Chemical Engineering 378—Science of Materials Engineering, Fall 2023

Location: 256 CB Time: 11:00-11:50 AM, MWF				
Prerequisites:	Chem 111, 112 or Chem 105, 106, 107, Calculus sequences; Chem 351 recommended			
Instructor:	Matthew J Memmott			
	330K Engineering Building; (801) 422-6237 <u>memmott@byu.edu</u> ;			
Website:	http://www.et.byu.edu/~mjm82/che378/che378.html			
Office Hours:	T-F 12:00 PM-1:00 PM			
TAs:	Andrew Thomsen (<u>thoms24@byu.edu</u>) T 2:00 PM - 4:00 PM, W 12:00 PM - 2:00 PM, F, 12:00 PM - 2:00 PM			
	Isaac Garlick (<u>ig236@byu.edu</u>): M 4:30 PM - 6:00 PM, Th 11:00 AM - 12:00 PM, F, 3:00 PM - 4:30 PM			

Course Objectives: This course examines the fundamentals of materials science and their applications to engineering design; it is especially geared to chemical engineers. Topics include electronic, molecular structure and forces; crystalline and amorphous structure of solids; phase transformations; thermodynamics of solids; defects; diffusion; crystallization; interfacial phenomena; mechanical properties; chemical and physical metallurgy of ferrous alloys; corrosion; and applications of metals, ceramics, glasses, polymers, composites and semiconductors. The following can be considered the broad course objectives for this class.

- (1) learn and understand:
 - a. the fundamental principles of material science
 - b. the properties, preparation and applications of important engineering materials, and
 - c. the relationships of these properties to electronic, atomic, molecular, and phase structures and composition
 - d. How to prepare, select, specify, use, purchase, and design materials
- (2) Improve your ability to identify, formulate, and solve open-ended engineering problems based on application of mathematics and physical phenomena,
- (3) Gain an appreciation for the field of materials science and engineering that will hopefully lead to a desire for further learning and study beyond this course.

The specific details and requirements of this course are indicated in the following sections. Also, a "roadmap" specific to the course along with applicable competencies is included to give a general overview of course trajectories.

Textbook:Materials Science and Engineering, An Introduction, 10th Ed. by William D. Callister, Jr. and David G.
Rethwisch, Wiley.

Reading:Lectures are designed to help students learn the course content, but many details and examples
are given in the text. Your learning will require repeated exposure to the material and dedicated
study. You will do significantly better in this course if you actually read the assignments!!
Daily
(almost) concept quizzes are given via learning suite, and must be completed before the beginning
of class. These quizzes are delayed by a lecture, so that, for example, the material learned on class
1 will be quizzed in class 3. This is to facilitate delayed recall of information, which is one of the
best ways to learn information according to "Make it Stick, The Science of Learning".

Homework: Homework assignments will be due almost every class period. Homework is designed to help you learn the course material through direct application. You are encouraged to work in groups, but you must turn in *your own* assignment, representing *your own* work. Homework late by up to one week will be accepted for 50% credit. Homework solutions will be posted in a book kept by the department secretaries. **You are on your honor not to use posted solutions in the working of late homework**.

OEPs:	In addition to the standard homework assignments, there will be one (1) open ended problem
	(OEP) due each week. These problems are designed to teach you how to approach a problem
	without a clearly defined solution, method, or even structure. These types of problems are
	extremely common in engineering industries. As a result, the ability to set up and solve problems
	with reasonable confidence in the solution is one of the most valuable skills in engineering, be it
	research or industry. The OEPs assigned in this class are designed to help you learn and apply
	an organized method to solving complex problems without a single discrete solution. They are
	also structured to help you learn how to think about the validity, meaning, and general feasibility
	of your solutions. In essence, the OEP solution checks (part 7 of each OEP) will help you
	develop engineering "horse-sense". These problems also reflect the types of tasks most often
	encountered in post-school life and will thus help you to be more successful not only in your
	job, but in all aspects of your life. The focus of the OEPs in this class is centered around three
	principles:

- 1) less focus on the answer, and more on the process used to obtain the answer,
- 2) focus on demonstrating your grasp of whether the answer is "reasonable", and
- 3) how well you check your answer based on known information.

