Course Syllabus

OSE 4951 Senior Design 1

Summer 2020

T, R, 8:00 AM – 10:50 AM Video Streaming

Discussion: Thursdays 10:00 AM – 10:50 AM, Video Streaming

Instructor: Dr. David Hagan
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407-823-6817
Office Hours: Anytime, by appointment

Catalog Description: OSE 4951 OPT-OPT 3(3,0) Senior Design I: PR: OSE 3053 and OSE 4520; CR: OSE 4410 and OSE 4470 and C.I. Development of the technical, communication, and team skills for successful design of optical and photonic systems. Preparation of project proposals for Senior Design II.

Co-teaching with EEL 4914C Senior Design 1:

Photonic Science and Engineering students are expected to engage in interdisciplinary projects with electrical and computer engineering students. For this reason, student will attend all classes with the electrical and computer engineering students enrolled in EEL 4914C Senior Design 1. Most assignments will be common to both courses, however, Dr. Hagan will be responsible for assessment and grading of students enrolled in OSE 4951. The grading standards will be common to both courses, but if there is a strong difference in the level of the photonics vs. the electrical/computer aspects of the projects, there may be a difference in the final grades of the group members. Projects that involve teams of OSE and EEL students and must be approved by the instructors of both OSE 4951 *and* EEL 4914C.

Note that due to a scheduling error in the CECS dean's office, the EEL 4914 class was scheduled with sections on both M,W and T,R. The live lecture will be on M,W. but you can watch the recording if you cannot attend live.

All students have been added to the EEL 4914 webcourse, which we will use exclusively for this class.

In addition to attending all EEL 4914C classes, photonics students must meet weekly as a group with Dr. Hagan in the discussion section with Dr. Hagan, which are held on Thursdays 10:00 AM – 10:50 AM, via Zoom.

The instructors for EEL 4914C are Dr. Lei Wei, HEC---418; and Dr. Samuel Richie, HEC 444

Texts: 1. DESIGN FOR ELECTRICAL AND COMPUTER ENGINEERS, McGraw-Hill (Ch 3)

2. SENIOR DESIGN FOR ELECTRICAL AND COMPUTER ENGINEERINGS STUDENTS, Pearson Custom Publishing (**3 chapters**)

Software: Varies by Project, Circuit Simulation Software, Schematic Capture Software, PCB Software, Matlab, Zeemax, Light Tools, etc.

Attendance in online classes and discussion sessions is required. The final grade will be based on your performance on attendance, exam performance, presentation performance, and final project documentation. In addition, failure to comply with course requirements or expectations may result in a lower grade as determined to be appropriate by the instructor.

Any act of academic dishonesty or unprofessional behavior will result in a failing grade on an exam or in the course.

Course Information

The OSE 4951 and OSE 4952 Senior Design courses are intended to serve as capstone courses for the Photonic Science and Engineering Bachelor of Science Degree. **These courses subject the students to an environment unlike the majority of their previous curriculum.** Students will encounter aspects of engineering design not found in prior coursework. Students will be responsible for their own learning as a team. In other classes, students are given homework, quizzes, labs and tests in a structured and scheduled manner, but in Senior Design it is the team's responsibility to schedule their project, assign responsibilities, build the functioning device or system that meets specifications, document the results of the team's efforts in written reports.

Summary of primary activities in the semester:

Week (Approx.)	Topic
1	Introduction and formation of groups. Initial project idea (individual)
2-4	**LECTURES:** Developing ideas, requirement specification, engineering management, engineering education, design constraints, standards.
3	Initial project documentation (group)
4	Meeting with professors to discuss initial project document.
4-10	Design Testing. Weekly design meeting, collecting data, recording in journal.
5	Submission of revised project documentation.
4-5	**Determination of requirements for prototyping and testing of critical photonics components and subsystems for Senior Design 1**
4	LECTURE: Engineering economics
5	LECTURE: Ethics
6-10	Quizzes on lecture materials. No new lectures.
11	60 page draft of Senior Design I report.

