Modesto Junior College

Course Outline of Record Report

09/03/2021

ENGR130 : Properties of Materials

General Information

Faculty Author:	• Jeremy Wilson
Attachments:	Engineering Batch DE Addendum Spring 2021 (1).pdf ENGR-130_SU20.pdf C-ID ENGR 140 B.pdf ENGR 130_141 Capacity form.pdf Download
Course Code (CB01) :	ENGR130
Course Title (CB02) :	Properties of Materials
Department:	Engineering
Proposal Start Date:	MJC Summer 2022
TOP Code (CB03) :	(0901.00) Engineering, General (requires Calculus) (Transfer)
CIP Code:	(14.0102) Pre-Engineering
SAM Code (CB09) :	Non-Occupational
Distance Education Approved:	No
Course Control Number (CB00) :	CCC000608803
Curriculum Committee Approval Date:	10/22/2019
Board of Trustees Approval Date:	11/13/2019
External Review Approval Date:	09/01/2018
Course Description:	This course 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. Laboratories provide opportunities to directly observe the structures and behaviors discussed in the course, to operate testing equipment, to analyze experimental data, and to prepare reports.
Proposal Type:	Add Distance Education An option for distance education is being added. The goal is to increase student enrollment.
Faculty Author:	No value

Discipline(s)

Master Discipline Preferred:	• Engineering

Bachelors or Associates Discipline Preferred: No value

Course Coding

Basic Skill Status (CB08)

Course is not a basic skills course.

Course Special Class Status (CB13)

Course is not a special class.

Grading

- A-F or P/NP

☐ Allow Students to Gain Credit by Exam/Challenge

Repeatability

0

Course Prior To College Level (CB21)

Not applicable.

Rationale For Credit By Exam/Challenge

No value

Type of Repeat

No value

☐ Allow Students To Audit Course

Course Support Course Status (CB26)

Course is not a support course

Associated Programs

☑ Course is part of a program (CB24)

Associated Program	Award Type	Active
Engineering (In Development)	A.S. Degree	MJC Summer 2022

Transferability & Gen. Ed. Options

Course General Education Status (CB25)

Y

Transferability

Transferable to both UC and CSU

Transferability Status

Approved

C-ID: California's Course Identification Numbering System	Categories	Status	Approval Date	Rationale (include Comparable Course, C-ID Descriptor, etc. if applicable.
Engineering (ENGR)	(ENGR)	Approved	No value	C-ID: ENGR 140B

Field Trips

Field trips are required.

- (•) Yes
- ( ) No
- ( ) Maybe

Comparable Lower-Division Courses at UC/CSU v2

Courses numbered 100-299 require identification two comparable lower-division courses from CSU or UC from the current institutional catalog (not schedule). At least one course from CSU, and if requesting/maintaining UC general elective transfer, one course from UC. Please identify the CSU campus offering this course. (Term type is indicated in parentheses)

CSU, Fresno (SEM)

CSU Catalog Year

2020-2021

Provide the CSU course code (e.g., ENGL 1A) from the most current official Catalog (not schedule). Curriculum changes each year.

ME 31 & ME 32

CSU Course Title

Engineering Materials and Engineering Materials Laboratory

Does course-to-course or lower-division, "major prep" articulation with this course exist for this academic year?

Yes

Select the institution that offers the second comparable course from CSU or UC. If seeking or maintaining UC transferability, you must supply a UC campus. (Term type is indicated in parentheses)

UC Davis (QTR)

CSU/UC Catalog Year

2020-2021

Provide the CSU course code (e.g., ENGL 1A) from the most current official Catalog (not schedule). Curriculum changes each year.

ENG 045

CSU Course Title

Properties of Materials

Does course-to-course or lower-division, "major prep" articulation with this course exist for this academic year?

No

Select the institution that offers the third comparable course from CSU or UC. If seeking or maintaining UC transferability, you must supply a UC campus if not already provided above. (Term type is indicated in parentheses)

No Value

CSU/UC Catalog Year

No Value

Provide the CSU/UC course code (e.g., ENGL 1A) from the current official Catalog (not schedule). Curriculum changes each year.

No Value

CSU Course Title

No Value

Does course-to-course or lower-division, "major prep" articulation with this course exist for this academic year?

