



CREDIT COURSE OUTLINE

I. COVER PAGE

(1) ENGR 4	(2) Engineering Materials	(3) 3
Number	Title	Units

(4) Lecture / Lab Hours:	(8)Classification:	
Total Course Hours		
Total Lec hours: 54.00	Degree applicable:	X
Total Lab hours: 0	Non-degree applicable:	
Total Contact hours: 54.00	Basic skills:	
Lec will generate <u>0</u> hour(s) outside work.	(9)RC	Fulfills AS/AA degree requirement: (area)
Lab will generate <u>0</u> hour(s) outside work.		
	General education category:	
(5) Grading Basis:	Grading Scale Only	Major: ENGINEERING
	Pass/No Pass option	Certificate of:
	Pass/No Pass only	Certificate in:
(6) Advisories:	(10)CSU	Baccalaureate: X
Eligibility for English 125 and	(11)Repeatable: (A course may be repeated three times)	0
Eligibility for English 126		
(7) Pre-requisites(requires C grade or better):		
CHEM 1A		
Corequisites:		

(12) Catalog Description:
 This is an introductory course on the properties of engineering materials and their relation to the internal structure of materials. Topics include: atomic structure and bonding; crystalline structures; phases and phase diagram; metals; polymers; ceramics; composites; mechanical deformation and fracture; structural control and influence of properties; materials naming and designating systems; and electrical properties.

II. COURSE OUTCOMES:

(Specify the learning skills the student demonstrates through completing the course and link critical thinking skills to specific course content and objectives.)

Upon completion of this course, students will be able to:

- I. classify crystal structures and crystal imperfections and determine their effects on material properties.
- II. use mechanical behavior data for a given material to predict a material's behavior under a certain load condition.
- III. interpret phase diagrams and predict material microstructures created by different heat treatments.
- IV. identify the properties of the various classes of materials and assess the proper material to be used in certain applications.

III. COURSE OBJECTIVES:

(Specify major objectives in terms of the observable knowledge and/or skills to be attained.)

In the process of completing this course, students will:

- I. define the types of bonds and list their properties.
- II. classify the various crystal structures and use crystallographic techniques to describe their features.
- III. describe crystalline imperfections and analyze their influence on material behavior.
- IV. analyze stress-strain curves and calculate materials' reactions to various stress conditions.
- V. differentiate elastic and plastic deformation.
- VI. describe the mechanisms for strengthening materials.
- VII. calculate failure loads of materials based on fracture and fatigue.
- VIII. calculate materials' reactions under high temperature loading.
- IX. interpret phase diagrams and solve problems based upon them.
- X. use phase diagrams to predict microstructural development in materials under heat treatment.
- XI. analyze the properties of the various classes of materials.
- XII. categorize and investigate the variety of materials within each materials class.
- XIII. outline and apply the electrical and corrosive properties of materials.

IV. COURSE OUTLINE:

Lecture Content:

- A. Structure of Materials
 - 1. Atomic Bonding
 - 2. Crystal Structures
 - 3. Crystallography
 - 4. Crystalline Imperfections
 - 5. Diffusion
- B. Mechanical Properties of Materials
 - 1. Stress and Strain
 - 2. Elastic and Plastic Deformation
 - 3. Deformation / Strengthening Mechanisms
 - 4. Fracture and Fatigue
 - 5. High Temperature Mechanical Properties
- C. Materials Processes
 - 1. Phase Diagrams
 - 2. Phase Transformations
- D. Types of Materials / Applications
 - 1. Metals
 - 2. Ceramics
 - 3. Polymers
 - 4. Composites
- E. Other Materials Properties
 - 1. Electrical Properties
 - 2. Corrosion and material degradation
- F. Materials selection

V. APPROPRIATE READINGS

Reading assignments may include but are not limited to the following:

- I. Sample Text Title:
 - 1. Recommended - Callister, W. *Materials Science and Engineering, An Introduction*, ed. 8 Wiley, 2010,
or
 - 2. Recommended - Callister, W. *Fundamentals of Materials Science and Engineering, an Integrated Approach*, ed. 3 Wiley, 2007,
- II. Other Readings
 - 1. Required - *Metals Handbook, Desk Edition, Second Edition, ASM International, 1998.*

- Global or international materials or concepts are appropriately included in this course
- Multicultural materials and concepts are appropriately included in this course

If either line is checked, write a paragraph indicating specifically how global/international and/or multicultural materials and concepts relate to content outline and/or readings.

