ENGR140 : Materials Science and Engineering

General Information

Author:	• Christopher Herwerth
Course Code (CB01) :	ENGR140
Course Title (CB02) :	Materials Science and Engineering
Department:	ENGR
Proposal Start:	Spring 2026
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
Will this course be taught asynchronously?:	Yes
Course Control Number (CB00) :	CCC000590160
Curriculum Committee Approval Date:	03/12/2025
Board of Trustees Approval Date:	04/22/2025
Last Cyclical Review Date:	03/12/2025
Course Description and Course Note:	ENGR 140 examines the internal structures of materials and their subsequent behaviors used in engineering applications, including metals, ceramics, polymers, composites and semiconductors. Students learn how to select appropriate materials to meet engineering design criteria and to understand the effects of heat, mechanical stress, imperfections, and chemical environments on material properties and performance.
Justification:	Mandatory Revision
Academic Career:	• Credit
Mode of Delivery:	• In-Person • Remote • Online
Author:	No value
Course Family:	No value

Academic Senate Discipline

Primary Discipline:	• Engineering
Alternate Discipline:	No value
Alternate Discipline:	No value

Course Development

Basic Skill Status (CB08)

Course is not a basic skills course.

☐ Allow Students to Gain Credit by Exam/Challenge

Course Special Class Status (CB13)

Course is not a special class.

Pre-Collegiate Level (CB21)

Not applicable.

Grading Basis

- Grade with Pass / No-Pass Option

Course Support Course Status (CB26)

Course is not a support course

General Education and C-ID

General Education Status (CB25)

Not Applicable

Transferability

Transferable to both UC and CSU

Transferability Status

Approved

C-ID	Area	Status	Approval Date	Comparable Course
ENGR	Engineering	Approved	09/03/2019	ENGR 140 - Materials Science and Engineering

Units and Hours

Summary

Minimum Credit Units (CB07)	3
Maximum Credit Units (CB06)	3
Total Course In-Class (Contact) Hours	54
Total Course Out-of-Class Hours	108
Total Student Learning Hours	162

Credit / Non-Credit Options

Course Type (CB04)

Credit - Degree Applicable

Noncredit Course Category (CB22)

Credit Course.

Noncredit Special Characteristics

No Value

Course Classification Code (CB11)

Credit Course.

☐ Variable Credit Course

Funding Agency Category (CB23)

Not Applicable.

☐ Cooperative Work Experience Education Status (CB10)

Weekly Student Hours

Course Student Hours

	In Class	Out of Class
Lecture Hours	3	6
Laboratory Hours	0	0
Studio Hours	0	0

Course Duration (Weeks)	18
Hours per unit divisor	54
Course In-Class (Contact) Hours	
Lecture	54
Laboratory	0
Studio	0
Total	54
Course Out-of-Class Hours	
Lecture	108
Laboratory	0
Studio	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, Recommended Corequisites, and Recommended Preparation

Prerequisite

PHY101 - Physics for Scientists and Engineers: A

Objectives

- Calculate the work performed by forces.
- Collect quantitative data from observations of physical phenomena.
- Organize data in tables, and present data using graphs.
- Use computers to perform calculations and to make graphs.

AND

Prerequisite

CHEM101 - General Chemistry A

Objectives

- Describe chemical processes in terms of chemical equations and be able to use the equations to answer quantitative questions concerning the process described.
- Use quantum theory to predict electronic structures of the atom.
- Analyze the properties of the elements and develop algorithms for the classification of the elements into logical groups.
- Utilize bonding theories to describe the chemical nature of ions and molecules.

- Demonstrate an understanding of intermolecular forces and apply those forces to the nature of solids and liquids.

Entry Standards

Entry Standards	Description
No value	No value

Course Limitations

Cross Listed or Equivalent Course	Description
No value	No value

Specifications

Methods of Instruction

Methods of Instruction	
Methods of Instruction	Lecture
Methods of Instruction	Multimedia
Methods of Instruction	Collaborative Learning

Out of Class Assignments

- Calculations (e.g., using a phase diagram to calculate the liquid and alpha mass fractions of a binary isomorphous system such as copper-nickel
- Individual project (e.g., degradation of a biodegradable polymer polylactic acid (PLA) fork)
- Group project (e.g., create a physical unit cell model such as a BCC (body-centered cubic) crystal structure, BCC, to explain the crystal structure of various metals)

Methods of Evaluation	Rationale
Exam/Quiz/Test	Quizzes
Presentation (group or individual)	Presentation of group projects
Exam/Quiz/Test	Exams
Exam/Quiz/Test	Final exam

Textbook Rationale

No Value

Textbooks

Author	Title	Publisher	Date	ISBN
Shackelford, James	Introduction to Materials Science for Engineers	Pearson	2021	9780136707219
Callister, William and Rethwisch, David	Materials Science and Engineering: An Integrated Approach	Hoboken, NJ: John Wiley and Sons	2021	9781119747734

Other Instructional Materials (i.e. OER, handouts)

No Value

Learning Outcomes

Course Objectives

Differentiate properties of various materials such as iron, ductile steel and composites.

