1. Department, Course Number, and Course Title:

MECHANICAL ENGINEERING

ME 430 PROPERTIES AND SELECTION OF ENGINEERING MATERIALS

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), or equivalent

5. Text and Materials: Material Science and Engineering, Sixth Edition, W.D. Callister, Wiley, 2003

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
- Mechanical properties of engineering materials, tensile test
- Hardness test, impact test, fatigue test, creep test.
- Dislocations and Slip Systems Mechanism.
- Cold work and residual stresses, annealing and hot working
- Failure of engineering materials: fracture, fatigue and creep
- Equilibrium phase diagrams and solid solution strengthening. Dispersion strengthening by solidification
- Iron-Carbon System, isothermal transformation
- Phase Transformations in Metals: Development of Microstructures
- Fabrication and thermal processing of metals
- Structure and properties of ceramics
- Types and application of ceramics

- Fabrication and processing of ceramics
- Polymer structures
- Characteristics, Applications and Processing of Polymers
- Composites
- Electrical behavior of materials, conductors and semiconductors
- Electronic devices and manufacturing of semiconductors, Selection of materials

8. Class Schedule: Number of Sessions per week: 2
Duration of each session: 1 hour 40 minutes

9. Contribution of course to meeting the professional component:

This course is part of the 24 units of technical electives required for the mechanical engineering program.
Engineering Science 4 units

10. Relationship of course to program objectives:

This course relates to the program objectives by contributing to the following measurable outcomes at the level indicated for all engineering graduates:

Knowledge outcomes:
- an ability to apply knowledge of mathematics, science, and engineering (abet a)
- an understanding of professional and ethical responsibility (abet f)
- a knowledge of measurement and manufacturing techniques

Skill outcomes:
- an ability to design and conduct experiments as well as to analyze and interpret data (abet b)
- an ability to design a process to meet desired needs. (abet c)
- an ability to communicate effectively (abet g)
- an ability to select materials and manufacturing processes.

Attitudes Outcome:

11. Prepared by: Neda Fabris 05/2005