No Value

Units and Hours

Summary

Minimum Credit Units (CB07)	4
Maximum Credit Units (CB06)	4
Total Course In-Class (Contact) Hours	108
Total Course Out-of-Class Hours	108
Total Student Learning Hours	216

Credit / Non-Credit Options

Course Credit Status (CB04)

Credit - Degree Applicable

Course Non Credit Category (CB22)

Credit Course.

Non-Credit Characteristic

No Value

Course Classification Code (CB11)

Credit Course.

Variable Credit Course

Funding Agency Category (CB23)

This course was partially developed using Economic Development funds.

☐ Cooperative Work Experience Education Status (CB10)

Weekly Student Hours

	In Class	Out of Classs
Lecture Hours	3	6
Laboratory Hours	3	0
Activity Hours	0	0

Course Student Hours

Course Duration (Weeks)	18
Hours per unit divisor	52.5
Course In-Class (Contact) Hours	
Lecture	54
Laboratory	54
Activity	0
Total	108
Course Out-of-Class Hours	
Lecture	108
Laboratory	0
Activity	0
Total	108

Time Commitment Notes for Students

No value

Units and Hours - Weekly Specialty Hours

Activity Name	Type	In Class	Out of Class
No Value	No Value	No Value	No Value

Prerequisites, Corequisites, and Advisories

Prerequisite

CHEM101 - General Chemistry 1 (in-development)

Prerequisite

PHYS101 - General Physics: Mechanics

Requisite Skills

Requisite Skills	Description
Describe the development of modern atomic theory. Derive the symbolic data. Calculate the atomic weight of an element using natural abundance data. Classify compounds as ionic or molecular by referring to the chemical formula. Name chemical compounds given the correct chemical formula; derive correct chemical formulas from compound names.	• CHEM 101 - Name and write the formula for binary ionic compounds, ionic compounds containing polyatomic ions, binary covalent compounds and acids. • CHEM 101 - Name and write the formula for binary ionic compounds, ionic compounds containing polyatomic ions, binary covalent compounds and acids. • CHEM 101 - Describe the development of the atomic theory and determine the number of protons, neutrons and electrons. Calculate the atomic weight of an element using the natural abundance. • CHEM 101 - Determine the key components of the periodic table and understand the periodic trends of effective nuclear charge, atomic and ionic size, ionization energies, electron affinities and properties of the elements.
Solve problems that relate to the Bohr Theory of the atom. Be able to correctly predict the electron configuration of atoms and ions and draw the corresponding orbital diagrams by referring to the periodic table.	• CHEM 101 - Demonstrate understanding of the nature of waves and the concept of quantized energy. Solve problems using the Bohr model of the atom. Understand and apply the theories of Schrodinger, Hund and Pauli. Write electron configuration and orbital diagrams for elements.
Explain the concept of electro negativity and apply this principle to the determination of the polarity of chemical bonds and molecules.	• CHEM 101 - Draw correct Lewis structures for elements and ions including those that violate the octet rule. Predict relative values of lattice energy for ionic compounds. Provide (draw) correct Lewis structures for molecules and ions. Predict the relative bond polarity for atoms connected by covalent bonds. Explain the concept of electronegativity and apply this principle to the determination of the polarity of chemical bonds and molecules. Provide resonance structures for ions and molecules. Use bond enthalpies to estimate enthalpy changes for chemical reactions.
Compare and contrast the differences between the solid, liquid and gaseous phases of matter. Identify the three types of intermolecular forces and, by inspection of chemical structures, predict which of these forces will be present in a particular molecule	• CHEM 101 - Describe the characteristic properties of the gaseous state. Demonstrate understanding of the concept of gas pressure by providing verbal descriptions and solving quantitative problems. Provide definitions of the following gas laws: Boyle's Law, Gay-Lussac's Law, Charles's Law and Avagadro's Hypothesis and also solve quantitative problems that relate to these laws. Solve quantitative problems related to the Ideal Gas Equation. Solve quantitative problems employing Dalton's Law of Partial Pressures. Define the terms effusion and diffusion; solve quantitative problems involving these concepts. Demonstrate understanding of the concept of Kinetic Molecular Theory by relating these concepts to observable gas properties. Use the van der Waals Equation to predict the properties of real gases. Demonstrate an understanding of the van der Waals constants. • CHEM 101 - Compare and contrast the differences between the solid, liquid and gaseous phases of matter. Identify the three types of intermolecular forces and, by inspection of chemical structures, predict which of these forces will be present in a particular molecule
Predict the relative sizes, ionization energies and electron affinities of atoms and ions based on the position of the element on the periodic table.	• CHEM 101 - Determine the key components of the periodic table and understand the periodic trends of effective nuclear charge, atomic and ionic size, ionization energies, electron affinities and properties of the elements. • CHEM 101 - Determine if a substance is a strong electrotype, weak electrolyte or nonelectrolyte. Predict the products, balance and write the molecular, total ionic and net ionic equations.

