COURSE TITLE: Optoelectronics and Photonics

CREDIT HOURS: 3

COURSE NUMBER: EEG 410

PREREQUISITES: General Physics, Modern Physics, Calculus II.

COURSE DESCRIPTION (as in the university bulletin): This course introduces students to a broad range of modern optoelectronic applications and devices. It starts with a review of physical and geometrical optics, followed by an introduction into fiber optics, lasers and LEDs, photodetectors, and photovoltaic devices. Core course for students who choose to specialize in electrical engineering, elective for others. Offered annually. Three lecture hours and one three-hour laboratory per week are required, 3 credits.

REQUIRED TEXT(S)/MATERIALS: S.O. Kasap, Optoelectronics and Photonics: Principles and Practices, 2013, 544pp. Supplemental material will be made available.

COURSE STUDENT LEARNING OUTCOMES:
Optoelectronic and Photonics is taught as set of lectures introducing junior/senior students to principles of physical optics, photonics, fiber optics, basic semiconductor physics, solid-state optoelectronic devices, including lasers, LEDs, photodetectors, and solar cells, polarization and modulation of light. Lectures are supplemented by related labs that provide students with hands-on experiences. Experiments can be performed and presented by groups of 2-3 students.

As this course progresses and at the conclusion of this course, the student will be able to do the following:

1. Solve analytical and design problems in physical optics and fiber optics;
2. Understand how photodetectors, LEDs, lasers, and solar cells work, and be able to design simple optoelectronic systems such as fiber optic and free space communication channels, interferometers, simple imaging systems.
3. Measure several parameters of optoelectronic systems such as attenuation, bit error rate, frequency dispersion, and relate these to the system designs.

Alignment of the course SLOs with ABET and University core SLOs

<table>
<thead>
<tr>
<th>Course SLO</th>
<th>Program/ABET SLO</th>
<th>University.Core SLO</th>
<th>Indirect/Direct Assessment Measures*</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>a/c/d/e/k</td>
<td>1/2/3/4</td>
<td>1/4/5</td>
</tr>
<tr>
<td>2</td>
<td>a/b/c/k</td>
<td>1/2/3/4</td>
<td>1/4/5</td>
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<tr>
<td>3</td>
<td>a/b/e</td>
<td>1/2/3/4</td>
<td>1/4/5</td>
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PROGRAM STUDENT LEARNING OUTCOMES (ABET Student learner Outcomes):

a) an ability to apply knowledge of mathematics, science, and applied sciences
b) an ability to design and conduct experiments, as well as to analyze and interpret data
c) an ability to formulate or design a system, process, or program to meet desired needs
d) an ability to function on multidisciplinary teams
e) an ability to identify and solve applied science problems
f) an understanding of professional and ethical responsibility
g) an ability to communicate effectively
h) the broad education necessary to understand the impact of solutions in a global and societal context
i) a recognition of the need for and an ability to engage in life-long learning
j) a knowledge of contemporary issues
k) an ability to use the techniques, skills, and modern scientific and technical tools necessary for professional practice.

CORE CURRICULUM STUDENT LEARNER OUTCOMES:

1. Listen and effectively communicate ideas through written, spoken and visual means. (communication)
2. Think critically via classifying, analyzing, comparing, contrasting, hypothesizing, synthesizing, extrapolating and evaluating ideas. (Critical thinking)
3. Apply information literacy/research skills to assist their systematic process of critical thought; articulating the problem; gather information from multiple sources and venues; evaluating the accuracy/thoroughness/timeliness of the collected data, and determining when/if the problem has been satisfactorily resolved. (Information Literacy/Research)
4. Apply and evaluate quantitative reasoning through the disciplines of mathematics, computational science, laboratory science, science, selected social sciences and other like-minded approaches that require precision of thought. (Quantification)