These problems will be graded based on your approach to the problem and on your assessment of the solution obtained. In addition to the weekly OEPs, there will be *at least* one (1) OEP on each exam.

Exams: Three (3) midterm exams and one (1) comprehensive final exam will be administered. The final exam is scheduled for Wednesday, December 20, 2023 from 11:00 AM-2:00 PM. The exam will be held in the regular lecture room unless otherwise stated. If you are unable to attend an exam you must notify me *well before* the exam and have a *good reason*.

Grading:

Grades for the course will be based on the following distribution:

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Н	lomework	25%	Open Ended Problems	10%
С	oncept Quizzes	5%	Midterm Exams (3)	30%
F	inal Exam	30%		

ABET Competencies:

	Students will be able to identify, formulate, and solve complex engineering
1.0	problems by applying principles of engineering, science, and mathematics.
	Students will exhibit critical and creative thinking skills for analysis and
1.9	evaluation of problems and cause-effect relationships.
	Students will be able to make order of magnitude estimates, assess
	reasonableness of solutions, and select appropriate levels of solution
1.10	sophistication.
	Students will be able to apply engineering design to produce solutions that meet
	specified needs with consideration of public health, safety, and welfare, as well
2.0	as global, cultural, social, environmental, and economic factors.
	Students will be able to acquire and apply new knowledge as needed, using
7.0	appropriate learning strategies.
	Students will be able to read and understand phase diagrams and use these to
8.38	determine physical phenomena.
	Students will understand how molecular interactions to the behavior of material
8.40	gives rise to macroscopic properties.
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8.41	Students will understand the mechanical behavior of materials.
8.42	Students will understand the physical/chemical behaviors of materials.
8.43	Students will understand the electronic behavior of materials.
	Students will be able to select materials, based on their properties and
8.45	behaviors, for a given application.



BYU Policy Statements

Academic Honesty The first injunction of the BYU Honor Code is the call to be honest. Students come to the university not only to improve their minds, gain knowledge, and develop skills that will assist them in their life's work, but also to build character. President David O. McKay taught that "character is the highest aim of education" (The Aims of a BYU Education, p. 6). It is the purpose of the BYU Academic Honesty Policy to assist in fulfilling that aim. BYU students should seek to be totally honest in their dealings with others. They should complete their own work and be evaluated based upon that work. They should avoid academic dishonesty and misconduct in all its forms, including but not limited to plagiarism, fabrication or falsification, cheating, and other academic misconduct.

- Honor Code Standards In keeping with the principles of the BYU Honor Code, students are expected to be honest in all of their academic work. Academic honesty means, most fundamentally, that any work you present as your own must in fact be your own work and not that of another. Violations of this principle may result in a failing grade in the course and additional disciplinary action by the university. Students are also expected to adhere to the Dress and Grooming Standards. Adherence demonstrates respect for yourself and others and ensures an effective learning and working environment. It is the university's expectation, and my own expectation in class, that each student will abide by all Honor Code standards. Please call the Honor Code Office at 422-2847 if you have questions about those standards.
- Preventing Sexual Harassment Title IX of the Education Amendments of 1972 prohibits sex discrimination against any participant in an educational program or activity that receives federal funds. The act is intended to eliminate sex discrimination in education. Title IX covers discrimination in programs, admissions, activities, and student-to-student sexual harassment. BYU's policy against sexual harassment extends not only to employees of the university, but to students as well. If you encounter unlawful sexual harassment or gender-based discrimination, please talk to your professor; contact the Equal Employment Office at 422-5895 or 367-5689 (24-hours); or contact the Honor Code Office at 422-2847.
- **Students with Disabilities** If you suspect or are aware that you have a disability, you are strongly encouraged to contact the University Accessibility Center (UAC) located at 2170 WSC (801-422-2767) as soon as possible. A disability is a physical or mental impairment that substantially limits one or more major life activities. Examples include vision or hearing impairments, physical disabilities, chronic illnesses, emotional disorders (e.g., depression, anxiety), learning disorders, and attention disorders (e.g., ADHD). When registering with the UAC, the disability will be evaluated and eligible students will receive assistance in obtaining reasonable University approved accommodations.