Solve complex problems using the principles of dimensional analysis.	• CHEM 101 - Solve complex problems using the principles of dimensional analysis.
Identify and apply the vocabulary and basic principles of mechanics.	• PHYS 101 - Define the translational kinematic variables (time, distance, position, average speed, instantaneous speed, average velocity, instantaneous velocity, average acceleration and instantaneous acceleration) as well as apply them in order to explain, analyze, and solve one-dimensional motion problems. • PHYS 101 - Define and apply concepts related to measurement to include units, systems of units, metric prefixes, standards, unit conversions, dimensional analysis, order of magnitude estimates and significant figures. • PHYS 101 - Derive, state, and apply the 4 kinematic equations of motion in order to solve one-dimensional motion problems, such as that of the falling body. • PHYS 101 - State Newton's Three Laws of Motion and apply them in order to explain physical phenomena and solve quantitative problems in dynamics.
Identify and use the techniques of measurement in mechanics. LAB	• PHYS 101 - Demonstrate the proper use of laboratory instruments in making measurements. • PHYS 101 - Record and analyze their measurements to the correct number of significant digits. • PHYS 101 - Use the scientific method in designing simple experiments to test a physical concept. • PHYS 101 - Apply the scientific method in collecting and analyzing data to form conclusions.
Demonstrate the graphical techniques of analyzing experimental data. LAB	• PHYS 101 - Demonstrate the proper use of laboratory instruments in making measurements. • PHYS 101 - Record and analyze their measurements to the correct number of significant digits. • PHYS 101 - Apply the scientific method in collecting and analyzing data to form conclusions. • PHYS 101 - Use graphing techniques, statistics, and computer modeling in the analysis of data to determine the relationship between physical quantities.

Specifications

Methods of Instruction

Methods of Instruction (Typical)	INSTRUCTIONAL METHODS
MOI	1. Lectures 2. Videos 3. Classroom discussion 4. Multimedia 5. Possible field trips

Assignments (Typical)

Evidence of Appropriate Workload for Course Units (quantity)

1. Weekly reading assignments of subject material in textbook
2. Weekly end-of-chapter homework assignments

3. Weekly written laboratory reports
4. One research paper and oral presentation (per term) of a material science related topic.

Evidence of Critical Thinking (quality)

1. Explanations of material science related processes, procedures, manufacturing techniques (e.g., "When would you choose to forge a metal component vs cast it?")
2. Designing graphical solutions (eg determining points, lines and planes in crystal lattice structures).
3. Calculating values using formulae included in the text/lecture (e.g., "If a component fabricated from a low carbon-nickel alloy is to be exposed to a tensile stress of 31 MPA at 649 deg C, calculate its rupture lifetime.")
4. Use of chart and diagrams to determine certain quantities (e.g., phase diagrams, isothermal transformation diagrams, continuous cooling transformation diagrams, etc.).
5. Within the crystal lattice, describe what is happening during plastic deformation.
6. Why is fine pearlite harder and stronger than coarse pearlite?
7. Use the graph given to determine the phases present (at 930 deg C) for a mixture of 55% Ti –45% Ni.

Methods of Evaluation (Typical)	Rationale
FORMATIVE EVALUATION	1. Weekly grading of homework problems 2. Periodic quizzes 3. Exams requiring analysis of problems and selection of appropriate technique 4. Weekly laboratory reports
SUMMATIVE EVALUATION	1. Comprehensive final exam

Equipment

No Value

Textbooks

Author	Title	Publisher	Date	ISBN
William D. Callister	Materials Science and Engineering: An Introduction (10th Ed.)	Wiley	2018	1119405498

Other Instructional Materials

No Value

Textbook Exceptions and Supplementals

Title of Other Material

No Value

Who prepared or published this supplemental material?

No Value

Publish date

No Value

Are any of the textbook editions cited on this proposal considered "Classics" (typically with a publish date more than 5 years old)?

