TAFT COLLEGE
West Kern Community College District

Prepared by: P. Blake
Reviewed by: G. Golling
Reviewed by: S. Aunai
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Engineering (ENGR) 1530 Materials Science and Engineering with Lab (4 Units) CSU:UC

Prerequisites: Physics (PHYS) 2221 General Physics (Calculus) and Chemistry (CHEM) 2211 General Chemistry

Prerequisite knowledge/skills: Before entering the course the student should be able to

1. apply the laws and principles of classical mechanics and statics to the analysis and solution of problems of force, linear and rotational motion under the action of forces and torques, motion in a plane under gravitational force, elastic and inelastic collisions, static equilibrium, work and energy under conservative and non-conservative forces, periodic motion, fluids, wave motion and vibrating bodies,
2. apply the concepts and techniques of calculus learned in a concurrent or prior calculus course, or presented in the physics course, to problems requiring them,
3. analyze complex problems, each of which requires the identification of multiple applicable physical concepts and their use in an appropriate manner and sequence,
4. perform experiments in a reasonable manner, and prepare adequate experimental reports presenting the numerical results and analyzing the sources and significance of errors,
5. list and discuss objectives of any experiment, the type of measurements made, why they were made, and how they entered into the determination of the desired result,
6. explain the use of the scientific method in the study of chemistry,
7. understand and appreciate the field of chemistry and explain its usefulness in a technical society,
8. correlate natural laws with mathematical solutions and further application of the laws to the solution of specific problems in chemistry,
9. explain the methods of accuracy, precision, and neatness in mathematical calculations,
10. demonstrate the proper care, use, and maintenance of equipment in the laboratory, and
11. identify the principles of chemistry which have direct application for professional fields that depend on these principles for understanding.

Advisory: Eligibility for English 1500 strongly recommended.

Total Hours: 48 hours lecture; 48 hours lab (96 hours total)

Catalog Description: This course and lab presents the internal structures and resulting behaviors of materials used in engineering applications, including metals, ceramics, polymers, composites, and semiconductors. The emphasis is upon developing the ability both to select appropriate materials to meet engineering design criteria and to understand the effects of heat, stress, imperfections, and chemical environments upon material properties and performance. The lab will apply concepts learned through usage of test equipment, data acquisition, analyzing data and writing engineering reports. C-ID: ENGR 140B

Type of Class/Course: Transfer Degree Credit

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Text: Callister, William and David G. Rethwisch. *Materials Science and Engineering: An Introduction.* 9th ed. New York: Wiley and Sons, 2015.

Messler, Robert. *The Essence of Materials for Engineers.* Burlington: Jones & Bartlett, 2011. Print.

Course Objectives:

By the end of the course a successful student will be able to:

1. Explain the relationship between the internal structure of materials and their macroscopic properties,
2. Explain methods (intentional or unintentional) of altering the structure of materials by mechanical, chemical, or thermal means in order to change material properties,
3. Illustrate the various systems for classifying materials, and compare differences in properties among material classes that derive from differences in structure,
4. Gather data from reference sources regarding the properties, processing, and performance characteristics of materials, and use it as a basis to recommend appropriate material(s) to meet engineering design criteria,
5. Operate various material test equipment safely and effectively, and
6. Demonstrate understanding of how to gather and analyze data, make recommendations for material use and write appropriate reports.

Course Scope and Content (Lecture):

Unit I Introduction to Materials
- A. Atomic Structure and Bonding
- B. Crystalline and noncrystalline solids
- C. Imperfections in crystals
- D. Diffusion

Unit II Material Selection in Engineering
- A. Purpose of Specifications
- B. Types of Materials
- C. Basic Properties

Unit III Mechanical properties and testing
- A. Stress and strain: modes, true/engineering
- B. Mechanical failure: fracture, fatigue, creep
- C. Strength, Stiffness, Hardness, Flexibility, Brittleness

Unit IV Metals and Metal Alloys
- A. Elastic and plastic deformation
- B. Iron-Carbon system, heat treatment of steels
- C. Strengthening and toughening
- D. Phase diagrams
- E. Phase transformations
- F. Forming and Fabrication

