

SYLLABUS: ECE 476 Electro-Optics, FALL 2019.

TIME: T – TH, 8:30 – 9:50 a.m. Room 3400 Engineering Building

PRE-REQ: ECE 302 and ECE 303 and ECE 305

INSTRUCTOR: Nelson Sepulveda (nelsons@egr.msu.edu)

Room C-127 Engineering Research Complex, Phone 517-432-2130

OFFICE HOURS: Scheduled: Tue and Thu: 7:30-8:30am. Monday 10:15am-10:45am. Also, by appointment. Room 2308-A EB.

COURSE WEB SITE: The primary web site is via the MSU D2L Course Management System. Login with your MSU ID and password at <https://d2l.msu.edu/>.

COURSE DESCRIPTION: Operational theory, characteristics and applications of optical components, light emitting diodes, lasers, laser diodes, photodetectors, photovoltaics, fiber optics, optical modulators and non-linear optical devices.

TEXT: The text is by S. O. Kasap, Optoelectronics and Photonics, Second edition, Prentice Hall, 2012.

LIBRARY RESERVE: The following materials are supplemental to the text, and can be found in the Main Library.

- B. G. Streetman and S. Banerjee, Solid State Electronic Devices, 6th Ed., : Prentice Hall, 2006. (ECE 474 text).
- M. A. Karim, Electro-Optical Devices and Systems, PWS-Kent Publishing Co., Boston,
- C. L. Chen, Elements of Optoelectronics and Fiber Optics, Irwin, 1996.

GRADING:

Midterm Exams (2): 60% (30% each)

Lab: 33%

Class participation: 7%

4pt scale course grades will be determined as follows:

4.0 (100-90%)	3.5 (89-85%)	3.0 (84-80%)	2.5 (79-75%)	2.0 (74-70%)	1.5 (69-65%)	1.0 (64-50%)	0.0 (49-0%)
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The exams are closed book and notes. Students can bring a single-page “cheat-sheet”, which can only contain equations, typical constants and variables, and tables. Unless stated otherwise, bring a calculator to the exams. You may use any scientific or graphing calculator, unless it has features described on the “Prohibited” list. Note: you may NOT use cell phones or any other communication device during an exam.

Prohibited:

- Handheld or laptop computers;
- Electronic writing pads or pen-input devices;
- Calculators built into cell phones or other electronic communication devices;
- Calculators with a typewriter keyboard (keys in QWERTY format).

Makeup Policy: A zero will be given for missed exams unless extenuating circumstances exist and/or arrangements are made with the course instructor prior to the assignment due date.

EXAM SCHEDULE: The midterm exams will be given in class during the regularly scheduled class time (1 hour and 20 minutes). The dates of the midterm exams are the following:

1. (1) October 15th and (2) December 5th 2019.
2. There will be no Final Exam for this course.

OTHER IMPORTANT DATES:

8/28/18 Classes begin for Fall semester 2019

09/02/18 Labor Day, no classes

09/23/2018 (8:00pm) End of tuition refund period--no refund after this date.

10/16/2018 (8:00pm) Last day to drop with no grade reported

10/16/18 Middle of Semester -- Last day for Fall 2018 withdrawal or dropping courses with no grade reported

11/28 – 11/29 Thanksgiving Break, no classes

12/06/18 Last class day

ACADEMIC HONESTY: Article 2.3.3 of the Academic Freedom Report states: “The student shares with the faculty the responsibility for maintaining the integrity of scholarship, grades, and professional standards.” In addition, this instructor adheres to the University regulations, policies, and ordinances on academic honesty and integrity, as specified in General Student Regulation 1.0, Protection of Scholarship and Grades; the all-University Policy on Integrity of Scholarship and Grades; and Ordinance 17.00, Examinations, all of which are available on the MSU Web site (www.msu.edu). Students who violate these rules may receive a penalty grade, including, but not limited to, a failing grade on the assignment or in the course. The following conduct is specifically cited: (1) Supplying or using work or answers that are not one's own; (2) Providing or accepting assistance with completing assignments or examinations; (3) Interfering through any means with another's academic work; (4) Faking data or results.

COURSE OUTLINE¹

I. Wave nature of light (chapter 1).

- a. Review on Electromagnetic Waves.
- b. Refractive Index.
- c. Group and Phase Velocities.
- d. Poynting Vector
- e. Fresnel Equations
- f. Snell's Law and Total Internal Reflection (TIR).
- g. Diffraction Principles

II. Dielectric Waveguides and Optical Fibers (4 lectures, chapter 2 and handouts).

- a. Waveguide Condition, Modes, and Dispersion.
- b. Step Index Fiber.
- c. Numerical Aperture.

¹ Note: Depending on the interest of the class, the instructor may make changes to the list of topics. This will apply particularly for the topic of lasers, which may be replaced with solar cells.

- d. Dispersion in Fibers.
- e. Bit rate, Dispersion, Electrical, and Optical Bandwidth
- f. Light Absorption and Scattering.
- g. Attenuation in Optical Fibers.

FIRST MIDTERM EXAM

III. Semiconductor Science and Light Emitting Diodes (chapter 3).

- a. Energy Band Diagrams.
- b. Direct and Indirect Bandgap Semiconductors.
- c. p-n junctions.
- d. Light Emitting Diodes.
- e. LED Materials.

IV. LASER (chapter 4).

- a. Stimulated Emission and Photon Amplification.
- b. Optical Fiber Amplifiers.
- c. Gas LASER Spectrum and the He-Ne LASER.
- d. Principle of the LASER Diode and Characteristics.
- e. Light emitters for optical Fiber Communications.
- f. Single Frequency Solid State LASERS.
- g. Quantum Well Devices.
- h. VCSELs and Optical LASER Amplifiers.
- i. Holography.

V. Photodetectors (chapter 5).

- a. Principle of the pn junction photodiode.
- b. External Photocurrent, Absorption Coefficient, and Photodiode Materials.
- c. Quantum Efficiency.
- d. pin Photodiodes and Phototransistors.
- e. Noise in Photodetectors.

SECOND MIDTERM EXAM