COLLEGE OF THE DESERT

Course Code ENGR-013

Course Outline of Record

1. Course Code: ENGR-013
2. a. Long Course Title: Materials Science
   b. Short Course Title: MATERIALS SCIENCE
3. a. Catalog Course Description:
   Application of basic principles of chemistry and physics to the mechanical, electrical, optical, thermal, magnetic, and deteriorative properties of materials. Special emphasis is given to the relationship between micro structure and the properties of metals, polymers, ceramics, and semiconducting materials.
   b. Class Schedule Course Description:
   Application of basic principles of chemistry and physics to engineering properities of materials. Emphasis given to the relationship between microstructure and properties of metals, polymers, ceramics, and semiconducting materials.
   c. Semester Cycle (*if applicable*): *N/A*
   d. Name of Approved Program(s):
   - ENGINEERING AS Degree and Transfer Preparation
4. Total Units: 3.00 Total Semester Hrs: 54.00
   Lecture Units: 3 Semester Lecture Hrs: 54.00
   Lab Units: 0 Semester Lab Hrs: 0
   Class Size Maximum: 35 Allow Audit: No
   Repeatability No Repeats Allowed
   Justification 0
5. Prerequisite or Corequisite Courses or Advisories:
   Course with requisite(s) and/or advisory is required to complete Content Review Matrix (CCForm1-A)
   Prerequisite: CH 001A and
   Prerequisite: MATH 001A
   Advisory: PH 003A
6. Textbooks, Required Reading or Software: *(List in APA or MLA format.)*
   a. Douglas, Elliot (2014). *An Introduction to Materials Science and Engineering - A Guided Inquiry* (1st/e). New York Pearson. ISBN: 0132136422
   College Level: Yes
   Flesch-Kincaid reading level: 13.3
7. Entrance Skills: *Before entering the course students must be able:*
   a. Describe atomic structure and explain the relationship to periodicity.
   - CH 001A - Describe atomic structure to the level of atomic orbitals and explain the relationship to periodicity.

   b. Describe mechanisms of the different types of chemical bonds.
   - CH 001A - Distinguish between different types of chemical bonds.

   c. Describe the kinetic theory of matter and the states of matter.
   - CH 001A - Describe the kinetic molecular theory of matter, states of matter and use the gas laws in calculations.

   d. Describe the properties of solutions and calculate values associated with those properties.
   - CH 001A - Describe the properties of solutions and perform relevant calculations.

   e. Estimate the derivative as the slope of the tangent line to a curve and to approximate the derivative function graphically.
   - MATH 001A - Interpret the derivative as the slope of a tangent line and use this interpretation to approximate the derivative function graphically.

   f. Use derivatives to solve rates of change problems and optimization problems.
   - MATH 001A - Use derivatives to solve rate of change problems, answer optimization questions and graph functions.

g. Use the graph of a function to interpret features of the antiderivative.
- MATH 001A - Use the graph of a function to interpret features of the antiderivative.

h. Use the differential to calculate linear approximations of functions at a point.
- MATH 001A - Demonstrate use of the differential to compute linear approximations for a given function at a point, including error analysis.

i. Understand the relationship between conservative forces and potential energy and conservation of energy in general
- PH 003A - Understand the relationship between conservative forces and potential energy and conservation of energy in general.

j. Understand the elastic properties of solids with special attention to the engineering applications of this topic.
- PH 003A - Understand the elastic properties of solids with special attention to the engineering applications of this topic.

k. Describe and solve many types of harmonic motion problems with springs
- PH 003A - Describe and solve many types of harmonic motion problems including springs and pendulums, look at damped and driven oscillation problems numerically.

8. Course Content and Scope:

Lecture:

1. Atomic Structure and interatomic bonding
2. The structure of crystals
3. Imperfections in solids
4. Diffusion
5. Mechanical properties of metals
6. Phase Diagrams
7. Phase transformations in Metals
8. Microstructures and their properties
9. Structures and properties of Ceramics with applications
10. Polymer Structures: Characteristics, applications and Processing
11. Composites
12. Corrosion and Degradation of materials
13. Electical and Magnetic properties of materials
14. Thermal and Optical properties of materials

Lab: *(if the "Lab Hours" is greater than zero this is required)*

9. Course Student Learning Outcomes:

1. Describe the characteristics and behavior of the basic classes of materials (metals, ceramics, polymers, semiconductors, composites).
2. Explain the relationalship between a material's microstructure and processing and its properties and performance.
3. Select appropriate materials for a specific engineering application.
4. Analyze and interpret experimental data.
5. Assemble analytical results in report form using text, sample calculations, and graphs where appropriate.
6. Organize effectively, assign tasks, and summarize results working in small groups.

