Syllabus Fall 2022 Physics U4500/55400
Sriram Ganeshan

Why Study Solid State (condensed matter physics): State of the art technologies in our daily life ride on the success of condensed matter physics in understanding many-body quantum phases at the mesoscopic scale. Spurred by rapid advances in quantum materials, recent works have made a lot of progress by developing a fundamental understanding of robust quantum phases with topology, symmetries, and strong interactions. However, it all begin by studying how matter organizes itself into various phases under the rules of quantum mechanics. For example, one cannot understand insulators or semiconductors without quantum mechanics.
The material covered in this course forms a foundation of the technology that we interface today. iPhones are basically built out of this course!!!

This course will cover the following topics:
The Drude Theory of Metals, The Sommerfeld Theory of Metals, Failures of the Free Electron Model, Crystal Lattices, The Reciprocal lattice, Electron Levels in a Periodic Potential: General Properties, Electrons in a Weak Periodic Potential, The Tight-Binding Method, The Semiclassical Model of Electron Dynamics, Quantum Theory of the Harmonic Crystal, Phonons in Metals, Defects in Crystals, Diamagnetism and Paramagnetism, Electron Interactions and
Superconductivity. We will include Berry phase effects in solids and topological aspects of band structures.
The course text will be based on the book Ashcroft and Mermin and we will also use other research materials.

The grades will be based on Homework (20%), Midterm (30%) and Final (50%).
****