



## Course Syllabus

### OSE 4410L, Optoelectronics Laboratory, 1 credit hour

<b>Instructor:</b> Aravinda Kar <b>Email:</b> akar@creol.ucf.edu <b>Phone:</b> (407) 823-6921 <b>Office:</b> CREOL 284 <b>Office Hours:</b> Tuesdays, 1 PM to 4 PM	<b>Term:</b> Spring, 2019 <b>Class Meeting Days:</b> Tuesdays <b>Class Meeting Time:</b> 8 AM to 10:50 AM <b>Class Location:</b> CREOL A210 <b>Website:</b> <a href="https://webcourses.ucf.edu">https://webcourses.ucf.edu</a>
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**Additional Notes:** I will be in my office at these times, but of course I will be happy to discuss the material with you anytime. The Teaching Assistant’s contact information is provided at the end of this document.

**Important dates:**

First day of classes for OSE 4410L course	Tuesday, January 8, 2019
Instructor to confirm academic activity in each class	Monday, January 7, 2019 - Friday, January 11, 2019
Last day to drop classes and request full refund	Thursday, January 10, 2019
Last day to drop/swap on myUCF	Thursday, January 10, 2019, 11:59 PM
Last day to add classes	Friday, January 11, 2019, 11:59 PM
Final Exam	No final exam for this Lab course, but there is a final Lab report which must be submitted by the deadline specified in the Lab schedule.

- **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](http://www.sds.sdes.ucf.edu) or at (407) 823-2371.

- **Financial aid and attendance:**

As of Fall 2014, all faculty members are required to document students' academic activity at the beginning of each course. In order to document that a student has begun the course, each student must complete an academic activity by the end of the first week of classes, or within the first week after adding the course. A student’s failure to complete the academic activity will result in a delay in the disbursement of the student’s financial aid.

**Course Catalog Description:**

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

**Co-requisites or Prerequisites:** OSE 4410 (Optoelectronics)

**Detailed Course Description and Learning Outcomes:**

**Detailed Description:** This lab course is associated with the theory course (OSE 4410) on the principles, design, and applications of optoelectronic devices. Basic specifications of key optoelectronic devices, including photodiodes, Light-Emitting Diodes (LEDs), diode lasers, LED and Liquid Crystal Displays are experimentally studied by the students. The experiments include both DC (static) and AC (dynamic) characteristics of the devices and 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.

**Learning Outcomes:**

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

**Topics:** The experiments are listed in the Lab schedule at the end of this document.

**Relationship of Course to ABET Criteria:**

ABET Criteria	Level of Emphasis During Course (Low, Medium, High)
(a) An ability to apply knowledge of mathematics, science, and engineering.	High
(b) An ability to design and conduct experiments, as well as to analyze and interpret data.	High
(c) An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.	None
(d) An ability to function on multidisciplinary teams.	None
(e) An ability to identify, formulate, and solve engineering problems.	None
(f) An understanding of professional and ethical responsibility.	Medium
(g) An ability to communicate effectively.	High
(h) The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context.	None
(i) A recognition of the need for, and an ability to engage in life-long learning.	None
(j) A knowledge of contemporary issues.	None
(k) An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.	None

**Textbook:**

- Lab Notes
- Optoelectronics and Photonics: Principles and Practices, S. O. Kasap, Prentice Hall, 2001

**Recommended Reference:**

- Semiconductor Optoelectronic Devices, P. Bhattacharya, 2nd Ed., Prentice Hall, 1997
- Fundamentals of Photonics, B. E. A. Saleh and M. C. Teich, 2nd Ed., Wiley, 2007

**Other Reference Books:** None

**Course Grading and Requirements for Success:**

- 1) **Pre-lab questions:** These questions are listed at the end of the Lab Note for each experiment. The answers to the questions for each Lab should be uploaded to the Webcourses by each student by the deadline specified in the Webcourses.
- 2) **In-lab report:** A short report must 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, conclusion, and answers to in-lab questions.
- 3) **Final report:** Each student is required to submit a long report on three experiments by selecting only one experiment from each of the three Lab types A, B and C. So the report will cover the topics of each of the three Lab types. See the Lab schedule at the end of this document for the Lab types A, B and C. The guideline for writing the final lab report is also provided in this document.

