NANO 251A / MATS 251B / MAE 265B

Magnetic Materials: Principles &Applications

Lectures: Tue, Thu 8:00 AM - 9:20 AM WLH 2113

Instructor: Prof. Eric Fullerton

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Website: http://nanomag.ucsd.edu/ and MATS 251B tab

Grading:
Homework: 25%, Assigned 1st, 3rd, 5th and 7th weeks and due in two weeks.
No late homework unless receiving prior approval. Solutions will be posted on web site.
Literature write-up: 10%
Due Th10th week
Midterm: 15%
Feb. 10
Final: 50%
3/20/2013 Th. 11:30 AM - 2:29 PM Location: TBA

Lecture policy: Attendance is expected, and class participation encouraged. All the material presented in the class is fair game on the quizzes and examinations.

Examinations: Exams will be closed book.

Academic Integrity: A zero tolerance policy towards academic dishonesty will be enforced. Academic misconduct includes but is not limited to cheating, plagiarism and collusion. A failing grade (F) will be awarded and the case forwarded to the Academic Integrity Office.

You are encouraged to read the official campus policy: http://www-senate.ucsd.edu/manual/appendices/app2.htm#AP14., Please speak with the instructor if you have any concerns.

Textbooks for class (electronic versions available at http://roger.ucsd.edu/)

Reading will be assigned weekly on Web site

Introduction to magnetic materials/ B.D. Cullity, C.D. Graham, Hoboken, N.J. : IEEE/Wiley, c2009 (at http://roger.ucsd.edu/ search for "Cullity magnetic materials")

Also:

Magnetism and magnetic materials / J.M.D. Coey, Cambridge University Press, 2010
(at http://roger.ucsd.edu/ search for "Coey magnetic materials")

Journal review article:
The defining length scales of mesomagnetism: a review

Dennis et al., J. Phys.: Condens. Matter **14**, R1175 (2002).

Biomedical Nanomagnetics: A spin through possibilities in imaging, diagnostics and therapy, K. M. Krishnan, IEEE Trans. Magn. **46**, 2523 (2010).

Books on reserve at the Library

Magnetism and magnetic materials / J.M.D. Coey, Cambridge University Press, 2010

Magnetic materials: fundamentals and applications / Nicola A. Spaldin, Cambridge ; New York : Cambridge University Press, 2010

Nanoscale magnetic materials and applications / J. Ping Liu ... [et al.] eds. ; foreword by Peter Grünberg Dordrecht ; New York : Springer, 2009

Introduction to magnetic materials/ B.D. Cullity, C.D. Graham Hoboken, N.J. : IEEE/Wiley, c2009

Modern techniques for characterizing magnetic materials / edited by Yimei Zhu Boston : Kluwer Academic Publishers, c2005

Modern magnetic materials : principles and applications / Robert C. O'Handley New York : Wiley, c2000

Magnetism : from fundamentals to nanoscale dynamics / J. Stöhr, H.C. Siegmann Berlin ; New York : Springer, c2006

Nanomagnetism : ultrathin films, multilayers and nanostructures / [edited by] D.L. Mills, J.A.C. Bland Amsterdam, Netherlands ; San Diego, CA : Elsevier, 2006

Literature Write-Up

Objective: Read a recent (< 10 years old) journal article on a new magnetic phenomena, material or applications. Provide a detailed report that fully discusses the approach, summarizes current state-of-the-art in the topic area, and evaluate the novelty of the results. The following provides additional guidelines for the write-up:

2) Length and formatting

- The write-up must not exceed 5 pages when printed on 8.5" by 11" paper with 1 inch margins (top, bottom, left, and right), single spacing, with font not smaller than 11 point (figure caption can use smaller font size but it must be legible).
- No more than 2 figures can be used.
- Cite all references used. The bibliography will not count towards page limit.

Course outline: (topics may be adjusted during the quarter)

Week 1 (Jan. 6 and 8)

Introduction to magnetism, magnetic order, dipolar fields, anisotropy

Problem set #1 assigned.

Week 2 (Jan. 13 and 15)

Basic energies, reversal and thermal stability single domain particles

Domain formation and magnetic reversal

Week 3 (Jan. 20 and 22)

Biomagnetic nano-magnetics

Problem set #1 – Due Jan. 22

Problem set #2 assigned

Week 4 (Jan. 27 and 29)

Dynamics and Micromagnetic modeling

Micromagnetic LLG program and simulations assigned

Week 5 (Feb. 3 and 5)

Permanent magnets and soft magnets

Problem set #2, Due, Feb. 5

Problem set #3, assigned

Week 6 (Feb. 10 and 12)

MIDTERM Feb. 10

Introduction to nano-magnetism, surface effects, exchange bias

Week 7 (Feb. 17 and 19)

Interlayer coupling (RKKY and Quantum Wells)

GMR/TMR and spintronics

Problem set #3, Due, Feb. 21

Problem set #4, assigned

Week 8 (Feb. 24 and 26)

Magnetic recording

Week 9 (Mar. 3 and 5)

Magnetic recording

Problem set #4, Due Mar. 5

Week 10 (Mar. 10 and 12)

MRAM

Final: 3/19/2015 Th 8:00 AM - 10:59 AM