



## Course description

This course will be an introduction to a broad range of topics in materials science and with a strong focus on how materials, processing and engineering come together in design and *vice versa*. Why are some materials hard and others soft? Why can certain plastics be lighter than steel and at the same time be stronger? How do I select materials for a sustainable design? A central theme will be in-class demonstrations and hands-on experiments so you will experience first-hand why materials do what they do and how to select the appropriate material for the right application or a design. This class will provide you with a solid foundation in materials science that will be valuable in understanding the world around you. Another goal of this class is to help you develop an entrepreneurial mindset so that you will understand the bigger picture; draw connections between what you learn in this class and what you have learned in other classes; recognize opportunities; and learn from mistakes to create value for yourself and others.

## Logistics

### Contact information instructor:

Dr. Theo Dingemans  
Office: 1113 Murray Hall  
[tjd@unc.edu](mailto:tjd@unc.edu)

### Office hours:

Tuesday and Thursday after class, or by appointment. Please check with me first to insure my availability.

### TA contact information:

N/A

### Class meeting location and times:

Tuesday and Thursday, 9:30-10:45 AM, HN0112

### Textbook and other instructional materials:

Required: *Materials, Engineering, Science, Processing and Design* 4<sup>th</sup> Edn. By Michael Ashby, Hugh Shercliff and David Cebon (Elsevier)

**Online resources:**

You will receive links towards online resources and instructions during class.

**Prerequisites:**

CHEM 102 and PHYS 116/118. Or permission from instructor.

**Target audience:**

This class will be for undergraduates that have an interest in materials science. The class will be taught at the freshman, sophomore and junior level.

**Policies**

I expect all students to

- Come to every scheduled class and let me know ahead of time if you cannot attend class.
- Turn in assignments on time; if an assignment is up to 24 hours late, there is a 25% deduction, and if an assignment is beyond 24 hours late, you will get a zero. If you need an extension, you must ask at least 24 hours before the time that the assignment is due (you can avoid a grade deduction this way).

**Honor code**

I will let you know if an assignment should be done individually or as part of a group. While I encourage you to help each other for individual work, it is a violation of the honor code if you copy or obtain solutions from another student.

**Student learning outcomes**

*By the end of this course, students should be able to:*

- Recognize and name material classes, list their generic properties and explain their behavior
- Explain the mechanical behavior of different structural materials and apply this to a design
- Discuss material selection and how this will impact fatigue and failure. Nothing lives forever!
- Select functional materials (electrical, magnetic, optical...) and apply this to a design
- Explain the role of processing on final material properties and design performance
- Justify material selection for a design from an environment and sustainability point of view

**Class topics:**

- Week 1 Introduction to materials, their history and their impact in everyday life
- Week 2 Matching material to design or does the design dictate the material?
- Week 3-4 Metals, ceramics and molecules: what holds them together?

- Week 5-6 Strength, stiffness, yielding and ductility
- Week 7-8 If you can make it, someone can break it: fracture, fatigue, creep, wear and tear
- Week 9-10 Durability, oxidation, corrosion and degradation
- Week 11-12 Functional materials and their role in structural and functional applications
- Week 13-14 Design, materials and the role of processing
- Week 15-16 Materials and sustainability: how to choose your materials wisely

### **Grading**

- Homework: 20%
- Two midterm exams: 30%
- In class experiments and lab report: 10%
- Final exam: 15%
- Class project: 25%

#### **Major course due dates:**

- exam 1: TBD
- exam 2: TBD
- Final exam: TBD

Final letter grades will be calculated with the following grade scale:  
You can adjust as necessary for your class

A: >93.0  
 A-: 90-92.9  
 B+: 87.0-89.9  
 B: 83.0-86.9  
 B-: 80.0-82.9  
 C+: 77.0-79.9  
 C: 73.0-76.9  
 C-: 70.0-72.9  
 D+: 67.0-69.9  
 D: 60.0-66.9  
 F: <60.0

### **Accommodation for students with disabilities**

*The University of North Carolina – Chapel Hill facilitates the implementation of reasonable accommodations, including resources and services, for students with disabilities, chronic medical conditions, a temporary disability or pregnancy complications resulting in difficulties with accessing learning opportunities. All accommodations are coordinated through the Accessibility Resources and Service Office. Please visit <http://accessibility.unc.edu> for more information.*

## **Syllabus changes**

I reserve to right to make changes to the syllabus, including project due dates and test dates (excluding the officially scheduled final examination), when unforeseen circumstances occur. These changes will be announced as early as possible so that students can adjust their schedules.