ENGR 0022: Material Structures and Properties

SPRING, 2025

INSTRUCTOR: Dr. Shijing Luo

OFFICE: Room 522 (New Building)

EMAIL: shijing.luo@scupi.cn

OFFICE HOURS: Monday & Tuesday & Friday: 14:00-17:30, or by appointment

LECTURES: Friday 8:15-11:00
Room 3-103

TA: Yang Zheyuan 2022141520094@stu.scu.edu.cn

QQ GROUP: 1035617943

COURSE NUMBER: 312014030

CREDITS: 3-credits

TEXTBOOK:

- William D. Callister, Jr., David G. Rethwisch, Materials Science and Engineering: An Introduction, 10th Edition, Wiley, January 2018. ISBN: 978-1-119-40549-8.
- Additional references and supplementary materials will be posted on Blackboard.

PREREQUISITE:

- Math 0230 –Analytic Geometry and Calculus 2
- PHYS 0174 –Physics for Science and Engineering 1
- CHEM 0960 –General Chemistry for Engineers 1

COURSE DESCRIPTION:

This course is 3 credits.

This course provides a foundational understanding of materials science and engineering, exploring the relationship between material structures and their properties. Students will study various materials, including metals, semiconductors, ceramics, polymers, and composites, and learn how microscopic structures influence macroscopic behaviors. Key topics include the structure of solids, mechanical

and physicochemical properties, materials processing, performance, and degradation. Through theoretical concepts and practical applications, students will develop the ability to design materials for specific optical, electrical, and magnetic properties.

COURSE OBJECTIVES:

This course is designed to equip students with essential knowledge and skills for analyzing, predicting, and innovating in materials science and engineering. A strong understanding of the structure-property relationship is crucial for materials design, processing, and application. By the end of this course, students will be able to:

1) Classify material families based on chemical composition, atomic and microstructures, physicochemical properties, and processing methods.
2) Explain the relationships between a material's atomic and/or micro-level structure and its resulting properties.
3) Design materials with tailored optical, electrical, and magnetic properties for enhanced performance.

LEARNING OUTCOMES:

After the successful completion of this course, students should develop:

1) an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.
2) an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts.
3) an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.
4) an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

GRADE DETERMINATION:

5%: Participation (including attendance and in-class performance)

10%: In-class quizzes

20%: Homework

30%: 1 midterm exam

35%: 1 final exam

Participation:

On-time attendance at all class activities is expected. Meanwhile, students are encouraged to join all kinds of class activities, including attending each class, asking/answering questions in classes, and giving presentations in the classes, etc.

Quizzes:

Quizzes will be assigned to students during class hours, the topics are usually related to the latest class or new theories/techniques introduced in the same class to check students' understanding of the basic knowledge. Generally, **no** make-up quizzes will be allowed for absences from the class, unless prior approval has been granted by the instructor or a valid emergency, supported by appropriate documentation, is provided.

Homework:

To be assigned after the lectures. Submission requirements (including due dates) for all assessments will be announced to students in class or on Blackboard. Late assignments will be deducted 30% per day and will not be accepted on & after the 4th day or after the solutions are distributed, whichever is earlier.

GRADE POLICY:

A: 90 – 100	B+: 80 – 84	B−: 73 – 75	C: 66 – 69	D: 60 – 62
A−: 85 – 89	B: 76 – 79	C+: 70 – 72	C−: 63 – 65	F: < 60

If students have any concerns regarding their grades, they may submit a rebuttal within **5 days** of the grade announcement. No rebuttals will be accepted after this period.

MATERIAL COVERED/INTENDED SCHEDULE:

The intended sequential contents covered in this class are shown in the following table and might be adjusted according to the class schedule.

Week	Contents	Descriptions
1 (02/28)	Chp 1 ~ 2	Introduction to materials structures and properties, atomic structures, and interatomic bonding, introduction to crystals
2 (03/07)	Chp. 3	Structure of crystalline solids
3 (03/14)	Chp. 4 ~ 5	Structural defects of solids, atomic and molecular diffusion in materials
4 (03/21)	Chp. 6	Mechanical properties of metals (stress-strain, elasticity, tensile properties, deformation, hardness, etc.)
5 (03/28)	Chp. 7	Dislocations and strengthening mechanisms of materials
6 (04/04)	No class	Public holiday
7 (04/11)	Chp. 8	Failure behaviors of materials
8(04/18)	Chp. 9	Phase diagrams of materials

9 (04/25)	Chp. 10 ~ 11	Phase transformations, evolution of microstructures and mechanical properties; applications and processing of metal alloys
10 (05/02)	No class	Public holiday
11 (05/09)		Midterm Exam
12 (05/16)	Chp. 12 ~ 13	Structures and properties of ceramics; Applications and Processing of Ceramics
13 (05/23)	Chp. 14 ~ 15	Characteristics, applications, and processing of polymers
14 (05/30)	Chp. 16	Properties of composite materials
15 (06/06)	Chp. 17	Corrosion and degradation of materials
16 (06/13)	Chp. 18 ~ 19	Electric & thermal properties
17 (06/20)	Chp. 20 ~ 21	Magnetic & optical properties
18		Final Exam Week

Copyrights:

The handouts used in this course are copyrighted. By "handouts" we mean all materials generated for this class, which include but are not limited to syllabi, in-class materials, videos, review sheets, and additional problem sets. Because these materials are copyrighted, you do not have the right to copy or distribute the handouts, unless the author expressly grants permission.

Academic Integrity:

All students are expected to adhere to the standards of academic honesty. Any student engaged in cheating, plagiarism, or other acts of academic dishonesty would be subject to disciplinary action. Any student suspected of violating this obligation for any reason during the semester will be required to participate in the procedural process, initiated at the instructor level, as outlined in the University Guidelines on Academic Integrity. This may include but is not limited to the confiscation of the examination of any individual suspected of violating the University Policy.