Apply knowledge of materials to engineering design decisions.

Compare the strengths and weaknesses of different types of engineering materials.

Explain the effects of fabrication on properties of materials such as heat-treating low carbon steel.

SLOs

Explain the relationship between internal structure of materials and their macroscopic physical properties. Expected Outcome Performance: 70.0

ILOs Core ILOs	Analyze and solve problems using critical, logical, and creative thinking; ask questions, pursue a line of inquiry, and derive conclusions; cultivate creativity that leads to innovative ideas.
	Demonstrate depth of knowledge in a course, discipline, or vocation by applying practical knowledge, skills, abilities, theories, or methodologies to solve unique problems.

ENGR Civil Engineering	Apply knowledge of mathematics, science and engineering; identify, form and solve engineering problems
	Demonstrate introductory skills using modern engineering tools necessary for engineering practice.
ENGR Engineering Technology - CAD & Design Drafting	Discuss how the design process and design/drawing techniques are used with other engineering processes to create a finished product.
ENGR Engineering Entrepreneurship Skill Award	Learn the engineering design process and how technical products are made, assembled, and integrated into complex systems.
ENGR Electrical Engineering A.S. Degree Major	analyze engineering problems and make appropriate decisions with the supervision of a licensed engineer;
	use science and mathematical skills required for occupational needs;
ENGR Mechanical Engineering - A.S. Degree Major	analyze engineering problems and make appropriate decisions with the supervision of a licensed engineer;
ENGR Computer Engineering AS	demonstrate appropriate technical written, verbal, drawing, and communication skills;

Examine intentional and unintentional methods of altering the structure of materials by mechanical, chemical, or thermal methods in order to manipulate material properties.

Expected Outcome Performance: 70.0

ILOs Core ILOs	Analyze and solve problems using critical, logical, and creative thinking; ask questions, pursue a line of inquiry, and derive conclusions; cultivate creativity that leads to innovative ideas.
	Demonstrate depth of knowledge in a course, discipline, or vocation by applying practical knowledge, skills, abilities, theories, or methodologies to solve unique problems.
ENGR Civil Engineering	Apply knowledge of mathematics, science and engineering; identify, form and solve engineering problems
	Demonstrate introductory skills using modern engineering tools necessary for engineering practice.
ENGR Engineering Technology - CAD & Design Drafting	Demonstrate skills in the production of working drawings of engineering structures
ENGR Engineering Entrepreneurship Skill Award	Learn the engineering design process and how technical products are made, assembled, and integrated into complex systems.
ENGR Mechanical Engineering - A.S. Degree Major	analyze engineering problems and make appropriate decisions with the supervision of a licensed engineer;
	use science and mathematical skills required for occupational needs;
ENGR Computer Engineering AS	analyze engineering problems and make appropriate decisions with the supervision of a licensed engineer;
ENGR Electrical Engineering A.S. Degree Major	analyze engineering problems and make appropriate decisions with the supervision of a licensed engineer;
	use science and mathematical skills required for occupational needs;

Characterize systems of classifying materials, and compare differences in properties among material classes that derive from differences in structure.

Expected Outcome Performance: 70.0

ILOs Core ILOs	Demonstrate depth of knowledge in a course, discipline, or vocation by applying practical knowledge, skills, abilities, theories, or methodologies to solve unique problems.
ENGR Civil Engineering	Demonstrate introductory skills using modern engineering tools necessary for engineering practice.

ENGR Engineering Technology - CAD & Design Drafting	Discuss how the design process and design/drawing techniques are used with other engineering processes to create a finished product.
ENGR Engineering Entrepreneurship Skill Award	Learn the engineering design process and how technical products are made, assembled, and integrated into complex systems.
ENGR Mechanical Engineering - A.S. Degree Major	demonstrate appropriate technical written, verbal, drawing, and communication skills;
ENGR Computer Engineering AS	demonstrate appropriate technical written, verbal, drawing, and communication skills;
ENGR Electrical Engineering A.S. Degree Major	demonstrate appropriate technical written, verbal, drawing, and communication skills;

Gather data from reference sources regarding the properties, processes, and performance characteristics of material, and evaluate appropriate materials to meet engineering design criteria.

Expected Outcome Performance: 70.0

ILOs Core ILOs	Analyze and solve problems using critical, logical, and creative thinking; ask questions, pursue a line of inquiry, and derive conclusions; cultivate creativity that leads to innovative ideas.
	Demonstrate depth of knowledge in a course, discipline, or vocation by applying practical knowledge, skills, abilities, theories, or methodologies to solve unique problems.
ENGR Civil Engineering	Apply knowledge of mathematics, science and engineering; identify, form and solve engineering problems
	Demonstrate introductory skills using modern engineering tools necessary for engineering practice.
ENGR Engineering Technology - CAD & Design Drafting	Demonstrate skills in the production of working drawings of engineering structures
ENGR Engineering Entrepreneurship Skill Award	Learn hands-on skills and problem solving techniques for businesses related to engineering design, installation, manufacturing, testing, technical sales, maintenance, and other such topics in engineering technology.
	Learn the engineering design process and how technical products are made, assembled, and integrated into complex systems.
ENGR Electrical Engineering A.S. Degree Major	analyze engineering problems and make appropriate decisions with the supervision of a licensed engineer;
ENGR Mechanical Engineering - A.S. Degree Major	analyze engineering problems and make appropriate decisions with the supervision of a licensed engineer;
ENGR Computer Engineering AS	analyze engineering problems and make appropriate decisions with the supervision of a licensed engineer;
	design a system, component, or process with supervision of a licensed engineer to meet desired needs.
	use science and mathematical skills required for occupational needs;

Additional SLO Information

Does this proposal include revisions that might improve student attainment of course learning outcomes?