10-12	Design Testing continues. Weekly design meeting, collecting data, recording in journal.
10	Meeting with professors to discuss report and progress.
11	100 page draft of Senior Design I report.
13	**Final exam week. Final report due (120 pages)**

Assessments:

The final grade will be primarily based on the **final project documentation** and the **prototyping and testing of critical project elements.** However, the overall course grade may be modified by attendance and by performance in other elements that are turned in for grading, including the initial project idea, initial project documentation, several draft reports, and quizzes given on the course material will be graded. However, these elements are treated as content in which the student must demonstrate mastery of the material. No grades are assigned, only indications of completion are recorded. If a student fails to demonstrate competency on an assignment, the assignment must be repeating until mastered. All required elements of the course must be mastered in order to receive a passing final grade. All course elements are evaluated by the course instructor. Usually all team members are awarded the same grade, however under certain circumstances team members may receive different grades. In cases where group members do not adequately contribute to the project, members may be dropped from the group and those students will receive a grade of F for the course.

Process for determining subject, specifications and constraints for the engineering design project

The engineering design project is jointly agreed upon by the instructor and a student team of 3 or 4 students, comprised of 1 or two photonics students with 2 or three electrical or computer engineering students. The project must incorporate sufficient open ended design content such that the students demonstrate the ability to identify, formulate, and solve engineering problems. The student team studies the problem, develops design alternatives, and selects an approach which can be implemented. The project should utilize the students' advanced knowledge of photonics, electrical and computer engineering, as appropriate to the particular composition of the team.

The student team may come up with their own ideas, or may choose to work on a problem set bay a faculty or industrial sponsor. Through writing of reports and discussions with the instructors in the first few weeks of the senior design 1 semester, the project may be changed in scope until the goals and specifications of the project are agreed upon jointly between the team and the photonics and ECE instructors.

Students are expected to acquire, prototype and test critical components and subsystems of the project during senior design 1 and provide evidence of this in the draft and final reports. In or around week 6, the instructor will meet with students to determine what are the critical photonics components and subsystems that need to be prototyped and tested. **Failure to do so will result in students' having to retake senior design in a future semester.** This prototyping and testing is required in senior design 1 so that the team is ready to build a functioning device or system that preforms correctly and meets specifications during senior design 2.

List of Topics covered in lectures:

- Introduction
- The Engineering Design Process
- Goals, Objectives, Specifications and Requirements
- Realistic Design Constraints
- Standards Based Design Practices
- The History of Engineering Education
- The Engineering Profession
- Engineering Management
- Engineering Research and Development
- Intellectual Property Protection
- Engineering Economics
- Engineering Ethics
- Engineering Documentation and Technical Presentations

Course goals:

To provide students a complete design experience, including the necessity to set design goals and objectives, integrate knowledge, exercise engineering judgement, plan to meet a budget and a schedule, to work as a team member, and to communicate in writing.

Learning Outcomes

This class is a required course for Photonic Science and Engineering students and serves as the first part of the capstone design course sequence. The course objectives are to enable students to:

- Gain an introduction to Engineering Education and the Engineering Profession
- Learn fundamentals of Engineering Management
- Develop knowledge of realistic design constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.
- Learn standards based design practices
- Gain knowledge of Product Life Cycles, Research and Development, and Intellectual property
- Incorporate appropriate human factors into designs
- Develop knowledge of Engineering Economics
- Recognize and address ethical issues related to design and engineering
- Develop an understanding of the Engineering Design Process, Engineering Teamwork and Project Documentation

Upon completing this course, the students will be able to:

- Identify specific goals of the designed system, including specifications and realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability constraints.
- Collect information on available components and standards related to design needs,
- Develop appropriate models and using computer tools for system analysis,
- Perform testing and failure analysis

- Prepare written proposals and delivering technical information through oral presentations, reports and logbooks
- Work in a team environment
- Recognize and address ethical issues related to design and engineering
- Develop a customer relationship and mentality

