **SPECIAL NOTES:**

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THE GRADING SYSTEM WILL BE AS FOLLOWS:

A = 90 - 100% B = 80 - 89% C = 70 - 79% D = 60 - 69% F = 50 - 59%

NOTE: THE STUDENT MUST ATTAIN A 50% IN BOTH THEORY AND LAB PORTIONS TO SUCCESSFULLY COMPLETE THE COURSE.

IF A STUDENT MISSES A TEST BECAUSE HE OR SHE MUST HAVE A VALID REASON (i.e. MEDICAL OR FAMILY EMERGENCY), IN ADDITION THE SCHOOL MUST BE NOTIFIED BEFORE THE SCHEDULED TEST DATE. THE STUDENT SHOULD CONTACT THE INSTRUCTOR IMMEDIATELY IF THE INSTRUCTOR CANNOT BE REACHED (HAVE A MESSAGE WITH THE DEAN'S OFFICE OR THE COLLEGE SWITCHBOARD). IF THIS PROCEDURE IS NOT FOLLOWED THE STUDENT WILL RECEIVE A MAKE UP TEST ON THE TEST WITH NO REWRITE OPTION.

REQUIRED STUDENT RESOURCES:

TEXT BOOKS: FIBER OPTIC COMMUNICATIONS, SECOND EDITION, G. C. PALAIS, PENTICE HALL, 1984.

ADDITIONAL RESOURCE MATERIALS AVAILABLE IN THE COLLEGE LIBRARY BOOK SECTION:

FAKNER, D. G. FIBER OPTIC DESIGN AND APPLICATIONS, PENTICE PUBLISHING COMPANY, INC., 1982, TR 1802.833

LADY, E. A. FIBER OPTICS, PENTICE HALL, INC., 1984, TR 8163.814

MOTOROLA, OPTOELECTRONICS: DEVICE DATA, REV. 2, MOTOROLA, INC., 1988, TR 752.868

TEH, C. HANDBOOK OF FIBER OPTICAL THEORY AND APPLICATION, ACADEMIC PRESS, INC., 1990, TR 1800.744

SPECIAL NOTES: