

ENGR 0022: MATERIAL STRUCTURE AND PROPERTIES

Fall 2024

Instructor: Shan Gong	Section 3 Wednesday 8:15am – 11:00am
Email: shan.gong@scupi.cn	Liberal Art Building 3-101
Office: N406	

Note: This syllabus may be subject to change. Please follow updates announced during class and posted on Blackboard website.

Course Pages

- <https://pibb.scu.edu.cn>

Office Hours

- Tuesdays: 9:00am–11:30am & Wednesday: 13:00pm–17:00pm
- By appointment via Email
- Online via QQ Group: 544010569

Teaching Assistant

- Chaowei Deng, 2021141520062@stu.scu.edu.cn
- If you have any question regarding to homework grading, please contact TA **within one week** after the homework is returned to you.

When emailing the instructor or TAs, include ENGR 0022 in the subject field of your message. Use your university email account (student_ID_number@stu.scu.edu.cn), since mails from other accounts might be stopped by the SCU spam filter.

Course Description

This course lays a fundamental knowledge and skill basis for engineers to understand materials structure, properties, and the relationship between the two. Topics covered include structure of solids, mechanical and physicochemical properties of materials, fabrication and processing of materials, materials performance, materials degradation, characteristics and application of materials. (3 credits)

Prerequisites

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

Course Objectives

A deep understanding of the relationship between structure and properties plays a key role in materials design, process, and application. To ensure such a good understanding, students should be able to perform tasks showing below upon completing this course:

1. Define material families based on chemical composition, atomic and micro structure, physico-chemical properties, and processing routes.
2. Describe relationships between materials structure at the atomic and/or micro level of materials and their properties.
3. Cultivate capability to design materials with desirable optical, electrical, and magnetic properties for enhanced application performance.

Applicable ABET Outcomes

1. An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.
2. An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.
3. An ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

Textbook

- William D. Callister, JR, and David G. Rethwisch, “Materials Science and Engineering”, 10th edition (2018)

Assessments

Homework:	20%
Midterm report:	10%
Midterm Examination:	30%
Final Examination:	30%
Attendance:	10%
	100%

- The Instructor reserves the right to moderate the assessment policy. This process may occur at the end of the semester.

Grade

90.00 – 100.00	A	85.00 – 89.99	A-	80.00 – 84.99	B+	76.00 – 79.99	B	73.00 – 75.99	B-
70.00 – 72.99	C+	66.00 – 69.99	C	63.00 – 65.99	C-	60.00 – 62.99	D	0.00 – 59.99	F

Class Policy

Regular attendance is essential and expected. Important dates and plans will be announced during class. **It is imperative that you come to class prepared.** This will generally involve reading one or more chapters of the textbook, viewing tutorial videos, thinking, engaging with fellow students, practice and performing preliminary calculations. This is a three credit hour class, which means you should expect to devote at least 9 to 12 hours of effort outside the scheduled class time every week.

Homework and Other Assignments

Homework problems and other assignments will be assigned periodically and are due as stated in the assigned paper. All work will be submitted electronically through the Blackboard system. Late submission **WILL NOT** be accepted. **Students' names and ID numbers** must be listed on the first page. It is **your duty** to make sure that submission through Blackboard has been properly processed. Unless specifically requested, emailed homework will not be accepted.

All of the homework scores will be used in your grade computation. Unless otherwise indicated, you can work with your fellow classmates in the class, but you must submit a distinct and independent write-up to receive credit. If plagiarism is caught, zero score for all homeworks.

If you have a compelling emergency that prevents you from turning in the homework on time, email Dr. Shan Gong.

If you believe an error has been made in the grading of an assignment, bring it to the attention of your TA **within ONE WEEK** from its return.

Please adhere to these homework guidelines:

- Put your name, ID number (last four digits), and class section at the top of the first page.
- All work must be shown for each solution to receive full credit. Present your solution in a logical fashion, showing and explaining all steps in detail.
- Obtaining the correct answer includes getting the correct quantity, number of significant digits, sign, and unit.

Exams

There will be two exams (one Midterm and one Final), all are **CLOSED-BOOK**. If you must miss an exam, you **MUST** make alternative arrangements with the instructor before the exam is given. If you miss an exam without prior notification, you will receive a score of **ZERO** for that exam except under extenuating circumstances.

Makeup Exams

Students who have not taken either the midterm or the final exam are **NOT** eligible to take the make-up exam. Only 75% of the make-up exam grade can be used to replace the final exam grade. Students taking make-up exams can only attain at most **D** grade.

Academic Integrity

1. It is a requirement that every student performs independent and collaborations under the academic guidelines set forth by SCUPI, Sichuan University, and University of Pittsburgh to ensure rightful learning performance.
2. Unacknowledged direct copying from the work of another person, or the close paraphrasing of somebody else's work, is called plagiarism and is a serious offence, equated with cheating

in examinations. This applies to copying both from other students' work and from published sources such as books, reports or journal articles.

3. Paraphrasing, when the original statement is still identifiable and has also no acknowledgement, is plagiarism. A close paraphrase of another person's work must have an acknowledgement to the source. It is not acceptable for you to put together Unacknowledged passages from the same or from different sources linking these together with a few words or sentences of your own and changing a few words from the original text: this is regarded as over-dependence on other sources, which is a form of plagiarism.

Accommodations

If you sustain disability or sickness that requires testing and/or classroom accommodations, please notify the course instructor, TA, and the university's Disability Resources and Services in time. You may be asked to present proof of disability or sickness to be provided the accessibility accommodations.

Course Content

A schedule in detail will not be available as the pace of the course will highly be determined by students' reception of the content.

Week	Contents	Topics
1 (09/04)	Chapters 1-2	Introduction to materials structures and properties, atomic structures and interatomic bonding
2 (09/11)	Chapter 3	Structure of crystalline solids
3 (09/18)	Chapters 4-5	Structural defects of solids, atomic and molecular diffusion in materials
4 (09/25)	Chapter 6	Mechanical properties of metals (stress-strain, elasticity, tensile properties, deformation, hardness, etc.)
5 (10/02)	Holiday	No Class
6 (10/09)	Chapter 7	Dislocations and strengthening mechanisms of materials
7 (10/16)	Chapter 8	Failure behaviors of materials (fracture, ductile and brittle fracture, fracture toughness testing, cyclic stresses, S-N curve, crack formation etc.)
8 (10/23)	Chapter 9	Phase diagrams of materials (binary, ternary alloys etc.)
9 (10/30)	Chapters 10-11	Phase transformations, evolution of microstructures and mechanical properties; applications and processing of metal alloys
10 (11/06)	Chapter 12-13	Structures and properties of ceramics; Applications and Processing of Ceramics
11 (11/13)	Chapter 14-15	Characteristics, applications, and processing of polymers
12 (11/20)	Chapter 16	Properties of composite materials
13 (11/27)	Chapter 17	Corrosion and degradation of materials
14 (12/04)	Chapter 18	Electrical properties of materials
15 (12/11)	Chapter 19	Thermal properties of materials
16 (12/18)	Chapter 20	Magnetic properties of materials
17 (12/25)	Chapters 21	Optical properties of materials