Relationship of Course to ABET (Engineering Accreditation) Criteria

ABET Criteria	Level of Emphasis During Course (Low, Medium, High)
1. an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics	M
2. an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors	H
3. an ability to communicate effectively with a range of audiences	H
4. an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts	H
5. an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives	M
6. an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions	H
7. an ability to acquire and apply new knowledge as needed, using appropriate learning strategies	M

COURSE NOTES:

Project Topics

Projects can be in any area of Photonic science and engineering but must also have elements that are suitable for members of the group who are electrical and/or computer engineers. Projects are subject to the instructor's approval. The instructor may propose some projects, however, it is the student's responsibility to find a suitable project. All projects must be physically realized, documented, and demonstrated at the end of the term.

Project Teams

Each project will be designed and implemented by a project team or group with a size restricted to only groups of three or four members. The instructor may assist in the formation of the teams, but you are encouraged to form your own working teams. If necessary, the instructor may dictate the group members. Photonics students are expected to team with electrical and /or computer engineering students. A typical team would have one Photonics student, two electrical and one computer engineering student. It would be very unusual to have more than two photonics students on a team.

Expenses

The university will not provide project parts beyond what is available in school laboratories. The cost of the project may be exclusively yours, exclusively your sponsor's, or may be shared. The most common case is that the project is funded by the student group or by a sponsoring group, agency, or corporation.

NOTE: If project expenses are paid in part or in whole by UCF, then the project becomes the property of the school and it must remain at UCF.

Final Documentation

The required final documentation consists of a formal technical document consisting of research, design, theory of operation, construction and testing.

Laboratory

Note that due to COVID-19, senior design labs are closed and student asr required to exercise social distancing. We are hoping that in the fall you will have access to senior design labs. However you should take care that the projects you are working on will have the possibility of being completed remotely. The college will attempt to loan you the equipment you may need and the Department of Electrical Engineering will send out a test equipment kit to each senior design 2 group. The paragraphs below describe what takes place in normal semesters.

No formal laboratory work is required. However, virtually all projects require hardware prototyping which will include construction and testing. Laboratory space and facilities will be available for this purpose.

In order to protect project installations, only students that are registered in the class will be allowed in the lab. You can work in the EECS senior design laboratories during non---business hours and on weekends by using your college keycards, and if needed requesting entry to the engineering building from the UCF Police Department. Identification will be required. Due to the policy stated below, the police will not provide entry to a single student. A minimum of two students are required when working in the laboratory. Permission to use the Photonics senior design lab will be obtained through Mr.

Michael McKee.

Machine shop course Photonics senior design students must complete a short machine shop course offered by the college of Optics and Photonics before the end of senior design 1 semester.

Safety University policy requires that for safety reasons, at least **two people must be present in the laboratory premises** at any time. Violators will be asked to leave the laboratory premises. Since it is not possible to police this policy at all times, violators will be working entirely at their own risk.

Consultations Consulting on each project will be available either from the course instructor or from any other Optics or ECE Department faculty member who has expertise on the subject of your project. Each team is encouraged to find a faculty member who will act as a technical advisor for the project. Appointments should be made for consultation times.

Important: The grading in the OSE 4952 (senior design 2) course will require that your prototype ***work as specified***. The final device or system must be a robust, engineered system. Optical components mounted on a breadboard are no acceptable. The machine shop course that students must take will help them learn how to make a robust mechanical system to house optical components, etc. Failure to meet this requirement will result in a grade of F or I depending upon the circumstances as dictated by the course instructor.

Final reports for photonics projects MUST contain a section at the end which contains results of testing of the final device or system. Where appropriate, this section should describe any explanation of why specifications or constraints were not met.