G. Alloys
H. Aluminums
I. Applications

Unit V Polymers
A. Structure – Amorphous and Crystalline
B. Properties
C. Forming and Fabrication
D. Applications

Unit VI Ceramics
A. Structure
B. Properties
C. Fabrication Methods
D. Applications

Unit VII Composites
A. What is a composite?
B. Structural Properties
C. Concrete and Wood
D. Carbon Fiber / Resin
E. Fiberglass
F. Others

Unit VIII Semiconductors
A. Properties
B. Fabrication

Unit IX Other Properties
A. Thermal
B. Electrical
C. Magnetic properties
D. Chemical
E. Corrosion
F. Fatigue

Course Scope and Content (Lab):

Unit I Introduction to Lab Processes
A. Safety
B. Notebooks
C. Reports
D. Data Gathering
E. Statistical Sampling

Unit II Material Testing - Metals
A. Tension
B. Compression
C. Impact

D. Hardness
E. Fatigue
F. Creep
G. Conductivity
H. Resistivity

Unit III Material Testing – Plastics and Composites
A. Tension
B. Compression
C. Impact
D. Hardness
E. Fatigue
F. Creep
G. Conductivity
H. Resistivity

Unit IV Material Treatments and Change of Properties
A. Strain Hardening
B. Precipitation Hardening
C. Recrystallization
D. Other

Learning Activities Required Outside of Class:

The students in this class will spend a minimum of 6 hours per week outside of the regular class time doing the following:

1. Studying assigned text, handout materials and class notes
2. Reviewing and preparing for quizzes, midterm and final exams
3. Completing individual homework assignments with clear calculations and engineering problem solving techniques.
4. Completing lab exercise and practicals

Methods of Instruction:

1. Lecture, demonstrations and discussions
2. Individual homework assignments with emphasis on application of engineering problems solving methods.
3. Case Studies
4. Laboratory work including experimentation, data collection, analysis and interpretation and report generation
5. Group Problem Solving

Methods of Evaluation:

1. Quizzes
2. Examinations
3. Participation
4. Individual assignments and group exercises
5. Team Presentations
6. Case Studies, Lab Reports Scenarios and Written Reports

Laboratory Category: Extensive Laboratory

Pre delivery criteria: All of the following criteria are met by this lab.
1. Curriculum development for each lab.
2. Published schedule of individual laboratory activities.
3. Published laboratory activity objectives.
4. Published methods of evaluation.
5. Supervision of equipment maintenance, laboratory setup, and acquisition of lab materials and supplies.

During laboratory activity of the laboratory: All of the following criteria are met by this lab.
1. Instructor is physically present in lab when students are performing lab activities.
2. Instructor is responsible for active facilitation of laboratory learning.
3. Instructor is responsible for active delivery of curriculum.
4. Instructor is required for safety and mentoring of lab activities.
5. Instructor is responsible for presentation of significant evaluation.

Post laboratory activity of the laboratory: All of the following criteria are met by this lab.

1. Instructor is responsible for personal evaluation of significant student outcomes (lab exercises, exams, practicals, notebooks, portfolios, etc.) that become a component of the student grade that cover the majority of lab exercises performed during the course.
2. Instructor is responsible for supervision of laboratory clean up of equipment and materials.

Supplemental Data:

TOP Code:	090100: Engineering, General (requires
SAM Priority Code:	E: Non-Occupational
Distance Education:	Not Applicable
Funding Agency:	Y: Not Applicable(funds not used)
Program Status:	1: Program Applicable

Noncredit Category:	Y: Not Applicable, Credit Course
Special Class Status:	N: Course is not a special class
Basic Skills Status:	N: Course is not a basic skills course
Prior to College Level:	Y: Not applicable
Cooperative Work Experience:	N: Is not part of a cooperative work experience education program
Eligible for Credit by Exam:	E: Credit By Exam
Eligible for Pass/No Pass:	NO
Taft College General Education:	NONE