Master Course Syllabus

For additional course information, including prerequisites, corequisites, and course fees, please refer to the Catalog: https://catalog.uvu.edu/

Semester: Spring
Year: 2025
Course Prefix: ENGR
Course and Section #: 2160-002
Course Title: Introduction to Materials Science and Engineering
Credits: 3

Course Description

Introduces students to properties of materials from macro and micro point of view. Includes failure analysis of materials, altering properties of materials, and fracture mechanics. Introduces properties of solid materials and their behavior as applied to engineering.

Course Attributes

This course has the following attributes:
☒ General Education Requirements
☐ Global/Intercultural Graduation Requirements
☐ Writing Enriched Graduation Requirements
☐ Discipline Core Requirements in Program
☐ Elective Core Requirements in Program
☐ Open Elective
Other: *Click here to enter text.*

Instructor Information

Instructor Name: Mohamed Shwani, Ph.D.

Student Learning Outcomes

- Explain the structure, properties, and behavior of different materials, including metals, ceramics, polymers, and composites.
- Analyze how atomic and molecular structures influence the mechanical, electrical, thermal, and magnetic properties of materials.
- Utilize common techniques to measure and interpret material properties, such as hardness, strength, conductivity, and thermal resistance.
- Apply materials' properties and principles to engineering design problems.
- Describe the effects of various processing techniques (e.g., heat treatment, casting, and additive
- manufacturing) on material properties and performance.
- Apply fracture mechanics to perform failure analysis.

- Select appropriate materials in engineering design.

Course Materials and Texts

- Materials Science and Engineering: An Introduction" 10th Edition by Callister and Rethwisch.
- Calculator

Course Requirements

Course Assignments, Assessments, and Grading Policy

1- **Homework:** Homework problems were selected to help you understand the concepts discussed in the textbook and lecture. You will be responsible for understanding and completing all homework assignments as individuals. You may work with friends or lab-mates on homework by sharing concepts or equations, but you are responsible for coming up with your answers and calculations as individuals. Copying someone else homework, using solutions from previous classes, or from the solution manual is considered unethical and will be treated as academic dishonesty.
All homework assignments must be submitted on paper (typed for concept problems and typed or handwritten for calculation problems). Homework must include all work (restate equations or example calculations even if you use excel). You may use a computer to assist in answering homework, but it still needs to be printed, and you do need to have some written or hand-typed explanations and equations to earn full credit.

2- **Exams:** There will be three exams administered during the semester (2 mid-semester and a final). You will only have 1 attempt to complete these. All exam questions are based on the learning objectives which will be re-iterated to you in a study guide page posted prior to the exam.

Final grades are rounded to the nearest tenth and assigned the corresponding letter grade:

A = 93-100	B - = 80-82.9	D+ = 67-69.9
A - = 90-92.9	C+ = 77-79.9	D = 63-66.9
B+ = 87-89.9	C = 73-76.9	D - = 60-62.9
B = 83-86.9	C - = 70-72.9	F = 0-59.9

Required or Recommended Reading Assignments

You will be assigned specific sections to read with each module. These are through the Zybooks textbook, which must be purchased through the link before accessing the assignments. This textbook edition was selected specifically because it provides unique interactive videos, animations, and comprehension questions to assist in your understanding. You earn points (and will see a checkmark by each activity) as you complete them. Be sure to complete all activities in the required sections assigned by their due date for full credit. Reading assignments for each chapter should be completed before we start doing that chapter in the class . You may read sections ahead of schedule. Any of the reading activities done after the due date will be recorded in Zybook but will not be added to your weekly reading assignment score. The grade in Canvas will update once you have at least clicked on the specific link under each module. Once you have clicked on that link, your grade will sync and stay synced (if

you already completed the reading. It will show your points in Grades; or if you later complete reading activities after the link has been clicked, your Grades will also update). If you feel you did the activities, but do not see your Grade update, please click on that module's Zybook link again.

General Description of the Subject Matter of Each Lecture or Discussion

Chapter 1: Introduction:
1.1-1.6: Historical perspective, Materials science and engineering, Why study materials science and engineering?, Classification of materials, Advanced materials and Modern materials' needs.

Chapter 2: Atomic structure and interatomic bonding:
2.1-2.10: Atomic structure: Fundamental concepts, Electrons in atoms, The periodic table, Atomic bonding in solids: Bonding forces and energies, Primary interatomic bonds, Secondary bonding or van der Waals bonding and Bonding type-material classification correlations.

Chapter 3: The structure of crystalline solids:
3.1-3.16: Crystal structures: Fundamental concepts, Unit cells, Metallic crystal structures, Density computations, Polymorphism and allotropy, Crystal systems, Crystallographic points, directions and planes, Crystalline and noncrystalline materials.

Chapter 4: Imperfections in solids:
4.1-4.7: Point defects, Miscellaneous imperfections: Dislocations—linear defects

Chapter 5: Diffusion:
5.1-5.5: Diffusion mechanisms, Fick's first law, Fick's second law—nonsteady-state diffusion and Factors that influence diffusion.

Chapter 6: Mechanical properties of metals:
6.2-6.12: Concepts of stress and strain, Elastic deformation, Plastic deformation, Property variability and design/safety factors: Variability of material properties.

Chapter 7: Dislocations and strengthening mechanisms:
7.2,7.3 - 7.10-7.13: Dislocations and plastic deformation, Mechanisms of strengthening in metals: Strain hardening, Recovery, Recrystallization and Grain growth.

