Spring 2015
OSE 4410L - Optoelectronics Laboratory

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Lab Hours: 12:00 – 3:00 PM (W)

Class room: CREOL A210

Credits: 1 hour, 2 hours seat time

Co-requisite or Prerequisite: OSE 4410 (Optoelectronics)

Catalog description:
Basics of semiconductor optoelectronic devices including photodiodes, light-emitting diodes, laser diodes, CCDs. Applications include solar cells, displays, photodetection, and optical communications.

Detailed description:
This lab course is associated with the theory course on the same topic (OSE 44410) on introduction to the principles, design, and applications of optoelectronic devices. A Basic specification of key optoelectronic devices, including photodiodes, Light-Emitting Diodes (LEDs), diode lasers, LED and Liquid Crystal Displays are experimentally obtained by the students. The experiments include both DC (static) and AC (dynamic) characteristics of the devices and will emphasize both the electrical and optical figures of merit. The advantages and disadvantages of various types of photodetectors and light sources are experimentally and quantitatively studied in the lab.

Goals:
- Verify of various theoretical concepts learned in the lecture class
- Understand how the fundamental cocepts affect the performance of practical optoelectronic devices.
- Learn measurement techniques to characterize optoelectronic devices
- Experiment with basic devices used in equipment for various applications

Textbook:
Optoelectronics and Photonics: Principles and Practices, S. O. Kasap, Prentice Hall, 2001.

References:

Semiconductor Optoelectronic Devices, P. Bhattacharya, 2nd Ed., Prentice Hall, 1997.

Fundamentals of Photonics, B. Saleh and M. Teich, Wiley.

Lab schedule

Date	Lab No.	Lab type	Topic
1/14	0		Introduction, syllabus, grading policy, lab etiquette, review of basic apparatus
1/21	1	Optical emitter (Lab type A)	Light-emitting diodes: Red, green and blue (I-V, I-P)
1/28	2		Light-emitting diodes: Red, green and blue (Spectrum)
2/4	3		Laser diodes: Red, green and blue (I-V, I-P)
2/11	4		Laser diodes: Red, green and blue (Spectrum)
2/18	5	Optical absorber (Lab type B)	Photoconductor - Optoelectronic effect for light detection
2/25	6		Photodiode: PIN photodetector
3/4	7		Photodiode: Solar cell (photovoltaic effect for power generation)
3/11	Spring break		
3/18	8	Application (Lab type C)	LED digital display and Liquid crystal digital display
3/25	9		Optical transmitter receiver: Optical output by free space transmission of optical signal
3/25			Due date for submitting a report on Lab type A or Lab type B by each student. The reports will not be graded at this time, but reviewed to provide feedback for improvement.
4/1	10		Optical transmitter receiver: Audio output by free space transmission of optical signal
4/8	11		Quadrant photodiode
4/15			
4/22	Due date for submitting a final report on Lab type A or Lab type B by each student. The reports will be graded.		
4/29	No final exam for this lab. UCF's final exam week 4/29 - 5/5.		

Important deadlines and grading policy

1) **Pre-lab questions:** These questions are listed in the lab manual at the end of each experiment. The answers to the questions of each lab should be submitted by each student at the beginning of the lab.
2) **In-lab report:** A brief report should be submitted by each student at the end of each lab. The report may contain at least a short title of the experiment, experimental procedure, data table, graph, data analysis and a short conclusion.
3) **Preliminary report (Due date: March 25, 12 noon):** The experiments have been classified into three types for this course, Lab type A, B and C (see the lab schedule). Each student should select the Lab Type A or B and write a preliminary report on all the experiments listed under the chosen Lab Type . These reports will not be graded, but reviewed to provide feedback for improvement.
4) **Final report (Due date: April 22, 12 noon):** Each student should revise the preliminary report, if necessary, and submit the final report. These report will be graded.

Grade evaluation:

Academic activity	Pre-lab	In-lab report	Final lab report
Grade weighting (%)	10	55	35

Grading scale:

A (90-100), **A**$^{-}$ (86 - <90)
B^{+} (82 - <86), **B** (78 - <82), **B**$^{-}$ (74 - <78)
C^{+} (70 - <74), **C** (66 - <70), **C**$^{-}$ (62 - <66)
D^{+} (58 - <62), **D** (54 - <58), **D**$^{-}$ (50 - <54)
F (<50)

The grading scale may be lowered only at the instructor's discretion depending on the degree of difficulty in the lab.

Lab policy

1) Attendance:
   - All students are required to attend all the lab classes to complete all the experiments.
   - If students miss a lab, zero credit will be given for that lab.
   - In case of emergency, students are required to email the TA before the start of the lab session. A make up lab session will be arranged if official documents regarding the absence are submitted to the instructor. Zero credit will be given for the lab without such documents.

2) Grading:
   - Late submissions of the pre-labs, in-labs, preliminary lab report and final lab report are not acceptable for grading. Zero credit will be given for all late-submitted assignments.
   - Pre-labs are due at the beginning of each lab. Zero credit will be given if a student does not finish the prelab even if the student shows up on time.
   - Late submissions are acceptable for grading in case of emergency if official documents are furnished regarding the emergency.

3) Academic integrity:
   - A group of two or more students may work as a team to carry out the experiments, but each student has to trun in their own pre-lab, in-lab, preliminary and final reports without copying from other students or sources. Experimental data can be shared among the members of the same team, but the rest of the report should be written individually.
   - UCF's rule will apply in the case of any breach in the academic integrity.

