

## ESM 378/ CHE 378/ MATERIALS CHEMISTRY (ELECTIVE)

Credit: 3

### 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.

**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	SOS	ASSESSMENT TOOLS
Learn synthesis, structures, and properties of advanced materials		

### COURSE TOPICS

- 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, photocopiers
- Week 12. Nanoparticles: Quantum confinement effects, optical properties etc.
- Week 13. Polymers – structures and properties

**CLASS/ LABORATORY SCHEDULE**

Determined by the Chemistry Department

**CURRICULUM**

This course contributes 3 credit hours toward meeting the required 48 hours of engineering topics.

**STUDENT OUTCOMES (SCALE 1-3):**

A	B	C	D	E	F	G	H	I	J	K
1				3						

**3 – Strongly supported**

**2 – Supported**

**1- Minimally supported**

**LEAD COORDINATOR(S) WHO PREPARED THIS DESCRIPTION AND DATE OF PREPARATION:**