Course Description: This is a comprehensive foundation course that addresses basic concepts of materials science that are useful for students interested in the structure and properties of materials, as well as enrolling in future courses in the materials field. The course is designed for graduate students and advanced undergraduates in the disciplines of chemistry, physics, math and biomaterials. Topics include bonding forces, crystal structures, defects, X-ray diffraction, solid-state phase diagrams, crystallization mechanisms, diffusion in solids, and mechanical, and electrical properties. The spectrum of everyday materials is wide – metals, ceramics, polymers, liquid crystals, colloids, organic crystals – and this course will cover key basic concepts of materials science, many which unify these kinds of materials.

Course Web Site: See NYU CLASSES for course details

Lectures: Monday and Wednesday (MW) 9:30 AM – 10:45 AM

Location: Bldg: ARC Rm: LL04
Academic Resource Center / 18 Washington Place

Instructors: Stefano Sacanna (MDI Laboratories, Brown 666, s.sacanna@nyu.edu)
Office Hours: Thursday 1000 – 1100; Friday 1000 - 1100

Michael D. Ward (MDI laboratories, Brown 554, mdw3@nyu.edu)
Office Hours: Thursday 1500-1600; Friday 1500-1600

Textbook: Materials Science and Engineering: An Introduction, Ninth Edition (or equivalent; older editions are adequate); W. D. Callister, Jr. and D. G. Rethwisch, John Wiley & Sons, Inc. The Textbook should be viewed as a guide, as we occasionally will supplement with other books and scientific literature. Also note – some lecture topics will NOT appear in the order of the the chapters in the book.


Prerequisites: Graduate students in Chemistry, Physics, Math, Biomaterials, and related fields. Senior-level undergraduates can enroll with permission of undergraduate advisor and course instructor.

Course Objectives
Learn the scientific principles underlying the structure of materials, from exotic colloidal structures to everyday stuff. Topics include interatomic and intermolecular bonding, crystal structure, defects, and microstructure. Understand the importance of phase behavior and diffusion in crystallization and principles of structural characterization. Learn fundamental relationships between structure and materials.
properties, including mechanical and electrical properties. Develop an understanding of various types of materials and their structure, properties and applications.

**Exams:**
Exam 1: Wednesday, October 18, 2017
Exam 2: Wednesday, December 13, 2017 (final class)

Exams will be IN CLASS (no final exam) and will be OPEN BOOK. Although the exams are open book, you will find the book to be a much less useful resource if you do not study beforehand so that you know where to find the material. Because the exam is open book, you should be prepared for challenging questions!

**Problem Sets**
Problem sets will be available for download on or before each Monday from the course CLASSES site. The cover page of the problem set should be the first page of the assignment, with you name and student ID number clearly written in the space provided. Problem sets MUST be stapled. If not, they will not be accepted. Completed problem sets will be due one week after their posting, and they must be submitted prior to the beginning of the Monday lecture. NO EXCEPTIONS. In cases of documented illness or family emergency, the missed problem set(s) will not be used in evaluating the student’s grade, but no more than two problem sets will be waived. You are allowed to work together on problem sets, but be aware that you will need to master the material to perform well on the exam. If you work with a classmate on a problem set, indicate clearly on the front of the problem set the name(s) of any classmates with whom you worked. Questions about course material and problem sets must be addressed during office hours, not by Email.

**Special Project**
This is a semester capstone assignment, due **Wednesday, November 29**. The assignment requires that you choose a COMPLEX machine or consumer product, and break it down into its individual components and materials. Each material must be described thoroughly, including the elemental composition, components, microstructure, crystallinity, methods of analysis that would be used to characterize each material, and representative characterization data for each component. The findings should be reported in the form of a YouTube video or a PowerPoint presentation. You will work in teams of 2 – 4 students, depending on the course enrollment.

**Grading:**

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<thead>
<tr>
<th>Component</th>
<th>Percentage</th>
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<tr>
<td>Problem Sets</td>
<td>20%</td>
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<tr>
<td>Exam 1</td>
<td>30%</td>
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<tr>
<td>Exam 2</td>
<td>30%</td>
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<tr>
<td>Special Project</td>
<td>20%</td>
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**Schedule of Topics (may be subject to slight changes)**

