OSE 6416: Organic Photonics
College of Optics and Photonics
University of Central Florida

COURSE SYLLABUS

Instructor:	Instructor Name: Jayan Thomas	Term: Spring 2016
Office:	Office Number: NSTC 480	Class Meeting Days: Tuesday and Thursdays
Phone:	Phone for Office: 407 882 0196; Cell: 407 697 3645	Class Meeting Hours: 3.00-4.15PM
E-Mail:	Instructor Email: Jayan.Thomas@ucf.edu	Class Location: CROL A214
Website:	Instructor's personal website: http://nanoscience.ucf.edu/thomas/	
Office Hours:	At request	

I. Welcome!

Welcome to course: **OSE 6416: Organic Photonics !**

II. University Course Catalog Description

OSE 6416: Organic Photonics (3 Credit hours)

III. Course Overview

This course reviews the optical and electronic properties in organic molecules and polymers that are highly critical for photonic and opto-electronic applications. Topics covered include hybridization of orbitals, HOMO-LUMO energy level formation, electronic delocalization, charge hopping, and hole and electron conduction. Special emphasis will be given to photoconducting and photosensitive materials, nonlinear optical materials, organic/polymer materials and polymers for optical components. Application of photoconduting polymers in excitonic solar cells, photorefractive display devices and other current and emerging technologies will be discussed. To facilitate students to fabricate polymer photonic devices, basic topics in polymer preparation and processing will be offered. Development, characterization and applications of nanomaterials, carbon nanotubes and graphene will be introduced.

IV. Course Objectives

Upon completion of the course, students will be able to demonstrate an in-depth knowledge of advanced polymer materials that are critically important in opto-electronics, photonics and nanotechnology based applications. The students will also exhibit the technical and material knowledge required to fabricate polymer based optical, photonic and electronic devices.

V. Course Prerequisites

Consent of instructor

VI. Course Credits

3 (3, 0)

VII. Required Texts and Materials

No prescribed text book.

VIII. Supplementary (Optional) Texts and Materials

Will be provided during the course

IX. Basis for Final Grade

Assessment	Percent of Final Grade
Assignments	20%
Seminar presentations	20%
Midterm Exam	30%
Final Exam	30%

X. Grading scale:

Grading Scale (%)	
89.50-100	A
79.50 – 89.49	B
69.50 – 79.49	C
59.50 – 69.49	D
0 – 59.49	F

XI. Course Policies: Grades

Late Work Policy:

There are no make-ups for the midterm, or the final exam.

Extra Credit Policy: No extra credit and curving will be offered.

Grades of "Incomplete":
The current university policy concerning incomplete grades will be followed in this course. Incomplete grades are given only in situations where unexpected emergencies prevent a student from completing the course and the remaining work can be completed the next semester. Instructor is the final authority on whether you qualify for an incomplete. Incomplete work must be finished by the end of the subsequent semester or the "I" will automatically be recorded as an "F" on your transcript.

Course Policies: Technology and Media

Email: Please use email for all important correspondence.

Classroom Devices: No electronic devices except calculators are allowed to use in the class room. No recording of the lecture is permitted.

Course Policies: Student Expectations

Disability Access: The University of Central Florida is committed to providing reasonable accommodations for all persons with disabilities. Students with disabilities who need accommodations in this course must contact the professor at the beginning of the semester to discuss needed accommodations. No accommodations will be provided until the student has met with the professor to request accommodations. Students who need accommodations must be registered with Student Disability Services, Student Resource Center Room 132, phone (407) 823-2371, TTY/TDD only phone (407) 823-2116, before requesting accommodations from the professor.

Attendance Policy:

- Regular class attendance is strongly advised and is necessary for students to understand many of the topics covered.
- Students must be on time to class.
- If missed a class, it is the responsibility of the student to find out the materials covered.

Professionalism Policy:

Per university policy and classroom etiquette; mobile phones, iPods, *etc*. **must be silenced** during all classroom lectures. Those not heeding this rule will be asked to leave the classroom/lab immediately so as to not disrupt the learning environment. Please arrive on time for all class meetings. Students who habitually disturb the class by talking, arriving late, *etc*., and have been warned may suffer a reduction in their final class grade.

Academic Conduct Policy:

Academic dishonesty in any form will not be tolerated. 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 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.

