ENEE789A: Magnetism and Spintronics

This course covers the fundamental physics of magnetism, magnetic materials, and spintronic devices. We aim at an understanding of the fundamental principles on different length scales that underlie the variety of magnetic materials and devices. State-of-the-art spintronic devices in industry and novel concepts of spintronics in laboratories will be discussed.

Prerequisite: No prerequisites (the good backgrounds in solid state physics and semiconductor devices are helpful).

Homework and exams

- Weekly problem sets will be assigned on Tuesdays and due on the following Tuesdays. They comprise 75% of the final grade.
- There will be a final project and presentation (25% of the final grade) in lieu of an exam. Topics will be selected by each student and approved by the lecturer by the first Tuesday of April. The presentation will be in the last two classes.

Probable course structure

- Magnetism physics
  --- Electron spin, exchange interaction, magnetic order, stoner instability
  --- Magnetic anisotropy, Heisenberg model, Ising model
  --- Spin wave, excitation, damping
  --- Domains, domain walls, frustrations, exotic spin textures
- Magnetic materials
  --- Bulk magnets
  --- Magnetic surfaces and interfaces
  --- Freestanding magnetic atomic membranes
- Spintronic devices
  --- Spin valve, magnetic tunnel junction
  --- Spin field effect transistor
  --- Spin injection, spin diffusion
- Beyond
  --- Topological insulator, quantum spin Hall insulator
  --- Skyrmion
  --- Hall effects