4) Lab Etiquette:
   - A group of two or more students may work as a team to carry out the experiments. Each student is required to fully participate in the expremients and cooperate with other team members.
   - Foods and drinks are not allowed in the lab.
   - Use of cellphones, headphones, writing homeworks or any activities unrelated to the lab are not allowed.
   - Students should not disturb or interfere with neighboring groups.
   - Keep your optical table area neat and free of any unnecessary tools and equipment. Your book bag and other personal belongings should be kept in a designated area away from the optical table.
   - After completing your experiment, turn off all equipment, disassemble the experimental setup and separate the circuit elements in groups of similar apparatus, e.g., all resistors and electrical connectros should be separated as two groups of apparatus.
   - Contact your TA to return all the components that you took at the beginning of the lab.
   - Clean your optical table before you leave the lab.

5) Lab safety:
   - Do not look at any laser beam or even the LED light directly.
   - Do not be in the path of any laser beam or even the LED light.
   - Wear safety goggles. The goggles should be suitable for the power and wavelength of the light that you will use in your experiment.

6) Professionalism and ethics:
   Per university policy and plain classroom etiquette, mobile phones, etc. must be silenced during all classroom lectures, unless you are specifically asked to make use of such devices for certain activities. Academic dishonesty in any form will not be tolerated! If you are uncertain as to what constitutes academic dishonesty, please consult The Golden Rule in the UCF Student Handbook (www.goldenrule.sdes.ucf.edu) for further details. As in all University courses, The Golden Rule Rules of Conduct will be applied. Violations of these rules will result in a record of the infraction being placed in your file and the student receiving a zero on the work in question AT A MINIMUM. At the instructor's discretion, you may also receive a failing grade for the course. Confirmation of such incidents can also result in expulsion from the University.

7) Students with special testing/learning needs:
   Students with special needs and require special accommodations must be registered with UCF Student Disability Services prior to receiving those accommodations. Students must have documented disabilities requiring the special accommodations and must meet with the instructor to discuss the special needs as early as possible in the first week of classes. UCF Student Disability Services can be contacted at www.sds.sdes.ucf.edu or at (407)823-2371.

8) Financial aid and attendance:
   Inform the UCF financial aid office that you began this course by the end of the first week of classes. Failure to do so will result in a delay in the disbursement of your financial aid. UCF financial aid office can be contacted at http://finaid.ucf.edu or at (407) 823-5285.

Report guidelines

1) Cover page: This page should contain the title of the experiment, title of the course, your name, date of experiment, date of writing the report, and department/college/university affiliation.

2) Abstract: This is a very short version of your lab report. A well-written abstract contains the answers to the following questions.
   - What did you do?
   - How did you do it?
   - What did you find?

   Although the abstract is the second page of the report, it should be written after completing the other sections of the report.

3) Introduction: It includes the following information.
   - Why you want to do the experiment - purpose of the experiment.
   - What you are going to do in the experiment and what techniques you are going to use.
   - Technical backgound - Explain the theory behind the experiment. Discuss any fundamental concepts and mathematical equations to understand your experiment.
   - Goal - What you hope to find.

4) Experimental procedure:
   - Present a circuit diagram of the experiemnt.
   - Discuss the role of each element in the circuit.
   - Provide a flowchart for the experimental procedure in a less detailed format - The flowchart is a roadmap of the experiment.

5) Experimental data:
   - Tabulate your data.
     - Number the tables sequentially as they appear in your report (e.g., Table 1, Table 2).
     - Insert a descriptive caption associated with each table number and place the caption above the table.
     - Each column should have a heading with units for the variable presented in the column.
     - Tables should not be split between page boundaires.
     - Use the table number in the text to refer the reader to view the data in the table.
   - Plot graphs whenver appropriate.
     - Number the figures sequentially as they appear in your report (e.g., Figure 1, Figure 2).
     - Insert a descriptive caption associated with each figure number and place the caption below the figure. The caption should indicate what is plotted on the y axis versus what is plotted on the x axis.
     - Label each axis with its variable and units.
     - Figures should not be split between page boundaires.

    - Remove gridlines, titles and equations from the graph. The titles and graphs can be included in the caption if they are important.
    - Insert a legend to identify each curve if more than one curve is drawn in a graph.
    - Use the figure number in the text to refer the reader to view the graph.
    - Cite the table number in the text that was used to plot a particular graph.
  - Include units for all the data and variables.

6) Results:
  - What are you doing with the data/graph? If you are determining the slope using the graph or calculating any property using the data, provide all the formulas that you use in your calculations, and show all of your work.
  - Provide units for all the data and variables.

7) Discussion: This section includes the interpretations of the results.
  - Discuss the physical significanc of your results, e.g., the slope or property that you have calculated in the result section.
  - Discuss how the results relate to any of the fundamental concepts in optoelectronics.
  - Discuss any practical applications of the results.

8) Conclusions: The first paragraph is like the introduction except that the introduction is a summary of you are going to do and conclusion is a summary of what you did.
  - What you did - Restate your experimental procedure briefly.
  - What you found - Restate the results and properties that you may have measured or calculated.
  - Comment on the results - What the results mean. Are the results good or bad? Why good or why bad?
  - Errors: Discuss the possible sources of errors.

9) References: List any book, journal paper or other sources that you might have used for writing this report. Each reference should be brief but complete for readers to access the citation.