I. Welcome!
Welcome to course: **OSE6938Y: Polymer Photonics!**

II. University Course Catalog Description
OSE6938Y: **Polymer Photonics** (3Credit hours)

III. Course Overview
This course reviews the optical and electronic properties in polymers and organic molecules 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 photoconducting polymers in excitonic solar cells, organic light emitting diodes, 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. Alternative lithographic techniques for fabricating nanophotonic and nanoelectronic devices will be discussed. 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
Provide a listing of assessments and their weighting in the semester total. In addition to (or even in lieu of) tests, consider exploring “authentic” assessments, which are based as closely as possible to real world experiences.

<table>
<thead>
<tr>
<th>Assessment</th>
<th>Percent of Final Grade</th>
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<tbody>
<tr>
<td>Assignments</td>
<td>20%</td>
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<tr>
<td>Seminar presentations</td>
<td>20%</td>
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<tr>
<td>Midterm Exam</td>
<td>30%</td>
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<tr>
<td>Final Exam</td>
<td>30%</td>
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X. Grading scale:

<table>
<thead>
<tr>
<th>Grading Scale (%)</th>
<th>Grade</th>
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<tbody>
<tr>
<td>90-100</td>
<td>A</td>
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<tr>
<td>80 - 89</td>
<td>B</td>
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<tr>
<td>70 - 79</td>
<td>C</td>
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<tr>
<td>60 - 69</td>
<td>D</td>
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<tr>
<td>0 - 59</td>
<td>F</td>
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X. 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.

**XI. 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.

**XII. 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

Course Outline

1. Introduction to organic/polymer photonic materials
   • Introduction to electronic properties of materials
   • Atomic orbitals, hybridization, sigma and pi bonds
   • Aromatic and conjugated molecules
   • Molecular interactions and hydrogen bonding
   • 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
   • Energy levels and electronic transitions in molecular aggregates
   • HOMO-LUMO energy level measurement techniques: Photoemission spectroscopy and Cyclic Voltammetry.
   • Band gap tailoring of $pi$-conjugated systems for specific applications

3. Advanced materials for photonic applications
   • Optical dyes, dimers, excimers, charge transfer molecules
   • Fullerenes, Carbon nanotubes, graphenes and other 2D van der Waals materials
   • Polymer device fabrication techniques

4. Applications of photoconducting polymers
   Photovoltaic cells:
   • Ionization potential and electron affinity; donor and acceptor molecules
   • Exciton diffusion length
   • Heterojunction, bulk heterojunction and dye-sensitized solar cells
   Organic light emitting diodes (OLED):
   • Basic properties and performance
   • Space charge limited and charge limited conduction

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