No

Is this proposal submitted in response to learning outcomes assessment data?

No

If yes was selected in either of the above questions for learning outcomes, explain and attach evidence of discussions about learning outcomes.

No Value

SLO Evidence

No Value

Course Content

Lecture Content

Introduction (3 hours)
- Introduction to materials science
- History and importance of materials science and engineering
- Types of engineering materials
- Classifications of materials based on structure

Structure of materials (5 hours)
- Atomic structure and bonding
- Periodic table of elements
- Crystal structures and crystallography
- Atomic models and quantum numbers
- Electron configurations
- Atomic bonding in solids, bonding forces and energies
- Relationship between arrangements of atoms and material properties

Crystalline structure in solids (5 hours)
- Imperfections in crystals such as polycrystalline, semi-crystalline and amorphous solids
- Atomic arrangement consisting of short range order and long range order
- Unit cells, allotropic or polymorphic transformations
- Points, directions and planes in the unit cell
- Interstitial sites, ionic crystals, covalent structures
- Diffraction techniques for crystal structure analysis
- Polycrystalline, semi-crystalline and amorphous solids

Diffusion (3 hours)
- Diffusion mechanisms, atom movement in materials
- Diffusion rates, (Fick's First Law) activation energy for diffusion
- Composition profile (Fick's Second Law) and diffusion in materials processing

Imperfections (3 hours)
- Imperfections in the atomic arrangement comprising point defects,
- Dislocations, Schmidt's Law, influence of crystal structure,
- Surface defects, importance of defects and control of slip process

Mechanical properties and testing (3 hours)
- Stress-strain curve and modulus of elasticity
- Mechanical properties of various materials using tensile testing
- Elastic and plastic deformation

Mechanical Properties Non-Ferrous Materials (3 hours)
- Tensile test of copper,
- Tensile test of aluminum
- Comparison of stress-strain curve to ductile steel

Mechanical Failure (3 hours)
- Fracture, fatigue and creep
- Cold working, strain hardening strengthening and toughening in metals

- Strength, toughness, resilience

Phase Diagrams (3 hours)
- Interpretation of phase diagrams
- Phase transformation
- Forming and fabrication
- Iron-carbon system

Thermal stressing (3 hours)
- Annealing and heat treatment
- Iron-carbon materials
- Heat treatment of steels

Degradation of Materials (3 hours)
- Chemical properties
- Electrochemical corrosion of metals
- Corrosion and oxidation
- Corrosion of ceramic materials and degradation of polymers

Composite Materials (3 hours)
- Structure and properties of composites
- Wood, concrete, fiberglass, carbon and aramid

Ceramics (3 hours)
- Structure and properties of ceramics
- Applications of ceramics
- Synthesis and processing of ceramic powders
- Characteristics of sintered ceramics, inorganic glasses and glass-ceramics

Polymers (4 hours)
- Structure and properties of polymers
- Classification of polymers
- Addition and condensation polymerization, degree of polymerization
- Structure of thermoplastics and the effect of temperature on thermoplastics
- Mechanical properties of thermoplastics, elastomers (rubbers) and thermosetting polymers

Thermal, Electrical and magnetic Properties (3 hours)
- Thermal properties of materials
- Electrical and magnetic properties
- Electrical conductivity
- Semiconductors
- Dielectric properties

Sustainability (4 hours)
- Selection of materials in engineering design
- Environmental and societal issues in materials science
- Recycling, materials cycle, lifecycle assessment
- Biodegradable and recyclable materials

Total hours: 54

Additional Information

Repeatability

Not Repeatable

Justification (if repeatable was chosen above)

No Value

Is it possible this course will have a material fee?

No Value

I have contacted my library liaison (https://campusguides.glendale.edu/faculty/liaisons):

No Value

What term(s) will this course be offered?

No Value

Will any additional resources be needed for this course? (Click all that apply)

No Value

If additional resources are needed, add a brief description and cost in the box provided.

No Value

Resources

Did you contact your departmental library liaison?

Yes

If yes, who is your departmental library liason?

Adina Lerner (Technology & Aviation, Visual & Performing Arts)

Did you contact the DEIA liaison?

Yes

Were there any DEIA changes made to this outline?

No

If yes, in what areas were these changes made:

No Value

Will any additional resources be needed for this course? (Click all that apply)

- No

If additional resources are needed, add a brief description and cost in the box provided.

No Value