Catalog Descriptions and Course Outcomes for MSE Core Classes

Updated March 24, 2023

Course Sequence

	Fall	Winter	Spring
Soph.	301*, 314	315	316-1
Jr.	316-2, 351-1	331, 351-2	332, 390
Sr.	391	361, 396-1	396-2

* Can also be taken spring quarter freshman year.

314: Thermodynamics of Materials

Classical and statistical thermodynamics; entropy and energy functions in liquid and solid solutions, and their applications to phase equilibria. Lectures, problem solving. Materials science and engineering degree candidates may not take this course for credit with or after CHEM 342 1. (new stuff)

315: Phase Equilibria and Diffusion in Materials

MAT_SCI 315 covers, broadly, two topics: phase equilibra and diffusion in materials.
In the first half of this course, we concentrate on foundational thermodynamics. Namely, the application of thermodynamics to the prediction and interpretation of phase diagrams. The level of presentation assumes that students have a background in the laws of thermodynamics - especially in the area of solution thermodynamics (MAT_SCI 314). We'll build from these foundations so that students can apply thermodymics to Type I, II, and III phase diagrams.
In the second half of the course we'll concentrate on the foundations of diffusion in solids. We'll introduce the atomistic descriptions of diffusion and introduce the physical laws (Fick's laws) that govern how atoms are transported in solids. We'll apply these behaviors in engineering scenarios.
Prerequisite: MAT_SCI 314-0 or equivalent.

316-1,2: Microstructural Dynamics

Principles underlying development of microstructures. Defects, diffusion, phase transformations, nucleation and growth, thermal and mechanical treatment of materials. Lectures, laboratory. Prerequisite: 315 or equivalent.

332: Mechanical Behavior of Solids

Plastic deformation and fracture of metals, ceramics, and polymeric materials; structure/property relations. Role of imperfections, state of stress, temperatures, strain rate. Lectures, laboratory. Prerequisites: 316 1; 316 2 (may be taken concurrently).

331: Soft Materials

Different kinds of polymeric materials. Relationships between structure and physical properties; rubber elasticity, the glassy state, crystallinity in polymers. Lectures, laboratory. Prerequisites: 301 or equivalent; 314 or CHEM 342 1.

351: Introductory Physics of Materials

Quantum mechanics; applications to materials and engineering. Band structures and cohesive energy; thermal behavior; electrical conduction; semiconductors; amorphous semiconductors; magnetic behavior of materials; liquid crystals. Lectures, laboratory, problem solving. Prerequisites: GEN ENG 205 4 or equivalent; PHYSICS 135 2,3.

361: Crystallography and Diffraction

Elementary crystallography. Basic diffraction theory; reciprocal space. Applications to structure analysis, preferred orientation. Point and 2D Detector techniques. Lectures, laboratory. Prerequisites: GEN ENG 205 4; PHYSICS 135 2,3. Mathematics including Calculus 1-3 and Linear Algebra will be required.

390: Materials Design

Analysis and control of microstructures. Quantitative process/structure/property/performance relations, with case studies. Computer lab for modeling multicomponent thermodynamics and transformation kinetics. Prerequisites: 315, 316 1,2, or consent of instructor.

391: Process Design

Processing of materials. Design and analysis of experiments to identify and optimize key parameters to control properties and performance. Resolving conflicting requirements. Statistical process control.

396: Senior Project in Materials Science and Engineering

To be taken in two consecutive quarters. Independent basic or applied research project, conceived and performed under the direction of a department faculty member. Prerequisite: senior standing in materials science program.

At the conclusion of the course students will be able to:

1. Understand the basis for making ethical decisions in the practice of science and engineering.
2. Formulate a research plan and workflow to address specific needs of a project. Document the plan, needs and constraints, and the engineering standards that will apply.
3. Execute the research plan, apply engineering standards, analyze results, and report on interim progress, both in oral reports and written documentation.
4. Write a review of the literature relevant to their research topic.
5. Give effective oral and written reports of ongoing and completed work to an audience of peers educated in materials science and engineering, but not specialists in the sub-topic.
6. Write a research report that analyzes the results and places them in the context of the field.