VI. METHODS TO MEASURE STUDENT ACHIEVEMENT AND DETERMINE GRADES:

Students in this course will be graded in at least one of the following four categories. Please check those appropriate. A degree applicable course must have a minimum of one response in category A, B, or C.

A. Writing			
Check either 1 or 2 below			
X	1. Substantial writing assignments are required. Check the appropriate boxes below and provide a written description in the space provided.		
	2. Substantial writing assignments are NOT required. If this box is checked leave this section blank. For degree applicable courses you must complete category B and/or C.		
	a) essay exam(s)	X	d) written homework
X	b) term or other paper(s)	X	e) reading reports
	c) laboratory report(s)		f) other (specify)

Required assignments may include but are not limited to the following:

- 1. Short answer problems, describing materials processes or structures.
- 2. Written paper on the use of an engineering material.

B. Problem Solving

Computational or non-computational problem-solving demonstrations, including:

X	a) exam(s)		d) laboratory reports
X	b) quizzes		e) field work
X	c) homework problems		f) other (specify):

Required assignments may include but are not limited to the following:

1. Calculation problems on topics of materials engineering.
2. Problem solving based on using materials tables and graphs.

C. Skill demonstrations, including:			
	a) class performance(s)		c) performance exams(s)
	b) field work		d) other (specify)

Required assignments may include but are not limited to the following:

D. Objective examinations including:			
X	a) multiple choice	X	d) completion
X	b) true/false		e) other (specify):
X	c) matching items		

COURSE GRADE DETERMINATION:

Description/Explanation: Based on the categories checked in A-D, it is the recommendation of the department that the instructor's grading methods fall within the following departmental guidelines; however, the final method of grading is still at the discretion of the individual instructor. The instructor's syllabus must reflect the criteria by which the student's grade has been determined. (A minimum of five (5) grades must be recorded on the final roster.)

If several methods to measure student achievement are used, indicate here the approximate weight or percentage each has in determining student final grades.

Exams: 70 % Projects: 15 % Homework: 15 %

VII. EDUCATIONAL MATERIALS

For degree applicable courses, the adopted texts, as listed in the college bookstore, or instructor-prepared materials have been certified to contain college-level materials.

Validation Language Level (check where applicable):

College-Level Criteria Met	
YES	NO
<u>X</u>	<u> </u>
<u>X</u>	<u> </u>
<u> </u>	<u>X</u>
<u> </u>	<u>X</u>

- Textbook
- Reference materials
- Instructor-prepared materials
- Audio-visual materials

Indicate Method of evaluation:

- Used readability formulae (grade level 10 or higher)
- Text is used in a college-level course X
- Used grading provided by publisher
- Other: (please explain; relate to Skills Levels)

Computation Level (Eligible for MATH 101 level or higher where applicable)

<u>X</u>	<u> </u>
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Content

Breadth of ideas covered clearly meets college-level learning objectives of this course	<u>X</u>	<u> </u>
Presentation of content and/or exercises/projects:		
Requires a variety of problem-solving strategies including inductive and deductive reasoning.	<u>X</u>	<u> </u>
Requires independent thought and study	<u>X</u>	<u> </u>
Applies transferring knowledge and skills appropriately and efficiently to new situations or problems.	<u>X</u>	<u> </u>

List of Reading/Educational Materials

- Recommended - Callister, W. *Materials Science and Engineering, An Introduction*, ed. 8 Wiley, 2010,
- Recommended - Callister, W. *Fundamentals of Materials Science and Engineering, an Integrated Approach*, ed. 3 Wiley, 2007,
- Metals Handbook, Desk Edition, Second Edition, ASM International, 1998

Comments:

<u>X</u>	This course requires special or additional library materials (list attached). Metals Handbook, Desk Edition, Second Edition, ASM International, 1998
<u> </u>	This course requires special facilities:

Attached Files:

<p>BASIC SKILLS ADVISORIES PAGE The skills listed are those needed for eligibility for English 125, 126, and Math 101. These skills are listed as the outcomes from English 252, 262, and Math 250. In the right hand column, list at least <u>three</u> major basic skills needed at the beginning of the target course and check off the corresponding basic skills listed at the left.</p>	
<p>(eligibility for English 126) (as outcomes for English 262)</p> <p><input checked="" type="checkbox"/> Using phonetic, structural, contextual, and dictionary skills to attack and understand words.</p> <p><input checked="" type="checkbox"/> Applying word analysis skills to reading in context.</p> <p><input checked="" type="checkbox"/> Using adequate basic functional vocabulary skills.</p> <p><input checked="" type="checkbox"/> Using textbook study skills and outlining skills.</p> <p><input checked="" type="checkbox"/> Using a full range of literal comprehension skills and basic analytical skills such as predicting, inferring, concluding, and evaluating.</p>	<p>Reading engineering materials textbook and other materials.</p> <p>Reading failure analysis case studies and evaluating cause of failure.</p> <p>Independently learning about engineering materials topics and organizing information.</p>
<p>(eligibility for English 125) (as outcomes for English 252)</p> <p><input checked="" type="checkbox"/> Writing complete English sentences and avoiding errors most of the time.</p> <p><input checked="" type="checkbox"/> Using the conventions of English writing: capitalization, punctuation, spelling, etc.</p> <p><input checked="" type="checkbox"/> Using verbs correctly in present, past, future, and present perfect tenses, and using the correct forms of common irregular verbs.</p> <p><input checked="" type="checkbox"/> Expanding and developing basic sentence structure with appropriate modification.</p> <p><input checked="" type="checkbox"/> Combining sentences using coordination, subordination, and phrases.</p> <p><input checked="" type="checkbox"/> Expressing the writer's ideas in short personal papers utilizing the writing process in their development.</p>	<p>Writing paragraph length answers to textbook homework problems.</p> <p>Writing description of materials processing required to obtain certain material properties.</p> <p>Writing a short research paper on a topic of engineering materials.</p>
<p><u>Check the appropriate spaces.</u></p> <p><input type="checkbox"/> Eligibility for Math 101 is advisory for the target course.</p> <p><input checked="" type="checkbox"/> Eligibility for English 126 is advisory for the target course.</p> <p><input checked="" type="checkbox"/> Eligibility for English 125 is advisory for the target course.</p> <p><i><u>If the reviewers determine that an advisory or advisories in Basic Skills are all that are necessary for success in the target course, stop here, provide the required signatures, and forward this form to the department chair, the appropriate associate dean, and the curriculum committee.</u></i></p>	

<p>REQUISITES</p>	
<p>Subject Prerequisite -- CHEM 1A GENERAL CHEMISTRY</p>	
<ul style="list-style-type: none"> • Competent knowledge of the periodic table, molecules, and compounds. Assessed from a pre-test administered at the beginning of the semester and the final exam administered at the end of the semester. 	<ul style="list-style-type: none"> • define the types of bonds and list their properties. • classify the various crystal structures and use crystallographic techniques to describe their features. • outline and apply the electrical and corrosive properties of materials.

ESTABLISHING PREREQUISITES OR COREQUISITES

Every prerequisite or corequisite requires content review plus justification of at least one of the seven kinds below. Prerequisite courses in communication and math outside of their disciplines require justification through statistical evidence. Kinds of justification that may establish a prerequisite are listed below.

Check one of the following that apply. Documentation may be attached.

1. The prerequisite/corequisite is required by law or government regulations.
Explain or cite regulation numbers:
2. The health or safety of the students in this course requires the prerequisite.
Justification: Indicate how this is so.
3. The safety or equipment operation skills learned in the prerequisite course are required for the successful or safe completion of this course.
Justification: Indicate how this is so.
4. The prerequisite is required in order for the course to be accepted for transfer to the UC or CSU systems.
Justification: Indicate how this is so.
5. Significant statistical evidence indicates that the absence of the prerequisite course is related to unsatisfactory performance in the target course.
Justification: Cite the statistical evidence from the research.
6. The prerequisite course is part of a sequence of courses within or across a discipline.
7. Three CSU/UC campuses require an equivalent prerequisite or corequisite for a course equivalent to the target course:
CSU, Fresno ME 31 requires CHEM 1A. Cal Poly, San Luis Obispo MATE 210 requires CHEM 111 or 124 or 127. UC, Davis ENG 45 requires CHEM 2A.