- ☐ Yes
- ☑ No
- ☐ Unsure

If yes, explain why this older text is used in the course. Reasons should focus on content only.

No Value

Materials Fees v2

Is there a materials fee for this course?

No

Provide a cost breakdown for all items provided for a materials fee. Each item must become "tangible personal property" of student upon payment of the fee and completion of the course.

No Value

Explain how these materials are related to the Student Learning Objectives for the course.

No Value

Explain how the materials have continuing value outside the classroom.

No Value

Is the amount of the material the student receives commensurate with the fee paid AND with the amount of material necessary to achieve the Student Learning Objectives for the course AND provided as the district's actual cost?

No Value

If no is checked, explain why.

No Value

If the district is NOT the only source of these materials, explain why the students have to pay a fee to the district rather than supply the materials themselves. (Cost savings? Health/Safety? Consistency/Uniformity?)

No Value

Learning Outcomes and Objectives

Course Objectives

Describe the atomic and microstructural characteristics which control the important properties of engineering materials.

Identify and apply techniques necessary to characterize crystallographic points, lines and planes.
Identify and describe imperfections in solids.
Describe the nature of atomic diffusion in solids.
Calculate stress and strain for circular and rectangular cross-sectional samples loaded in tension.
Create a stress/strain diagram based on analysis of a loaded sample or from a laboratory tensile test.
Calculate true stress and strain.
Distinguish between multiple hardness testing systems including Rockwell, Brinell, Knoop,Vickers, etc.
Identify atomic dislocation movement mechanisms and the effects on material properties.
Identify methods of limiting dislocation movement in solids.
Create S-N diagrams for samples under cyclical loading.
Analyze and decipher phase diagrams for binary isomorphous and eutectic systems.
Identify microstructures of the iron-carbon system.
Predict the formation of microstructures in the iron-carbon system based on cooling rates.
Identify and describe thermal processing techniques for steel and aluminum alloys.
Describe the molecular structure of common ceramics.
Describe processing and fabrication techniques of ceramics.

Describe the molecular structure of common polymers.

Describe processing and fabrication techniques of polymers.

Describe the construction of common composites. .

Compare the mechanical properties of common composites.

Describe the atomic factors that affect the electrical properties of solids.

Describe the mechanisms of semiconduction in solids.

Lab Objectives

Measure material properties and/or evaluate processing treatments using standard materials testing equipment and techniques.

Write laboratory reports that communicate the collection, analysis, and interpretation of experimental data according to professional engineering standards.

Recommended Objectives

Describe heat-treating methods, material processing techniques, and fabrication techniques in an industrial setting.

CSLOs

Measure material properties and/or evaluate processing treatments using standard materials testing equipment and techniques.
Expected SLO Performance: 0.0

Explain the relationship between the internal structure of materials and their macroscopic properties.
Expected SLO Performance: 0.0

Explain methods (intentional or unintentional) of altering the structure of materials by mechanical, chemical, or thermal means in order to change material properties.
Expected SLO Performance: 0.0

Illustrate the various systems for classifying materials, and compare differences in properties among material classes that derive from differences in structure.
Expected SLO Performance: 0.0

Content

Course Content

1. Atomic structure and bonding
2. Crystal structures and crystallography
3. Imperfections in crystals, including polycrystalline, semi-crystalline, and amorphous solids
4. Diffusion
5. Elastic and plastic deformation in metals
6. Strengthening and toughening in metals
7. Mechanical properties and testing
8. Stress-strain analysis
9. Mechanical failure: fracture, fatigue, creep
10. Phase diagrams
11. Phase transformations
12. Iron-Carbon system, heat treatment of steels
13. Metals and Metal Alloys
14. Forming and Fabrication
15. Thermal, electrical and magnetic properties, including semiconductors
16. Chemical properties, including corrosion
17. Structure and properties of polymers
18. Structure and properties of ceramics

Lab Content

1. Atomic structure and bonding
2. Crystal structures and cyrstallography
3. Imperfections in crystals, including pllycrysalline, semi-crystalline, and amorphous solids
4. Diffusion
5. Elastic and plastic deformation in metals
6. Strengthening and toughening in metals
7. Mechanical properties and testing
8. Stess-strain analysis
9. Mechanical failure: fracture, fatigue, creep
10. Phase diagrams
11. Phase transformations
12. Iron-Carbon system, heat treatment of steels
13. Metals and Metal Alloys
14. Forming and Fabrication
15. Thermal, electrical and magnetic properties including semiconductors
16. Chemical properties, including corrosion
17. Structure and properties of polymers
18. Structure and properties of ceramics
19. Structure and properties of composites, including wood and concrete (optional)
20. Selection of materials in engineering design (optional)