<table>
<thead>
<tr>
<th>Week: Date</th>
<th>Topic</th>
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<tbody>
<tr>
<td>1: September 6 (W)</td>
<td>Course introduction, Classes of Materials (Ward)</td>
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<tr>
<td>2: September 11</td>
<td>Crystal Structures (Ward)</td>
</tr>
<tr>
<td>3: September 18</td>
<td>Directions, Planes, Diffraction (Ward)</td>
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<tr>
<td>4: September 25</td>
<td>Bonding and Intermolecular Forces (Sacanna)</td>
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<tr>
<td>5: October 2</td>
<td>Metals vs. Ceramics, Defects and Dislocations (Sacanna)</td>
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<td>6: October 9 (M)</td>
<td>Fall Recess Day</td>
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<tr>
<td>6: October 11 (W)</td>
<td>Mechanical Properties (Sacanna)</td>
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<tr>
<td>7: October 16 (M)</td>
<td>Mechanical Properties (Sacanna)</td>
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<tr>
<td>7: October 18 (W)</td>
<td>Exam 1</td>
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<tr>
<td>8: October 23</td>
<td>Phase Diagrams; thermodynamic concepts (Ward)</td>
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<tr>
<td>9: October 30</td>
<td>Phase Transitions, Crystallization (Ward)</td>
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10: November 6  Kinetics; TTT diagrams (Ward)
11: November 13  Diffusion (Sacanna)
12: November 20  Soft Materials and Colloids (Sacanna)
12: November 22-24  Thanksgiving Holiday (Wed – Fri)

**November 29**  Special Projects Due

13: November 27  Electrical Properties (Ward)
14: December 4 (M)  Electrical Devices (Ward)
14: December 6 (W)  SPECIAL PROJECT PRESENTATIONS I (Ward/Sacanna)
15: December 11 (M)  SPECIAL PROJECT PRESENTATIONS II (Ward/Sacanna)
15: December 13  Exam 2

15: December 15 (F)  Last Day of Classes (University)

**Academic Dishonesty**

Academic dishonesty is incompatible with the practice of science or any profession. If evidence of dishonesty is found, the policy of the College of Arts and Sciences or the Graduate School of Arts and Sciences, as appropriate, will be followed. This includes any form of plagiarism, copying, collusion or cheating during an examination of any kind. All such cases are reported to the Director of Undergraduate Studies or the Director of Graduate Studies. University policy states: “Students who engage in such behavior will be subject to review and the possible imposition of penalties in accordance with the standards, practices, and procedures of NYU and its colleges and schools. Violations may result in failure on a particular assignment, failure in a course, suspension or expulsion from the University, or other penalties.” If suspended or expelled from the University, a notation will be made on your record as to the cause. A notation is very SERIOUS, as it could translate to a barring of entry to a professional school of any kind, e.g. medical school, graduate school and, possibly, difficulty in landing a job.

Excellent students such as you are probably offended at even the mention of cheating. But temptation can arise even among the accomplished. If you are having difficulties, see Professors Ward or Sacanna immediately. Read and understand the above before you consider compromising your integrity - and your future.

**Disabilities**

Students with Disabilities are encouraged to contact the instructor for a confidential discussion of their individual needs for academic accommodation. It is the policy of NYU to provide flexible and individualized accommodation to students with documented disabilities that may affect their ability to fully participate in course activities or to meet course requirements. To receive accommodation services, students must be registered with the Moses Center for Students with Disabilities (mosescsd@nyu.edu) as soon as possible. Any student who needs a reasonable accommodation based on a qualified disability is required to register with the Moses Center for assistance. The Moses Center will send the course instructors official notification of your accommodation needs. Please make an appointment with the instructor to discuss the accommodations and how course requirements and activities may impact your ability to fully participate.

**Classroom Etiquette**

Courteous and civil behavior is expected and anything apart from that will not be condoned. A university exists for the free but critical exploration of ideas and developing understanding of a myriad of topics. This can only be achieved through respect for the institution itself and among the scholars that comprise it. Anything other than polite (which does not exclude passionate or spirited debate) behavior is inexcusable. The fundamental rule is simple: Be considerate of others in the classroom. In order to
prevent distractions, to allow others to concentrate on proceedings, and to make learning as efficient and facile as possible, certain proscriptions are necessary:

- During exams, the use of DVD, mp3, mp4, etc. players; netbook, tablet, laptop, PDA, tablet computers or any other personal, portable electronic device other than a calculator is prohibited, unless expressly allowed by the instructor.
- No foods, soft drinks, etc. are allowed in the classroom. Water is allowed.
- Gum and (need I say this) tobacco chewing is prohibited.
- Any distraction to others, including conversation and electronic devices, is not acceptable.
- Please silence cell phones before class. If your cell phone makes a disturbance, you will be asked to leave the class.
- If you need to leave the class, avoid disruption as much as possible. If you suspect or know you may have to leave class early or otherwise, sit at the desk nearest an exit door to keep disruption at a minimum.