

**Title: Special Problems**  
**(Subtitle: Advanced Materials for Chemical Engineers)**

**1. OUTLINE**

**Course Description:** students will learn advanced materials encountered in chemical engineering. First, structures of traditional materials, i.e., metals and ceramics, will be explained. Then, more recently developed materials, such as polymers, composites, nanomaterials, and advanced carbon materials, will be covered. Properties are understood in terms of the microstructure of materials. Emphasis is placed on the relationship between the structure (controlled by processing methods) and the properties of advanced materials that are important for chemical engineers.

**Course Objectives:** students are expected to understand: (1) microstructures of basic materials, (2) differences between metals, ceramics, and polymers, (3) properties in terms of the microstructures of advanced materials, and (4) processing of advanced materials for applications.

**Course Contents:**

I. Introduction:

Thermodynamics (kinetics), State of Matter  
Cohesion in Materials  
Crystal Structure (crystal systems, Miller indices) and Amorphous Structure

II. Structures and Properties of Traditional Materials:

Metals (crystalline structures, alloys and phase diagrams)  
Ceramics (crystalline ceramics, glass transition, amorphous glass, minerals)  
Elastic Properties of Crystalline Materials  
Plastic Deformation of Crystalline Materials  
Stress-Strain Behavior of Materials

III. Structures and Properties of Modern Materials:

Preparation of Polymers (polymerizations)  
Polymers (crystalline polymers, amorphous polymers, elastomers)  
Rubber Elasticity and Plastic Deformation of Polymers  
Composites (particulate, fibrous and laminated composites)  
Advanced Carbon Materials (Carbon Nanotubes, Graphene)  
Nano Structures  
Nanocomposites

## **2. LECTURER**

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## **3. LECTURE ROOM**

ENG C-115

## **4. TIME**

Wed: 5:00 - 8:00 p.m.

## **5. REFERENCE BOOKS**

The Science and Engineering of Materials, by D. R. Askeland, P. P. Fulay, W.J. Wright, Sixth Edition, Cengage Learning (2011)

Materials Science and Engineering: An Introduction, by W.D. Callister, Jr., D.G. Rethwisch, Eighth Edition, John Wiley & Sons (2010)

## **6. GRADE**

First Exam: 35 %  
Second Exam: 35 %  
Term Paper: 30 %