College of San Mateo
Official Course Outline

1. **COURSE ID:** ENGR 270 **TITLE:** Materials Science **C-ID:** ENGR 140B
   Units: 4.0 units **Hours/Semester:** 48.0-54.0 Lecture hours; 48.0-54.0 Lab hours; and 96.0-108.0 Homework hours
   Method of Grading: Letter Grade Only
   Prerequisite: CHEM 210, PHYS 250

2. **COURSE DESIGNATION:**
   Degree Credit
   Transfer credit: CSU; UC

3. **COURSE DESCRIPTIONS:**
   Catalog Description:
   Application of basic principles of physics and chemistry to the engineering properties of materials with emphasis on the relationship between atomic- and micro-structure and the mechanical and electrical properties of metals, concrete, polymers, ceramics, and semiconducting materials. The effect of heat, stress, imperfections, and chemical environment on material properties. Selection of materials to meet engineering design criteria. Acquisition, analysis, and presentation of experimental data. (Spring only)

4. **STUDENT LEARNING OUTCOME(S) (SLO'S):**
   Upon successful completion of this course, a student will meet the following outcomes:
   1. Describe the characteristics and behavior of the basic classes of materials (metals, ceramics, polymers, semiconductors, composites).
   2. Explain the relationship between a material's microstructure and processing and its properties and performance.
   3. Explain the effect of mechanical, chemical, and thermal processing on a material's structure and properties.
   4. Carry out a preliminary selection of appropriate materials for a specific engineering application.
   5. Conduct experiments using standard laboratory equipment.
   6. Analyze and interpret experimental data.
   7. Present experimental results in laboratory report using text, calculations, and graphs as appropriate.
   8. Work effectively in small groups.

5. **SPECIFIC INSTRUCTIONAL OBJECTIVES:**
   Upon successful completion of this course, a student will be able to:
   1. Describe the characteristics and behavior of the basic classes of materials (metals, ceramics, polymers, semiconductors, composites).
   2. Explain the relationship between a material’s microstructure and processing and its properties and performance.
   3. Explain the effect of mechanical, chemical, and thermal processing on a material's structure and properties.
   4. Carry out a preliminary selection of appropriate materials for a specific engineering application.
   5. Conduct experiments using standard laboratory equipment.
   6. Analyze and interpret experimental data.
   7. Present experimental results in laboratory report using text, calculations, and graphs as appropriate.
   8. Work effectively in small groups.

6. **COURSE CONTENT:**
   Lecture Content:
   1. Classification of Materials
   2. Atomic Structure and Interatomic Bonding
   3. Structure of Crystalline Solids
   4. Imperfections in Solids
   5. Diffusion
   6. Mechanical Properties of metals
   7. Dislocations and Strengthening Mechanisms
   8. Failure
   9. Phase Diagrams
   10. Phase Transformations in Metals

11. Metal Alloys
12. Structure and Properties of Ceramics
13. Polymer Structures, Characteristics, and Applications
14. Composites
15. Semiconductors
16. Environmental Degradation of Materials
17. Materials Selection and Design Considerations
18. Additional Topics

Lab Content:

Typical Lab topics:
Design issues (group icebreaker)
Crystal structures
Crystal defects
Mechanical properties (2-3 weeks; tensile test, hardness test, impact test)
Heat treatment (2-3 weeks; heat treatment of steels, mechanical testing, specimen polishing and etching; microscopic observation)
Composites including concrete (2-3 weeks; fabrication, mechanical testing)
Additional topics (e.g. polymers, photolithography, photovoltaics, field trip to testing lab) vary with each offering.

7. **REPRESENTATIVE METHODS OF INSTRUCTION:**

Typical methods of instruction may include:

A. Lecture
B. Lab
C. Other (Specify): Lectures to introduce new material and topics. Textbook reading assignments to expand knowledge. Individual take-home problems to develop skills. Laboratory experiments and exercises to reinforce and extend concepts covered in lecture.

8. **REPRESENTATIVE ASSIGNMENTS**

Representative assignments in this course may include, but are not limited to the following:

Writing Assignments:

Lab reports describing purpose of lab, supporting theory/analysis, experimental set-up, procedure, results, analysis, conclusions.

Reading Assignments:

Weekly reading assignments in textbook.

Other Outside Assignments:

Weekly problem-solving assignments.

9. **REPRESENTATIVE METHODS OF EVALUATION**

Representative methods of evaluation may include:

A. Exams/Tests
B. Homework
C. Lab Activities
D. Individual problem-solving assignments. Group problem-solving assignments (optional). Individual problem-solving exams. Individual or group laboratory reports. Individual or group oral presentations (optional).

10. **REPRESENTATIVE TEXT(S):**

Possible textbooks include:

A. Callister, W.D.Jr., D.G. Rethwisch. *Materials Science and Engineering: An Introduction*, 9th ed. Hoboken, NJ: Wiley, 2014
B. J. F. Shackelford. *Introduction to Materials Science for Engineers*, 7th ed. Upper Saddle River, NJ: Prentice-Hall, 2009

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