**Grade evaluation:**

Academic activity	Pre-lab	In-lab report	Final lab report
Grade weighting (%)	11	55	34

Grading Scale (%)	Rubric Description
$90 \leq A \leq 100$ $86 \leq A^- < 90$	Excellent with some gradation, has a strong understanding of all concepts and is able to apply the concepts in all and novel situations. Has full mastery of the content of the course.
$82 \leq B^+ < 86$ $78 \leq B < 82$ $74 \leq B^- < 78$	Good with some gradation, has a strong understanding of most of the concepts and is able to apply them to stated and defined situations.
$70 \leq C^+ < 74$ $66 \leq C < 70$ $62 \leq C^- < 66$	Average with some gradation, has a basic understanding of the major concepts of the course and is able to apply to basic situations.
$58 \leq D^+ < 62$ $54 \leq D < 58$ $50 \leq D^- < 54$	Below average with some gradation, has a basic understanding of only the simple concepts and is able to apply to only a limited number of the most basic situations.
$F < 50$	Demonstrates no understanding of the course content.

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

## Lab policy

- 1) Class Website:  
Lab Notes and In-lab Report Forms will be available on UCF Webcourses before each class.
- 2) Attendance and make-up Lab policy:
  - All students are required to attend all the lab classes to complete all the experiments.
  - If a student misses a lab, zero credit will be given for that lab.
  - If an emergency arises and a student cannot submit assigned work on or before the scheduled due date or cannot attend a Lab on the scheduled date, the student **must** notify the instructor **no less than 24 hours before** the scheduled date and **no more than 48 hours after the** scheduled date. A make-up lab session will be arranged if official documents regarding the emergency are submitted to the instructor. Zero credit will be given for the lab without such documents.
- 3) Grading:
  - Late submissions of the pre-labs, in-labs and final lab report are not acceptable for grading. Zero credit will be given for all late-submitted assignments.
  - Pre-labs are due by the deadline specified in the Webcourses. Zero credit will be given if a student does not submit the prelab on time.
  - Late submissions are acceptable for grading in case of emergency if official documents are furnished regarding the emergency. The student must report the emergency to the instructor no less than 24 hours before the submission deadline and no more than 48 hours after the submission deadline. Zero credit will be given for the missed submission if official documents regarding the emergency are not submitted to the instructor within one week of the submission deadline.
- 4) Grade Objections:  
All objections to grades should be made **in writing within one week** after the graded work is returned. Objections made after this period has elapsed will **not** be considered – NO EXCEPTIONS.
- 5) Academic integrity:
  - A group of two or more students may work as a team to carry out the experiments, but each student has to turn 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.
- 6) 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 experiments 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 connectors 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.

7) 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.

8) 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](http://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.

## Guidelines for final lab report

- 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 background - 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 experiment.
  - 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. See section 10 for an example of a table caption.
    - Each column should have a heading with units for the variable presented in the column.
    - Tables should not be split between page boundaries.
    - Use the table number in the text to refer the reader to view the data in the table.
  - Plot graphs whenever 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. See section 11 for examples of figure captions.
    - Label each axis with its variable and units.
    - Figures should not be split between page boundaries.
    - 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 significance 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. Follow the format of **Optics Express** to cite and list your references.
- 10) Example of a table caption:

Table 1. Spectral values and characteristics of LED semiconductors.

LED	$V_f$ (V)	$\lambda$ (nm)	$\nu \times 10^{14}$ (Hz)	$E_g$ (eV)	Semiconductor
Infrared	1.4	900	3.33	1.37	GaAs
Red	1.9	678	4.42	1.82	CdSe
Light red	1.8	656	4.57	1.88	CdSe
Orange	2.0	644	4.65	1.92	GaAsP
Yellow-orange	2.1	597	5.02	2.1	GaAsP
Yellow	2.0	598	5.01	2.1	GaAsP
Green	2.2	574	5.23	2.15	AlAs

11) Examples of figure captions:

