

Physics Department, IIT Kanpur
PHY 624: Magnetism in Materials (2022-23-II)

Instructor: Dr. Chanchal Sow (email: chanchal@iitk.ac.in, Ph. 4768)

Time Table: ? Venue: ?

Office Hour: On appointment (by email).

Detailed description (40 Lectures):

This is a first course in magnetism in order to provide a detailed background to an undergraduate/graduate student in order to understand the state-of-the-art research in this area. A background in electromagnetism (at PHY103 level) and quantum mechanics (at PHY431/PSO201 level) is required and some exposure to thermal/statistical/condensed matter physics is desirable.

S. No.	Topic	Lects.
1	Introduction: review of magneto-statics; magnetic moments and angular momentum; Bohr-van Leeuwen theorem; quantum mechanics of spin; Bohr magneton; classical mechanics of magnetic moments;	5
2	Physics of isolated magnetic moments: Diamagnetism and paramagnetism; Adiabatic demagnetization, nuclear spins, hyperfine structure.	5
3	Crystal fields and Magnetic resonance techniques.	5
4	Interactions: Dipolar and exchange interactions.	4
5	Magnetic Ordering: Ferromagnetism; Antiferromagnetism; Ferrimagnetism; Spin glasses and other random orders; Nuclear ordering; Measurements of magnetic ordering.	4
6	Models of magnetic ordering: Landau theory; Heisenberg and Ising models; Symmetry breaking and phase transitions; Excitations; Domains and the magnetization process; hard and soft magnetic materials, magnetic anisotropy.	5
7	Magnetism in metals: free electron model; Pauli paramagnetism, Stoner model, Landau diamagnetism, magnetism of electron gas, excitations in the electron gas, The Kondo effect.	4
8	Magnetism in low dimensional systems: nano-particle magnetism; one- and two-dimensional magnets; thin film and multilayers.	6
9	Modern techniques for characterizing magnetic materials.	2

Recommended books:

1. "Magnetism in Condensed Matter" by S Blundell, Oxford 2001.
2. "Introduction to magnetic materials" by Cullity and Graham, Willey 2009.
3. "Physics of Magnetism" by S Chikazumi and S H Charap, John Wiley & Sons.

Grading: (Out of 200)

Home-Works + Attendance: 50

Mid-Sem: 50 (1 hour)

End-Sem: 100