

ESM 378/CHE 378/ Materials Chemistry (Elective)

Course Catalog description:

Our high-technology world is driven forward by advances in materials chemistry. This class will discuss some of the materials that underpin these technologies, as well as some of the novel classes of materials that are being developed for future applications. The course will cover the synthesis, structures, and properties of advanced materials, focusing on a range of topics with current societal importance (e.g. energy, computers, nanoscience, etc.). Specific topics may include batteries, fuel cells, catalysts, metals, semiconductors, superconductors, magnetism, and polymers.

3 credits

Pre- or Corequisite(s): CHE 375 or Permission of the instructor

Text(s) or other required material:

Solid State Chemistry, Lesley Smart and Elaine Moore, 2nd edn. Publisher, Nelson Thornes, UK; Assigned reading from review articles. E.g. "Building better batteries, M. Armand, J. –M. Tarascon," Nature, p652 (2008).

Course learning outcomes:

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Topics Covered:

Week 1-2: Review of basic solid state chemistry and crystallography – packing in ionic solids, lattices and unit cells, symmetry (local and translational)

Week 3. Basics of structure solution (diffraction)

Week 4-5. Basics of Band Theory. Insulators, metals, semiconductors, conductors and superconductors

Week 6. Effects of unpaired electrons: Magnetic properties. Ferromagnets, antiferromagnets and ferrimagnets.

Week 7-8: Defects and non-stoichiometry: Ionic conductivity: Solid electrolytes for solid oxide fuel cells, separations and catalytic converters. Electronic effects of doping.

Week 9: Intercalation chemistry: Batteries

Week 10. Porous structures and surfaces: separations and catalysis

Week 11. Optical properties: How materials interact with light. Solar cells, photocopyers

Week 12. Nanoparticles: Quantum confinement effects, optical properties etc.

Week 13. Polymers – structures and properties

Class/ Laboratory Schedule, i.e. number of sessions each week and duration of each session:

Determined by the Chemistry Department

Contribution of Course to **meet requirement of Criterion 5:**

Relationship of course to program outcomes:

Person(s) who prepared this description and date of preparation: