

**1. Department, Course Number, and Course Title:**

**MECHANICAL ENGINEERING**

**ME 454 SPECIAL TOPICS IN MECHANICAL ENGINEERING**

- 2. Designation:** Required  Elective   
Lower Division  Upper Division
- 3. Course Description:** Production, strengthening, alloying and thermal treatment of metals. Types and properties of polymers, ceramics and composites. Semiconductor materials and devices. Material selection and protection against deterioration.
- 4. Prerequisites:** ME 207, Material Science and Engineering, or equivalent
- 5. Text and Materials:** The Science and Engineering of Materials, 3rd Ed., Published by PWS Publishing Company, 1997
- 6. Course Objectives:** The student will develop knowledge of types and properties of common engineering materials, their modification by thermal and mechanical treatment, their manufacturing characteristics and time and environment dependent behavior with the end result of selecting proper material for specific application.

Course Outcomes

- the understanding of mechanical properties of engineering materials
- the familiarization with standardized tests used to determine properties
- the understanding of heat treatment methods that alter the properties of materials
- the understanding of material solidification and familiarization with common casting practices
- the ability to read phase diagrams and estimate the composition, quantities and properties of each phase
- familiarization with different methods of strengthen materials including grain size, cold work, dispersion and solid solution.
- the understanding of equilibrium and non-equilibrium phase diagrams of steel and cast iron and influence of alloying elements.
- the basic knowledge of properties of non-ferrous metals and alloys
- the familiarization with properties and structures of ceramics materials
- the basic understanding of formation, behavior, properties and forming of thermosetting, thermoplastic and elastomeric polymers
- introductory knowledge of composite materials
- the understanding of the electrical behavior of materials including conductivity of metals, semiconductors and superconductors.
- Familiarization with the semiconductor devices including their fabrication
- The ability to select proper material for the given engineering application based upon behavior, properties and cost.
- the broad education necessary to understand the impact of engineering solutions in a global/societal context.
- an ability to communicate effectively in written form.

**7. Topics Covered:** (in Order of Presentation)

- Review of atomic bonding, imperfection in the atomic arrangement and diffusion (Ch. 1 - 5)
- Mechanical properties of engineering materials, tensile test (Ch.6)
- Hardness test, impact test, fatigue test, creep test (Ch. 6)
- Introduction into fracture mechanics (Ch. 6)
- Cold work and strain hardening (Ch. 7)
- Microstructures and residual stresses, annealing and hot working (Ch. 7)
- Solidification process, solidification strengthening, defects casting processes and metal joining (Ch. 8)
- Unary phase diagrams and solid solution strengthening. Dispersion strengthening by solidification (Ch. 9,10)
- Dispersion strengthening by phase transformation and heat treatment (Ch. 11)
- Steels and heat treatment of steel, hardenability (Ch. 12)
- Types of steel, stainless steels cast irons (Ch. 12)