DIRECT AND INDIRECT ASSESSMENT MEASURES FOR EACH SLO

1. Laboratory reports measured by rubrics for student’s competency in effectively communicating the hypothesis, purpose, methods, results and analysis of an experiment. 75% of students should reach the minimally acceptable score of 75% (C).
2. Essays assessed by rubrics to measure effective communication of biological concepts. 50% of the students should reach the minimally acceptable score of 75% (C).
3. Research papers assessed by rubrics to measure students’ ability to use the scientific literature to research a topic and to use that research to write grammatically-correct, coherent and well supportive paper. 75% of students should reach the minimally acceptable score of 75% (C).
4. Pre and post-test questions using select course and program SLO-specific questions to assess learning. 85%-100% of the students should demonstrate learning gains on the post-test and 50% of the students should reach the minimally acceptable score of 75% (C).
5. Select multiple choice questions on hour and final examinations designed to measure specific SLOs. 75% of students should reach the minimally acceptable score of 75% (C).
6. Short answer questions on hour and final examinations designed to measure specific SLOs. 75% of students should reach the minimally acceptable score of 75% (C).
7. Essay questions on hour and final examinations designed to measure specific SLOs. 75% of students should reach the minimally acceptable score of 75% (C).
CALCULATION OF FINAL GRADES:
The final grade shall be the average of grades earned on quizzes, tests, assignments, laboratory reports, midterm and final examinations. The final examination is comprehensive and includes everything covered during the semester.

Course Evaluation
Homeworks 20%
Labs 30%
Final Exam 50%
Total 100%

<table>
<thead>
<tr>
<th>A grades (%)</th>
<th>B grades (%)</th>
<th>C grades (%)</th>
<th>D and F grades (%)</th>
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</thead>
<tbody>
<tr>
<td>A = 95 – 100</td>
<td>B+ = 87 – 89</td>
<td>C+ = 77 - 79</td>
<td>D+ = 66 - 69</td>
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<tr>
<td>A− = 90 – 94</td>
<td>B = 84 - 86</td>
<td>C = 74 - 76</td>
<td>D = 55 - 65</td>
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<tr>
<td></td>
<td>B− = 80 - 83</td>
<td>C− = 70 - 73</td>
<td>F = below 55</td>
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SCHEDULE OF LEARNING OPPORTUNITIES (ASSIGNMENTS):

<table>
<thead>
<tr>
<th>Week</th>
<th>Start Date</th>
<th>Chapter(s)</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>8/24</td>
<td>1.1, 1.2. Light propagation in homogeneous media. Frequency Dispersion.</td>
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<tr>
<td>2</td>
<td>TBD</td>
<td>1.3, 1.4. Group velocity and Poynting’s vector.</td>
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<tr>
<td>3</td>
<td>TBD</td>
<td>1.5, 1.6. 1.7. Snell’s law, reflection, transmission, total internal reflection, antireflection coatings.</td>
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<td>4</td>
<td>TBD</td>
<td>1.8, 1.9. Absorption of light. Spatial and temporal coherence.</td>
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<td>5</td>
<td>TBD</td>
<td>1.10, 1.11, 1.12. Interference, resonators, diffraction.</td>
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<tr>
<td>6</td>
<td>TBD</td>
<td>2.3, 2.4. Optical fibers, light coupling to optical fibers.</td>
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<tr>
<td>7</td>
<td>TBD</td>
<td>2.5, 2.6, 2.7. Dispersion in single-mode fibers. Bit error rate, dispersion, optical and electric bandwidth.</td>
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<tr>
<td>8</td>
<td>TBD</td>
<td>2.9, 2.10. Attenuation in optical fibers. Fabrication methods.</td>
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<td>9</td>
<td>TBD</td>
<td>3.1, 3.2, 3.3. Basic semiconductor physics, p-n junction</td>
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<td>10</td>
<td>TBD</td>
<td>3.11, 3.12, 3.13. Light emitting diodes.</td>
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<tr>
<td>11</td>
<td>TBD</td>
<td>4.1, 4.2, 4.4, 4.9. Gas and semiconductor lasers.</td>
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<tr>
<td>12</td>
<td>TBD</td>
<td>5.1, 5.3, 5.4, 5.5. Photodetectors.</td>
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<tr>
<td>14</td>
<td>TBD</td>
<td>6.1, 6.2. Light polarization, anisotropic materials.</td>
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<td>16</td>
<td>TBD</td>
<td>6.5. Liquid crystal displays.</td>
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<tr>
<td>17</td>
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<td>Final Exam</td>
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Attendance and other policies:
Attendance is required and will be taken each class. In accordance with University Policy, (see handout) you will be allowed four unexcused absences. Any student missing four or more classes will automatically fail the course. Students are expected in class on time. Lateness will not be tolerated. Three tardiness' constitute one absence.