Recommended Course Content

Recommended Course Content

1. Structure and properties of composites, including wood and concrete
2. Selection of materials in engineering design

Recommended Lab Content

No Value

Distance Education (DE) Addendum

Is this course being proposed for Distance Education? If so, select Yes below from the list in the dropdown and complete the questions. If no, select No and skip all questions.

- Yes

Modality Type:

- Hybrid
- Online (ECO)

Methods of Instruction:

- Asynchronous Discussion
- Synchronous Discussion
- Viewing and Listening to Videos
- Facilitated Discussions
- Written Assignments
- Reading Course Materials
- Quizzes, Exams, and Surveys
- Multimedia Presentations
- Collaborative Peer/Group Activities
- Group Meetings/Review Sessions (hybrid only)

If Other is selected for Methods of Instruction, please describe:

No Value

Describe how the methods of instruction selected above will allow students to meet the course's learning outcomes:

The course information can be covered asynchronously through recorded videos with closed captioning or through synchronous lectures using web-based video teleconference software. The instructor will use Canvas to administer student assignments, reading materials, discussions, and interactive online simulations as well as exams/quizzes for summative and formative assessments. Discussions will be used in the online modality to provide a non-traditional assignment to provide equity for students. During synchronous lectures, students will be able to ask questions and interact with the instructor much in the same way as in-person instruction. Students will be able to receive assistance during office hours held by video teleconference. Lecture content will be reinforced with in-person lab exercises and written lab reports.

Describe how the methods selected will be presented in an accessible way (Title 5 §55206). For information about accessibility standards in online classes, see the OEI Rubric, Section D (Copy this link and paste in a separate browser to visit OEI Rubric: https://onlinenetworkofeducators.org/course-design-academy/online-course-rubric/)

Heading styles will be used in Canvas and other documents to make navigation of Canvas easy for students and accessible for screen readers. Lists will use the bullet tool instead of being developed manually, images will have robust captions, tables will be formatted according to accessibility, and hyperlinks will be defined properly. The accessibility checker will be used in Canvas to make sure all these standards are met. Instructors will make sure videos have closed captions that are high quality, consistent, and meet the needs of deaf

and hard-of-hearing audiences.

Regular and Effective Contact (REC) Methods and Examples: Select the methods below that ensure regular effective contact (REC) will take place among students and among students and faculty (Title 5 §55204) by being initiated by the instructor, regular and frequent, and meaningful or of an academic nature. Select the methods of REC that may be used:

No Value

REC Among students: How will students interact with each other in the course? What methods will be used? Check all that apply.

- Discussion Boards
- Group Projects
- Third-Party Tools (e.g. FlipGrid, VoiceThread, etc...)

REC Among students and faculty: How will faculty interact with students in the course? What methods will be used? Check all that apply

- Announcements
- Assignment Feedback
- Office Hours
- Discussion Boards
- The Online Course Syllabus
- Email
- Video Conferencing Technology (e.g. Zoom, MS Teams, etc...)

Other Methods of REC among students and among students and faculty. Please describe and provide example(s).

No Value

In hybrid or teleclass courses, describe what parts of the course are done face-to-face and what parts are done online.

For this hybrid course, lectures will be done online and the lab sessions will be face-to-face.

Checkoff List

Does this proposal meet the five development criteria as stated in the CCCCO Program and Course Approval Handbook (PCAH)?

Yes

Are library resources needed for this course?

No library resources are needed for this course.

Do you have any special concerns/needs or comments? If yes, describe.

No Value

Have you included documentation, if necessary, by uploading file(s) in the Cover Info tab? For example, advisory committee meeting minutes, C-ID descriptor, etc.)

Yes, I have uploaded file(s).

If this is a new course, have you attached the completed class capacity form by uploading the file in the Cover Info tab?

No, this is not a new course

If you are requesting Distance Education, did you complete the DE addendum tab?

Yes

If requesting transferability, have you completed the comparable courses field?

Yes

Add any additional comments you want reviewers to read.

No Value