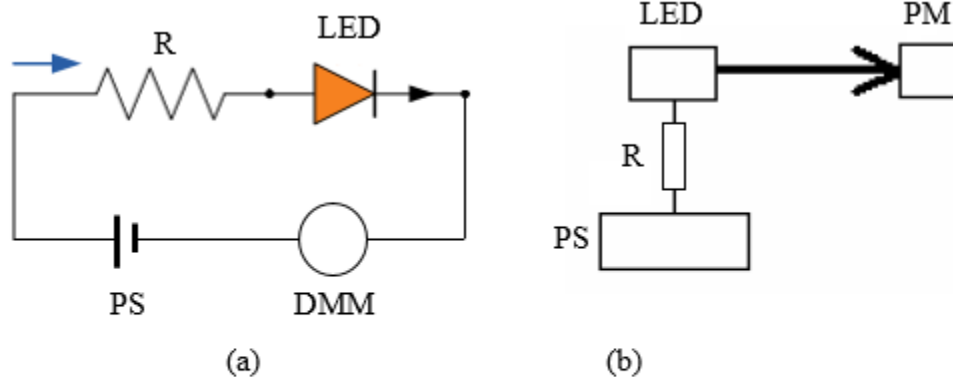


Fig. 1. Experimental set-up for measuring the variation of the power of light emitted by an LED as a function of current, (a) circuit diagram and (b) block diagram. R: Resistor, LED: Light-emitting diode, PS: dc power supply, DMM: Digital multimeter and PM: Power meter.

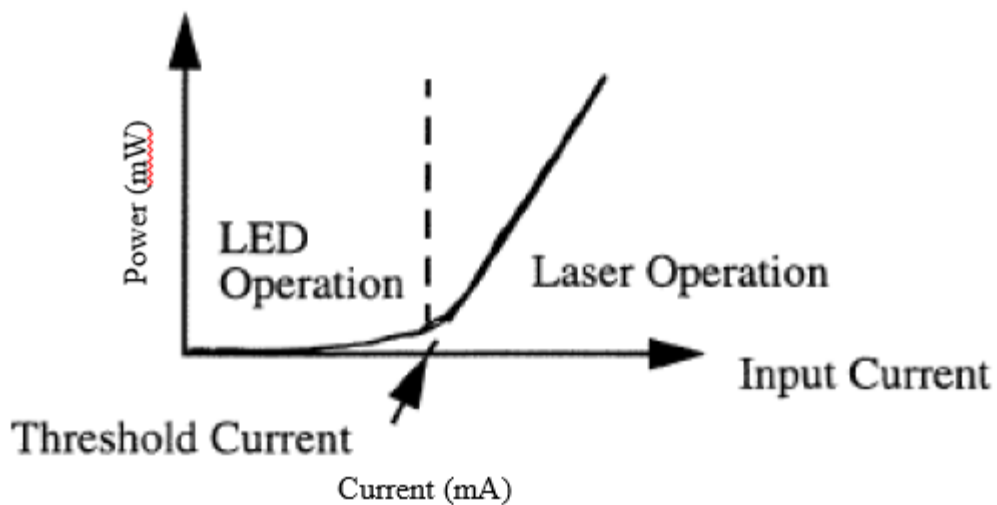


Fig. 2. Variation of output power of a diode laser with respect to current for determining the threshold current. The graph also shows the LED and laser operating regimes.



## Lab schedule

Date	Lab No.	Lab type	Topic
1/08	0		Introduction, syllabus, grading policy, lab etiquette, review of basic apparatus
1/15	1	Optical emitter (Lab type A)	Light-emitting diodes: Red, green and blue (I-V, I-P)
1/22	2		Light-emitting diodes: Red, green and blue (Spectrum)
1/29	3		Laser diodes: Red, green and blue (I-V, I-P)
2/05	4		Laser diodes: Red, green and blue (Spectrum)
2/12	5	Optical absorber (Lab type B)	Photoconductor - Optoelectronic effect for light detection
2/19	6		Photodiode: PIN photodetector
2/26	7		Photodiode: Solar cell (photovoltaic effect for power generation)
3/05	8	Application (Lab type C)	LED digital display and Liquid crystal digital display
3/12	--		<b>Spring break</b> (3/11 – 3/15)
3/19	9		Optical transmitter receiver: Optical output by free space transmission of optical signal
3/26	10		Optical transmitter receiver: Audio output by free space transmission of optical signal
4/02	11		Quadrant photodiode
4/9			Discuss the guidelines for writing the final lab report. Each student is required to submit a long report on three experiments by selecting only one experiment from each of the three Lab types A, B and C.
4/16			No Lab. Time for writing the final report.
4/23			<b>Due date for submitting a final report by each student before 11:59 PM Eastern Standard Time. The report is on three experiments to cover each of the three Lab types A, B and C.</b> No Lab (UCF's study day - No classes)
4/30			No final exam for this Lab course. UCF's final exam period 4/24 - 4/30.

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