Tests missed due to excused absences must be made up within one week. There will be no make-up exam/test for unexcused absences.

Please, switch off your phones before entering the classroom. Receiving and making calls during classes will not be tolerated. It constitutes disruption and distraction to the professor and the students.

Students are required to purchase the prescribed book for this class. It will be practically impossible for any student to attain the expected learner outcomes in this course without owning a book.

Academic integrity

Lincoln University faculty approved a statement on academic integrity in November 1995. (see handout) For acts of academic dishonesty (cheating or plagiarism), there are three possible sanctions; these include a warning, failure for the project (exam or paper), and failure for the course. The written warning becomes part of your academic file in the Registrar’s Office and, if there are no subsequent incidents of academic dishonesty, the letter will be removed at the time of graduation. For this course, the first instance of academic dishonesty will result in failure for the project; a second instance will result in failure for the course.

1. Academic Integrity. Students are responsible for proper conduct and integrity in all of their scholastic work. They must follow a professor's instructions when completing tests, homework, and laboratory reports, and must ask for clarification if the instructions are not clear. In general, students should not give or receive aid when taking exams, or exceed the time limitations specified by the professor. In seeking the truth, in learning to think critically, and in preparing for a life of constructive service, honesty is imperative. Honesty in the classroom and in the preparation of papers is therefore expected of all students. Each student has the responsibility to submit work that is uniquely his or her own. All of this work must be done in accordance with established principles of academic integrity.

Acts of Academic Dishonesty (Cheating)
Specific violations of this responsibility include, but are not limited to, the following:

- Copying, offering and/or receiving unauthorized assistance or information in examinations, tests, quizzes; in the writing of reports, assigned papers, or special assignments, as in computer programming; and in the preparation of creative works (i.e. music, studio work, art).
- The fabrication or falsification of data, results, or sources for papers or reports.
- The use of unauthorized materials and/or persons during testing.
- The unauthorized possession of tests or examinations.
- The physical theft, duplication, unauthorized distribution, use or sale of tests, examinations, papers, or computer programs.
- Any action that destroys or alters the work of another student.
- Tampering with grades, grade books or otherwise attempting to alter grades assigned by the instructor.
- The multiple submission of the same paper or report for assignments in more than one course without the prior written permission of each instructor.

Plagiarism
If a student represents “another person’s ideas or scholarship as his/her own,” that student is committing an act of plagiarism. The most common form of plagiarism among college students is the unintentional use of others’ published ideas in their own work, and representing these ideas as their own by neglecting to acknowledge the sources of such materials. Students are expected to cite all sources used in the preparation of written work, including examinations. It is each student’s responsibility to find out exactly what each of his/her professors expects in terms of acknowledging sources of information on papers, exams, and assignments.

Students with disabilities

Lincoln University approved a statement on the accommodation of students with disabilities. Lincoln University is committed to non-discrimination of students with disabilities and therefore ensures that they have equal access to higher education, programs, activities, and services in order to achieve full participation and integration into the University. In keeping with the philosophies of the mission and vision of the University, the Office of Student Support Services, through the Services for Students with Disabilities (SSD) Program, provides an array of support services and reasonable accommodations for students with special needs and/or disabilities as defined by Section 504 of the Rehabilitation Act of 1973 and the Americans with Disabilities Act of 1990. The Services for Students with Disabilities Program seeks to promote awareness and a campus environment in which accommodating students with special needs and/or disabilities is natural extension of the University’s goal.

Students with disabilities must inform the relevant office or contact the course instructor.