Physics Department, IIT Kanpur

PHY 624 : Magnetism in Materials (2020-21-II)

Instructor: Dr. Anjan K. Gupta (off: SL217F, email: anjankg@iitk.ac.in, Ph. 7549)
Time Table: TWF 3-4 pm, **Venue:** ????
Office Hour: On appointment (by email)

Course Web page: http://home.iitk.ac.in/~anjankg/teaching/Phy624-2017.html

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. A special emphasis will be given to the nano-magnetism as significant fraction of current research is happening this area.

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;	8
2	Physics of isolated magnetic moments: Diamagnetism and para-magnetism; 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; Domain structure and magneto-crystalline anisotropy;	6
7	(Ferro-)Magnetism in low dimensional systems: nano-particle magnetism; one- and two-dimensional magnets;	8

Recommended books:

1) "Magnetism in Condensed Matter" by Stephen Blundell, Oxford 2001.
2) "Introduction to magnetic materials" by Cullity and Graham, Willey 2009.
3) "The theory of Magnetism made Simple" by Daniel C. Mattis, World Scientific 2006.
4) “Introduction to the theory of Ferromagnetism”, A. Aharoni, Oxford, 1996.

Grading: (out of 250)

Home-Works + Attendance: 50
Mid-Sem: 40 (1 hour)
End-Sem: 120
Term paper: 40