Academic activity:

Students' academic activity is required by UCF to be recorded at the beginning of each course. In order to document that you began this course, please complete the following academic activity by the end of the first week of classes or as soon as possible after adding the course, but no later than August 30. Failure to do so may result in a delay in the disbursement of your financial aid. **The assignment to satisfy this requirement is for all students to submit a written description of an idea for a senior design project on or before 12:00 PM (noon) Friday, May 15, 2020. This will be submitted by every student through the EEL 4914 webcourse, and is done by the individual, independent of the project group.**

University of Central Florida

College of Optics and Photonics

OSE 4951/4952

Outline of Senior Design I and II Grading Rubrics

The final goal is to design and build a workable prototype which can be demonstrated to faculty reviewers during the one-hour presentation and demonstration (PD) at the end of Senior Design 2. This document first outlines the grading rubric for Senior Design II, followed the Senior Design I rubric, which is aimed at ensuring students' success in Senior Design II. Due to the complex nature of senior design and the large number of students and projects, this document may not cover all eventualities. Instead, students should use it as a general guideline to understand the grading policy for Photonics Senior Design 1 and 2 at UCF.

Note that plus/minus grading is not used in senior design.

Senior Design II Grading Rubric:

Group Base Grade (GBG):

The based grade for the group in SD2 is determined by averaging over reviewer panel scores after PD with minor adjustment by the instructors (for example, accounting for reviewer bias, level of photonics content, etc.). Averaging score is between 90-100 (A), 80-90 (B), 70-80 (C), 60-70 (D), 60 and below (F). The Reviewer scorings form can be found in the file "Project Reviewer Evaluation Form" in webcourses.

> ***Note 1:*** It is the group's responsibility to form a review panel and submit Project Reviewer Commitment Form on time. Panels for Photonics groups must have representation from Optics and Photonics Faculty. If the group fails to form a panel, then the group will receive F.
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> ***Note 2:*** If the group fails to show up at scheduled presentation or arrive late for 15 minutes or more, then the group will receive F. If one member fails to show up at the final presentation, then this individual will receive F and redo SD1 and SD2.
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> ***Note 3:*** If the group fails to demonstrate their project as workable during the 10-minute demonstration time allocated within the one hour PD to reviewer panel, then the group needs to reschedule the demo within a week (before the final submission date) and receive one letter grade deduction in GBG. If the group cannot demonstrate their project to be workable by then, then the group will receive a grade of F.
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> ***Note 4:*** The Photonics Science and Engineering program requires that the project must have substantial photonics design content, and the photonics systems must be well-constructed consistent with the intended use of the product (not using tape, flimsy materials and usually not optical breadboard). Also, the final resort must include results of testing of the final device or system. The ECE program requires that the project include substantial PCB design. Noncompliance may affect photonics and ECE student differently – see part (A) on individual grades below.

For any group that receives a grade of F, the whole group must EITHER: Redo SD2 if the whole group

can re-enroll together OR: redo SD1 if the whole group cannot hold together or if the Photonics and ECE instructors decide that the group needs to be broken up.

Group Final Grade: Once the group base grade (GBG) is decided, the Photonics and ECE instructors will check the following items to determine the Group Final Grade. Failure to meet the any one of the following requirements will result one letter grade deduction from the GBG. Multiple failures may result in multiple letter grade deductions.

(1) Does the SD2 final report meet the requirements? (page, content, submitting on time, hard copy, soft copy). The SD2 report requirements are identical to the SD1 report requirement.
(2) Were all group activities on time? (CDR presentation absence? Final Presentation on time? CDR meeting on time, middle term demo on time? reviewer commitment form on time?)
(3) Is the group Website ready? Has the group presented at Senior Design Showcase?

For most groups, all team members will typically receive the GFG as his or her individual grade, but some groups each member may receive a different grade according to the following rules.

Justification of each individual grade:

Each team member's grade can be altered from GFG, i.e., each team member may receive a different grade due to following factors. Multiple violations may result multiple letter grade deduction. For example, a student who fails to attend ABET section for 3 times may receive 3 letter grade deductions.