Chapter 8: Failure:
8.2-8.15: Fracture, Fatigue and Creep.

Chapter 9: Phase diagrams:
9.2-9.20: Definitions and basic concepts, Binary phase diagrams and The iron-carbon system.

Chapter 10: Phase transformations:
10.2-10.9: Phase transformations, Microstructural and property changes in iron-carbon alloys.

Chapter 11: Applications and processing of metal alloys:

11.2-11.10: Types of metal alloys, Fabrication of metals, Thermal processing of metals.

Chapter 12: Structures and properties of ceramics:
12.2-12.11: Ceramic structures, Mechanical properties.

Chapter 14: Polymer structures:
14.2-14.13: Hydrocarbon molecules, Polymer molecules, The chemistry of polymer molecules, Molecular weight, Molecular shape, Molecular structure, Molecular configurations, Thermoplastic and thermosetting polymers, Copolymers, Polymer crystallinity, Polymer crystals, Defects in polymers.

Chapter 16: Composites:
16.2-16.15: Particle-reinforced composites.

Chapter 17: Corrosion and degradation of materials:
17.1-17.13: Corrosion of metals, Degradation of polymers.

Required Course Syllabus Statements

Generative AI
AI programs are not a replacement for your human creativity, originality, and critical thinking. Writing, thinking, and researching are crafts that you must develop over time to develop your own individual voice. At the same time, you should learn how to use AI and in what instances AI can be helpful to you. The use of generative AI tools (e.g. ChatGPT, Google Bard, etc.) is permitted in this course for the following activities:

- Brainstorming and refining your ideas.
- Fine tuning your research questions.
- Finding information on your topic.
- Drafting an outline to organize your thoughts.

Using Remote Testing Software
☐ This course does not use remote testing software.

☒ This course uses remote testing software. Remote test-takers may choose their remote testing locations. Please note, however, that the testing software used for this may conduct a brief scan of remote test-takers' immediate surroundings, may require use of a webcam while taking an exam, may require the microphone be on while taking an exam, or may require other practices to confirm academic honesty. Test-takers therefore shall have no expectation of privacy in their test-taking location during, or immediately preceding, remote testing. If a student strongly objects to using test-taking software, the student should contact the instructor at the beginning of the semester to determine whether alternative testing arrangements are feasible. Alternatives are not guaranteed.

Required University Syllabus Statements

Accommodations/Students with Disabilities
Students needing accommodations due to a permanent or temporary disability, pregnancy or pregnancy-related conditions may contact UVU Accessibility Services at accessibilityservices@uvu.edu or 801-863-8747.

Accessibility Services is located on the Orem Campus in BA 110.

Deaf/Hard of Hearing students requesting ASL interpreters or transcribers can contact Accessibility Services to set up accommodations. Deaf/Hard of Hearing services can be contacted at DHHservices@uvu.edu

DHH is located on the Orem Campus in BA 112.

Academic Integrity

At Utah Valley University, faculty and students operate in an atmosphere of mutual trust. Maintaining an atmosphere of academic integrity allows for free exchange of ideas and enables all members of the community to achieve their highest potential. Our goal is to foster an intellectual atmosphere that produces scholars of integrity and imaginative thought. In all academic work, the ideas and contributions of others must be appropriately acknowledged and UVU students are expected to produce their own original academic work.

Faculty and students share the responsibility of ensuring the honesty and fairness of the intellectual environment at UVU. Students have a responsibility to promote academic integrity at the university by not participating in or facilitating others' participation in any act of academic dishonesty. As members of the academic community, students must become familiar with their rights and responsibilities. In each course, they are responsible for knowing the requirements and restrictions regarding research and writing, assessments, collaborative work, the use of study aids, the appropriateness of assistance, and other issues. Likewise, instructors are responsible to clearly state expectations and model best practices.

Further information on what constitutes academic dishonesty is detailed in UVU Policy 541: *Student Code of Conduct*.

Equity and Title IX

Utah Valley University does not discriminate on the basis of race, color, religion, national origin, sex, sexual orientation, gender identity, gender expression, age (40 and over), disability, veteran status, pregnancy, childbirth, or pregnancy-related conditions, citizenship, genetic information, or other basis protected by applicable law, including Title IX and 34 C.F.R. Part 106, in employment, treatment, admission, access to educational programs and activities, or other University benefits or services. Inquiries about nondiscrimination at UVU may be directed to the U.S. Department of Education's Office for Civil Rights or UVU's Title IX Coordinator at 801-863-7999 – TitleIX@uvu.edu – 800 W University Pkwy, Orem, 84058, Suite BA 203.

Religious Accommodation

UVU values and acknowledges the array of worldviews, faiths, and religions represented in our student body, and as such provides supportive accommodations for students. Religious belief or conscience broadly includes religious, non-religious, theistic, or non-theistic moral or ethical beliefs as well as participation in religious holidays, observances, or activities. Accommodations may include scheduling or due-date modifications or make-up assignments for missed class work.
To seek a religious accommodation, a student must provide written notice to the instructor and the Director of Accessibility Services at accessibilityservices@uvu.edu. If the accommodation relates to a scheduling conflict, the notice should include the date, time, and brief description of the difficulty posed by the conflict. Such requests should be made as soon as the student is aware of the prospective scheduling conflict.

While religious expression is welcome throughout campus, UVU also has a specially dedicated space for meditation, prayer, reflection, or other forms of religious expression.