Policy on cheating and plagiarism:

The following university policies are in effect:

Academic honesty and integrity are expected of everyone all the time. Plagiarism or cheating of any kind on an examination, quiz or assignment will result at least in an "F" for that assignment (and may, depending on the severity of the case, lead to an "F" for the entire course) and may be subject to appropriate referral to the Office of Student Conduct for further action, including (but not limited to) warning, removal from course, probation, suspension, expulsion, or permanent conduct record with UCF. For more information, please contact the Office of Student Conduct at 823-2851. Also see the UCF Golden Rule at http://www.goldenrule.sdes.ucf.edu/ for further information. Assignments and any graded element of the course must also be your own work. There is nothing wrong with seeking the assistance of others (in fact, helping each other to study for examinations is highly recommended) for help in understanding concepts, principles, or methods, but simply obtaining answers from another person and turning them in as your own is certainly unacceptable. It will be assumed that you will adhere to the academic creed (Integrity, scholarship, community, creativity, and excellence are the core values that guide our conduct, performance, and decisions) of this University and will maintain the highest standards of academic integrity. In other words, don't cheat by giving answers to others or by taking them from anyone else. I will also adhere to the highest standards of academic integrity, so please do not ask me to change (or expect me to change) your grade or to bend or break rules for one person that will not apply to everyone.

Course Outline

1. Introduction to organic/polymer photonic materials

- Introduction to electronic properties of materials
- Atomic orbitals, hybridization, sigma and pi bonds
- Molecular interactions and hydrogen bonding
- Aromatic and conjugated molecules
- Band theory of organic materials
- Electronic conduction in semiconductors
- Structural factors and band gap tuning
- Electron conducting, hole conducting and ion conducting polymers
- Solitons, polarons, and excitons, the elementary excitations of conducting polymers

2. Charge conduction in organic/polymer materials

- Charge generation by photo-excitation and recombination
- Diffusion and drift of charge carriers
- HOMO-LUMO energy level measurement techniques
- Band gap tailoring of *pi*-conjugated systems for specific applications

3. Advanced materials for photonic applications

- Optical dyes and charge transfer molecules
- Fullerenes, Carbon nanotubes, graphenes and other 2D van der Waals materials

4. Applications of organic photonic materials

Photovoltaic cells:

- Ionization potential and electron affinity; donor and acceptor molecules
- Heterojunction, bulk heterojunction, dye-sensitized and perovskite solar cells

Light emitting diodes: Fundamentals

Photorefractive polymers:

- Fundamentals of photorefractivity: charge generation, transport and trapping, space charge field build-up
- Nonlinear chromophores, diffraction efficiency and two-beam coupling gain

Tentative course schedule

Date	Topics
01/09	Introduction of the course
01/11	Fundamental electronic properties of atoms
01/16	Molecular interactions and dipoles
01/18	Importance of hybridization
01/23	Molecular orbital theory
01/25	Band theory of organic materials 1
01/30	Band theory of organic materials 2: Structural factors
02/01	Charge generation by photo-excitation
02/06	Electro-optic materials 1: Achieving electronic polarizability in organic molecules
02/08	Electro-optic materials 2: Nonlinear optical properties
02/13	Band gap tailoring of pi-conjugated systems
02/15	Optical dyes and charge transfer molecules
02/20	Fullerenes, Carbon nanotubes, graphenes and other 2D van der Waals materials
02/22	Polymers
02/27	Polymer properties and processing techniques
03/01	Mid-term exam
03/06	Photovoltaics 1: Electronic conduction in semiconductors and p-n junctions
03/08	Photovoltaics 2: Photovoltaic devices and measurements
03/13	Spring break-no class
03/15	Spring break-no class
03/20	Photovoltaics 3: Heterojunction, bulk heterojunction, dye-sensitized and perovskite solar cells
03/22	Electro-optic materials processing techniques
03/27	Fundamentals of organic photorefractivity 1: Charge generation, transport and

	trapping, space charge field build-up
03/29	Fundamentals of organic photorefractivity 2: Nonlinear chromophores, diffraction efficiency and two-beam coupling gain
04/03	Organic light emitting diodes
04/05	Organic light emitting diodes
04/10	Student Presentation
04/12	Student Presentation
04/17	Student Presentation
04/19	Last day of class-Review
04/24	Study day
04/26	Final Exam: Thursday, April 26, 2018 1:00 PM – 3:50 PM