10. Course Objectives: *Upon completion of this course, students will be able to:*

a. Construct a simple atomic model showing electrons, protons, and the nucleus.
b. Describe ionic, covalent, metallic, hydrogen, and van der Waal's bonds.
c. Draw lattice structures for face-centered cubic, body-centered cubic, and hexagonal close-packed unit cells.
d. Compute densities of atoms in a given crystal structure.
e. Define point defects, line and planar defects, and edge, screw and mixed dislocations and describe how they affect mechanical properties.

f. Compare mechanical properies of different material classes.
g. Utilize stress/strain diagrams to determine yield point, ultimate strength, Young's modulus, ductility, resilience, and toughness.
h. Describe strenthening mechanisms of coldworking, solid solution hardening, grain size reduction and their effects on mechanical properties.
i. Calculate mole fraction and weight fraction of a phase using the lever rule.
j. Recognize and describe isomorphous, eutectic and eutectoid phase diagrams.
k. Identify the important microconstituents of steels: ferrite, pearlite, cementite, austenite and martensite and their properties.
l. Describe the effects of tempering, annealing, and quenching on mechanical properties of metals.
m. Use a time-temperature transformation (TTT) and continuous cooling transformation (CCT) diagrams to design a heat treatment process for steel to obtain specified properties.
n. State the purposes of and describe the procedures for the following heat treatments: annealing, normalizing, full annealing, tempering, austempering, and spheroidizing.
o. Describe the structural aspects of ceramic matericals including ionic bonding, compounds, and multi-component systems.
p. List major applications of ceramic materials and factors involved in designing ceramics for those applications.
q. Define momoner and polymer, and describe the intitiation and growth of a polymer chain.
r. Calculate the aveage molecular weight of a polymer.
s. List major applications of polymers and factors involved in designing polymers for those applications.
t. Decribe how metal conductivity varies with temperature.
u. Describe energy band characteristics of conductors, insulators, and semiconductors.
v. Describe how doping a semiconductor enhances conductivity.
w. Describe magnetic, electrical, optical and thermal properties of engineering materials and how microstructure affects these properties.

11. Methods of Instruction: *(Integration: Elements should validate parallel course outline elements)*
    a. Discussion
    b. Lecture
    c. Participation

12. Assignments: *(List samples of specific activities/assignments students are expected to complete both in and outside of class.)*
    In Class Hours: 54.00
    Outside Class Hours: 108.00
    a. Out-of-class Assignments

    Students will be assigned regular homework that will be assigned from the text. In addition, at least one design project will be assigned that requres students to work in groups both in and out of class.

    b. In-class Assignments

    Students will participate in class discussions involving application of the information presented in class. The assigned design project will require in-class interaction and oral progress reports to the entire class.

13. Methods of Evaluating Student Progress: *The student will demonstrate proficiency by:*
    - Written homework
      Weekly problem assignments
    - Guided/unguided journals
      Comprehensive notebook/journal documenting all work, including lecture notes, in-class activties, homework activities and design project work.
    - Group activity participation/observation
      Student design project will be a group/team activity requiring a significant amount of student interaction
    - Mid-term and final evaluations
      Multiple exams and a comprehensive final exam
    - Student participation/contribution
      Class participation includes discussion of the application of lecture material, sharing of the solutions of various

problems, and progress reports of design project

14. Methods of Evaluating: Additional Assessment Information:

15. Need/Purpose/Rationale -- *All courses must meet one or more CCC missions.*
PO-GE C1-Natural Sciences
Use college-level mathematical concepts and methods to understand, analyze, and explain issues in quantitative terms.
IO - Scientific Inquiry
Analyze quantitative and qualitative information to make decisions, judgments, and pose questions.
IO - Critical Thinking and Communication
Apply principles of logic to problem solve and reason with a fair and open mind.

16. Comparable Transfer Course

University System	Campus	Course Number	Course Title	Catalog Year
CSU	California Polytechnic University, San Luis Obispo	MATE 210	Materials Engineering	2015
UC	UC Irvine	ENGR 54	Principles of Matericals Science and Engineering	2015
CSU	California Polytechnic University, Pomona	MTE 207	Materials Science and Engineering	2015

17. Special Materials and/or Equipment Required of Students:
none.

18. Materials Fees: ☐ Required Material?

Material or Item	Cost Per Unit	Total Cost

19. Provide Reasons for the Substantial Modifications or New Course:

Course periodic review.

20. a. Cross-Listed Course *(Enter Course Code)*: *N/A*
b. Replacement Course *(Enter original Course Code)*: *N/A*

21. Grading Method *(choose one)*: Letter Grade Only

22. MIS Course Data Elements
a. Course Control Number [CB00]: CCC000525445
b. T.O.P. Code [CB03]: 90100.00 - Engineering, General (req
c. Credit Status [CB04]: D - Credit - Degree Applicable
d. Course Transfer Status [CB05]: A = Transfer to UC, CSU
e. Basic Skills Status [CB08]: 2N = Not basic skills course
f. Vocational Status [CB09]: Not Occupational
g. Course Classification [CB11]: Y - Credit Course
h. Special Class Status [CB13]: N - Not Special
i. Course CAN Code [CB14]: *N/A*
j. Course Prior to College Level [CB21]: Y = Not Applicable
k. Course Noncredit Category [CB22]: Y - Not Applicable
l. Funding Agency Category [CB23]: Y = Not Applicable

m. Program Status [CB24]: 1 = Program Applicable

Name of Approved Program *(if program-applicable)*: ENGINEERING

Attach listings of Degree and/or Certificate Programs showing this course as a required or a restricted elective.)

23. Enrollment - Estimate Enrollment
    First Year: 20
    Third Year: 25

24. Resources - Faculty - Discipline and Other Qualifications:
    a. Sufficient Faculty Resources: Yes
    b. If No, list number of FTE needed to offer this course: *N/A*
25. Additional Equipment and/or Supplies Needed and Source of Funding.
    none.
26. Additional Construction or Modification of Existing Classroom Space Needed. *(Explain:)*
    N/A
27. FOR NEW OR SUBSTANTIALLY MODIFIED COURSES
    Library and/or Learning Resources Present in the Collection are Sufficient to Meet the Need of the Students Enrolled in the Course: Yes
28. Originator Carl Farmer Origination Date 03/01/16