



<b>Phys 4405</b>	<b>TOPICS IN SOLID STATE PHYSICS</b>	<b>(CR3)</b>
<b>Preq.</b>	<b>Phys 3402</b>	

### Objectives

To study selected topics in solid state physics such as quantum theory of magnetism and superconductivity.

### Syllabus

Diamagnetic and paramagnetic solids, magnetic susceptibilities of diamagnetic and paramagnetic substances, Quantum theory of paramagnetism, Pauli paramagnetism of conduction electrons, Types of superconductors, BCS theory, magnetic field induced superconducting to normal state transitions, parameters evidencing the superconducting phase transitions, free energy change during superconducting transition, London relations and coherence length of superconductor, Quantized flux due to Cooper pairs flowing in a ring, calculation of the sustaining time of supercurrents, fabrication of junctions for Josephson effects, principle and theory of SQUIDS, high-temperature superconductors, electric polarization, calculation of macroscopic electric field, dielectric constant and polarizability, phase transitions in ferroelectric crystals, Landau description of the order of phase transitions, differentiation of anti-ferroelectric, piezoelectric and ferro-elastic materials. Quantization of free electron orbits in a magnetic field, De Haas-van Alphen effect, the quantum Hall effect, Quantum dots, Quantum dot crystals, Kondo effect, Epitaxial hetero- and quantum structures, Coulomb blockade.

### Recommended Books

1. *Quantum Theory of the Solid* by J. Callaway, 2<sup>nd</sup> Edition, Elsevier, (2013)
2. *Solid-State Physics: Introduction to the Theory* by J. D. Patterson, B. C. Bailey (3<sup>rd</sup> Edition), Springer (2018)
3. *Introduction to Solid State Physics* by C. Kittel (8<sup>th</sup> Edition), Wiley (2012)
4. *Solid State Physics* by N. W. Ashcroft and N. D. Mermin, Cengage (2011)
5. *Solid State Physics: An introduction* by P. Hofmann (2<sup>nd</sup> Edition), Wiley-VCH (2015)