**ENGR 0022**

**Materials Structure and Properties**  
Fall 2019

Lecturer: Dr. Xinfeng (Kevin) Quan

TA: Jie An (qq 150535\*\*\*\*) Yaling Li (120921\*\*\*\*)

Office: 226 Zone 4

Office hour:  9:30 - 11:30 am Monday, Tuesday, Thursday

Email: xinfengq@scu.edu.cn

**Catalog 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.

Chem 0960 is required for a smooth study.

Credit hours: 3.0

**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:

* Define material families based on chemical composition, atomic and micro structure, physicochemical properties, and processing routes.
* Describe relationships between materials structure at the atomic and/or micro level of materials and their properties.
* Explain how processing alters materials structure and hence modify materials properties.

While above objectives are more “global”, specific learning outcomes of each topic will be listed in detail in the lecture slides as each chapter goes. Besides knowledge and skills on materials related topics, this course will also target on training students’ capabilities on research, team work, and academic communication.

**Required Textbook**

* *Materials Science and Engineering, 9th edition, SI Version* by William D. Callister, JR, and David G. Rethwisch, 2014.

**Course Format**

This course will be flipped in the way that pre-class assignment, lecture, and a studio session will be used similarly to what you have experienced in Chemistry to Engineers. So be prepared to continue being proactive in studying for an ideal grade.

As you may have noticed the moment you are reading this syllabus, we will have a ~ 100 people size class. Three instructors (me and two TAs) will not be enough for face-to-face interactions with each study team during the studio session. Volunteers of a temporary TA will be called for from those who finished the task early. Extra help will be given to those temporary TAs on how to help and evaluate their peers. Multiple times of being a temporary TA will earn that student a TA certificate signed by an institute authority (the dean as planned). You can talk to me before the class starts if you are interested in such a role.

**Recitation**

Online recitation will be offered in a relatively free fashion. Extra explanation will be offered via QQ or BB depending on students’ requests.

**Grades**

Exams 1 & 2                          200 pts

Final Exam                            150 pts

Homework                              40 pts

Studio work                            30 pts

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Total                                       420 pts

Expect your first exam in early October. Study hard.

**Letter Grade**

Final letter grade will be given according based on accumulative scores of all homework, studio, and exams.

**Absence and Makeup**

In principle, any absence in exams is not allowed except for irresistible reasons (diseases, accidents, deaths, etc.). For other reasons, you should contact me in advance. Make-up exams will not be guaranteed.

**Failure of the Course**

If you unfortunately failed the course (assigned an F), you can either retake the course or pass a make-up exam at the beginning of the next semester. Based on your performance in the make-up exam, a “D” or an “F” should be expected as the final grade.

**Copyrights**

If not specifically pointed out, all materials used in this course are copyrighted, meaning that without my explicit permission you do not have the right to copy any of the materials for any purpose other than your own personal academic use. The copyrighted materials used in this course include but do not limit to syllabi, exams, class slides, problem sets, and other handouts.

**Academic Integrity**

Upon accepting admission to SCUPI, you immediately assume to follow the SCUPI academic integrity guidelines. See a staff in the administrative office if you are not aware of it. The guidelines should be followed in homework, examinations, and other academic work. Violations of these guidelines may result in zero points for an exam or failure of the course.

**Study Tips**

* Do your homework ON YOUR OWN!!! You can discuss with a friend, but do it independently. Make sure you can solve similar problems after completion.
* Come to classes and take notes.
* Check regularly with a friend on things you might have missed in your notes. Discuss regularly the content of the course with a friend to make sure you really understand it.
* Consult a text book in Chinese if you have trouble understanding the required text book. However, make sure you learn all the terminology in English. The exam is in English!
* Come to my office hour and let me know any trouble you might have.

**Course Content**

1. Structure of solids
   * Materials classification and selection
   * Atomic structure and interatomic bonding
   * Fundamentals of crystallography
   * The structural of crystalline solids
   * Polymer structure
   * Imperfection of solids
2. Mechanical and physicochemical properties of materials
   * Diffusion
   * Mechanical properties of metals
   * Dislocations and strengthening mechanisms
3. Materials performance
   * Failure
   * Phase diagram
   * Phase transformation
4. Characteristics and application of materials.
   * Properties and applications of metals
   * Properties and applications of ceramics
   * Characteristics and applications of polymers
   * Composite materials
5. Fabrication and processing of materials
   * Fabrication and processing of engineering materials
6. Materials degradation
   * Corrosion and degradation of materials

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A schedule in detail will not be available as the pace of the course will highly be determined by students' reception of the content. There may or may not be written or presentation assignments based on the allowance of time.