

## **ECE 6540 – Organic Optoelectronics**

### **Topical Outline**

Role of semiconducting plastics in current technologies; reviews of the basic concepts of chemistry; terminology; molecules, polymers, supramolecular structures; molecular weight, number average molar mass; weight average molar mass; heterogeneity index; glass transition temperature.

Bohr's classical model of the hydrogen atom; Aufbau process; electronic configuration of elements; molecular orbitals;  $\sigma$  and  $\pi$  orbitals; dipole moment; ionization potential and electron affinity.

Linear optical properties of dielectrics: Maxwell's equations in CGS and SI units; polarizability, complex dielectric function, propagation equation, complex refractive index, dispersion, Lorentz oscillator; Fourier representation; crystal optics, tensor notation, index ellipsoid.

Introduction to nonlinear optics; properties of the nonlinear susceptibility tensor; contracted notation.

Nonlinear optical properties of molecules: first and second hyperpolarizabilities; structure-property relationships in nonlinear organic materials; two-level model. Euler's angles and the transformation matrix; oriented gas model, Maxwell Boltzmann distributions, order parameters.

Introduction to electro-optics; electro-optic modulators: properties and applications.

Introduction to modern xerography.

Photogeneration in organic solids; Onsager model for photogeneration. Charge transport in organic solids; disorder formalism; positional and energetic disorder; time-of-flight experiments. Charge injection into organic solids; Child's law; space-charge limited current method; introduction to photorefractivity; Kukhtarev model for photorefractivity.

Two-beam coupling in photorefractive materials; photopolymers and holographic storage

Light emission in organic solids; the linear harmonic oscillator; transition selection rules; fluorescence, and phosphorescence; Forster and Dexter energy transfer. Flat panel display technologies; Physics of liquid-crystal displays; organic light-emitting diodes: materials, devices and applications; fundamentals of radiometry

Organic photovoltaic cells; solar spectrum; equivalent circuit; conversion efficiency, excitonic solar cells, electrochemical solar cells. Organic field-effect transistors; organic memories; flexible organic circuits.