SAULT COLLEGE OF APPLIED ARTS & TECHNOLOGY

SAULT STE. MARIE, ONTARIO

COURSE OUTLINE

Course Title: MICROWAVE & RADAR

Code No.: ELN 307-3

Program: ELECTRONIC TECHNOLOGY

Semester: FIVE

Date: AUGUST, 1985

Author: P. SZILAGYI

New: ______ Revision: X

APPROVED: Chairperson ______ Date ______

CALENDAR DESCRIPTION

MICROWAVE & RADAR	ELN 307-3
Course Name	Course Number

PHILOSOPHY/GOALS:

A third year course at a 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, transmitter and receiver circuits are also included.

Laboratory projects and experiments support the theoretical concepts.

METHOD OF ASSESSMENT:

3 written tests, weighted at	75%
lab activity, weighted at	25%
	100%

TEXTBOOK(s):

"Fiber Optics" by E. Lacy

REFERENCE TEXTS:

"Fiber Optics, Theory and Applications" - Video Conference Guide

COURSE OBJECTIVES

BLOCK 1 **BASIC THEORY AND OPERATION**

- advantages
- fundamentals of light
- light measurements
- light series and transmitters
- direct and indirect modulation

BLOCK II **OPTICAL FIBERS**

- glass and plastic fibers
- light propagation modes
- unidirectional and bidirectional transmission
- fiber losses
- cable configurations
- splices, connectors and couplers

BLOCK III **OPTICAL DETECTORS**

- photoemissive, photoconductive and photovoltic effects
- photo diodes and phototransistors
- receivers
- typical systems
- measurements and measuring instruments

LABORATORY EXPERIMENTS

1. BIASING LIGHT EMITTING DIODES

   OBJECTIVES: The forward and reverse characteristics of light emi diodes, radiation patterns reverse voltage protection.

2. FIBER OPTIC LED's

   OBJECTIVES: To demonstrate the similarities ad differences betwe conventional LED's and fiber optic LED's.

3. PHOTODETECTORS

   OBJECTIVES: To demonstrate the operation of phototransistors and simple IC receiver.

4. <u>FIBER OPTIC SYSTEMS</u>

OBJECTIVES: To demonstrate a working fiber optic system.

5. <u>INTERFACING TO OPTICAL FIBER</u>

OBJECTIVES: To interface RS-232, TTL, CMOS level signals to optical fibers.

6. <u>MICROPROCESSOR TO FIBER OPTIC INTERFACE</u>

OBJECTIVES: To generate and output a PWM signal from a 6800 microprocessor and transmit it down an optical fiber.

7. <u>EVALUATION OF OFF-SHELF FO EQUIPMENT</u>

OBJECTIVES: To evaluate the Hewlett-Packard HFBR-0260 Fiber Optic transceiver and the Motorola MFOL 02RIT fiber optic link.

<u>SPECIFIC OBJECTIVES</u>

After the completion of Block I, the student shall be able to recall the advantages of fiber optic technology.

- Draw the block diagram of a fiber optic communication system
- Recall and apply Snell's Law and calculate the critical angle of two different medium
- Convert between radiometric and photometric light measurement units
- Determine the size of a solid angle
- Solve numerical examples based on "SI" light measurement units
- Explain the functioning of Al - Ga - As LED's and injection laser dio
- Compare the characteristics and applicability of LED's and Laser's
- Draw the transmission losses versus wavelength characteristics of opt fibers
- Explain the difference between surface emitting LED, Burrus LED, edge emitters
- Understand the block diagram of a laser driver with temperature stab ation and laser driver with integral optical feedback
- Understand direct and indirect modulation of light sources and wavel division multiplexing
- Convert between light frequency and wavelength

After the completion of Block II, the student shall be familiar with t construction of an optical fiber, recall the advantages of glass and/c plastic core and cladding.

- Recall the reflective and refractine propagation mode in step index anc grade index fiber. Compare single mode and multi-mode operation.
- Calculate the acceptance code of a given fiber
- Calculate the numerical aperture
- Compare the bandwidth of an optical fiber to the bandwidth of a coaxia cable
- Enlist the types of losses in optical fiber
- Explain absorption, scattering and radiation
- Explain signal delay, model dispersion, pulse dispersion and chromatic dispersion
- To be familiar with cable configurations, coatings, strength bearing materials, protective jackets, armor protection, fiber fit in the tube and the bundle concept
- Enlist types of splices, connectors and couplers
- Identify causes of optical losses, like misalignment, displacement, surface finish
- Be able to calculate dB losses from % losses or % losses from given dB losses
- Recall types of connectors: tube method, straight sleeve, double eccentric, tapered sleeve, three rod, fewel bushing, four pin resilien ferrules
- Recall types of couplers: Transmissive star, reflective star, directional couplers with optical tap-off, direct electrical tap-off, directional couplers for duplex transmission
- Be able to draw and explain the star and loop bus configuration

After the successful completion of Block III, the student will be able t

- enlist the main applications of the photoemissive, photoconductive and photovoltak effect.
- compare and explain the attributes of various optical detectors; like: bandwidth, quantum efficiency, noise, dark current, spectral response
- identify the cross-sectional views and explain the functioning of PN photo function, PIN diode, Schottky photodiode, Avalanche photodiode (APD), phototransistor and photo darlington.
- calculate photodetector responsivity for given wavelength and quantum efficiency.
- calculate maximum bandwidth of a photodetector
- analyse the circuit diagram of various receivers with integrated photodetectors, analog IC's and digital output drivers
- analyse the block diagram of a typical commercial FO system
- do measurements with an optical power meter
- explain the principle of functioning of an optical time domain reflectometer.