(A) Issues with clearly identifiable parts of the project: For example if the photonics part of the project is trivial, then photonics student(s) will receive a lower grade, or if the PCB does not work, then the ECE student will receive a lower grade. Additionally, if the final resort does not include evidence of testing of the final device or system, the photonics student(s) will receive a letter grade penalty. Also, if, for example, faculty reviewers note that "power did not work", the person in charge of power may receive a lower grade. Another example, "optics part is great", so the person in charge of optics may receive a better grade).
(B) Peer review form (team member peer review form can alter an individual grade, either lower or higher)
(C) Instructor judgement based on whole SD2 performance and attendance of each individual at "ABET" classes, or attendance of group meetings with instructors.

Senior Design I Grading Rubric:

Group Base Grade (GBG):

The base grade for the group in SD1 is determined by three factors: (1) Is the project running on time? (2) Does the project contain substantial design? (3) Do the reports meet the requirement? In an A grade report, we need to see evidence of all of the above.

(1) Is the project running on time? At the end of SD1, each team must show evidence of prototyping and testing of the critical components and subsystems identified with the Photonics Senior design instructor in week 6. This testing must be sufficient to assure the instructors that the project has a good chance of working by the end of senior design 2. If this criterion is not met, the photonics students may have to repeat senior design 2.

(2) Does the project contain substantial design? If the project does not contain substantial design, (particularly optical/photonics design for PSE students and PCB design for ECE students), then the whole project will run into problems in SD2. ECE students must go beyond amateurish or hobbyist-like activities. For example, today, a hobbyist can spend several afternoons to order a few development boards and download a few software programs to perform some nice functions or demonstrate some nice actions. But these hobbyists typically have no idea what are behind these boards and software. Similar, you can buy photodiodes, LEDs, lasers, etc. that come with spec sheets that offer up circuit designs. You, as a photonics engineer, must add something more than this. Your project must, to some extent, rely on the advanced concepts you have learned in your photonics coursework. If the photonics part of the project is something an electrical engineer could have done, then it is not going to merit an A-grade. Also, your ECE team mates must comply with the ECE Major PCB policy, that is, each team must have substantial PCB design and implementation in their project. To ensure this, at the end of SD1, we must see in the A grade report substantial schematic design which can be turned into PCB layout in SD2.

(3) Does the report meet the final report requirement? Detail can be found in Project Documentation Guidelines. In summary, length: 30 originally authored pages per person; line space: 1; page size: 8.5" x 11", with 1" margins (top, right, and bottom), 1.5" left for binding; paragraph: fully justified. Starting from Executive summary, containing Standard and design constraints. Content that is superfluous, irrelevant, or does not directly relate to your project will not be counted towards the page count. In summary, put limitation on the following: white spaces, copy of data sheet material and tutorial material, photos of common items, debug windows, software codes, etc.

Group Final Grade (GFG): Once we decide (GFG), the instructor will check following items to determine GFG. Failure to meet the following requirement (any one aspect) will result one letter grade deduction from GBG. Multiple failures may result multiple letter grade deduction.

(1) Was the SD1 final report submitted on time? (Hard copy, softcopy).
(2) Were all group activities on time? (Divide and Conquer submission and team meeting on time? 60 page, 100-page Draft document submission on time, sufficient page, and meeting on time?)

The Instructors will further check the following factors to determine individual grades:

(A) Successful prototyping and testing of critical photonics components and subsystems. – The photonics students in a group are responsible for this and may receive grade deductions if this is not satisfactorily carried out.
(B) Attendance at "ABET," classes, bootcamp, and Team meetings with instructors (late or absence). Each absence may result one letter grade deduction and can be accumulated.
(C) Passing quizzes. Failure to pass one quiz may result one letter grade deduction, which can be accumulated.
(D) Instructor judgement based on whole SD1 performance of each individual or group peer review form. Instructor may request each individual member in a team to submit his or her individual portion of contribution to the team work or using Group Peer Review Form. These mechanisms aim to identify those individuals who substantially fail to deliver their parts of work in SD1. As a consequence, some individuals may be removed from the team and have to redo SD1 in future.