

# MSE 498 D/599 E: Quantum Materials

Spring Quarter, 2021

**Instructor:** Prof. Matthew Yankowitz ([myank@uw.edu](mailto:myank@uw.edu))

**Lectures:** WF 11:30am – 12:50pm

*(Some lectures may be delivered asynchronously; recordings of all lectures will be uploaded to Canvas)*

**Office Hours:** M 2-3pm *(Available for Zoom discussion, or upon request)*

## Course description:

Introduction to modern materials with physical and electronic properties dominated by quantum mechanical effects. This course will first cover a brief review of the relevant aspects of quantum mechanics and electronic properties of solids. Then, the field of ‘quantum materials’ will be surveyed, in which the properties of materials are defined by strong electronic correlations, nontrivial band topology, or both. Ferromagnetism, superconductivity, and topological insulators will be discussed, as will the connection to two-dimensional materials such as graphene.

*Prerequisite:* Prior exposure to quantum mechanics and the electronic properties of solids.

## Grading:

- **Homework**                      **30%**                      (Due roughly every 2 weeks)  
Homework will be submitted on Canvas by 10am on the due date, and self-graded by the following class period. The instructor will confirm your grading. Solutions for self-grading will be posted just after 10am on the due date, and late homework will not be accepted after this time. Collaboration (*not copying*) is permitted, as long as students list the names of collaborator on their homework.
- **Midterm**                      **20%**                      (Date TBD)
- **Report**                      **20%**                      (Due on the first day of finals week)  
Brief written report (with figures and references) on the topic of your choosing (mutually agreed upon with the instructor).
- **Final Exam**                      **30%**                      (Wednesday, June 9 2:30 – 4:20pm)

## Overview of topics to be covered:

1. Brief review of quantum mechanics
2. Brief review of crystals and electronic properties of solids
3. Classical/quantum Hall effects and topology
4. Ferromagnetism
5. Superconductivity
6. Two-dimensional moiré quantum materials

## Course materials:

No course text is required. Lecture notes will be posted on Canvas, and links to appropriate references will be provided as necessary.