

## Structure and Properties of Materials (MAT 509), Fall 2022

### SYLLABUS

This course aims to give a general understanding of the relationship between the observed properties of materials and the internal atomistic structure with an emphasis on electronic properties. The content also emphasizes today's methods for characterization of electrical and optical properties and how the physics of the solid state is tailored in today's technological applications.

**Instructor:** Asst. Prof. Ogun Özçelik

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**Office hours:** Flexible hours upon demand. Please email for appointment.

#### Grading:

Midterm 35%, Final: 35%, HW & Quiz: 30%

There will be one announced quiz or homework every two weeks. The lowest quiz or HW grade will not be taken into account at the end of the semester for each student. There will be no makeups for quizzes. Attendance is not obligatory but full attendance is highly encouraged.

#### Textbook:

Lectures are compiled from a variety of references. Recommended books are:

Charles Kittel, Introduction to Solid State Physics.

William D. Callister, David G. Rethwisch, Materials Science and Engineering: An Introduction

David J. Griffiths, Introduction to Quantum Mechanics

James Livingston, Electrical Properties of Engineering Materials

Rolf Hummel, Electronic Properties of Materials

C. Barrett, W. D. Nix, A. S. Tetelman, The Principles of Engineer Materials

#### Subjects to be covered in the course (tentative):

1. Classical models of the atom and matter
2. Wave particle duality, quantization of energy states, photoelectrons
3. Heisenberg's principle, Schrödinger's equation and solutions for external potentials
4. Electron in a box, tunneling and superposition principle
5. Many atom systems, primary and secondary bonding, intermolecular bonds.
6. Free electron model & band theory of solids
7. Semiconductors, charge carriers, doping
8. Band diagrams and density of states of materials
9. Crystalline materials
10. Bravais lattices, Brillouin zones, Fourier analysis for crystals
11. Lattice vibrations and phonons, optical properties of materials
12. Thermal and magnetic properties