COMMONWEALTH GRADUATE ENGINEERING PROGRAM
DISTANCE LEARNING COURSE PLANNING SHEET
UNIVERSITY OF VIRGINIA

Course:	MSE 614 – Magnetism and Magnetic Materials
Semester:	Fall 2008
Instructor:	William A. Soffa
Phone No.:	434-243-2532
Office Address:	University of Virginia; Dept. of Materials Science & Engineering; Wilsdorf Hall 128; 395 McCormick Road; P. O. Box 400745; Charlottesville, VA 22904
E-Mail Address:	was2n@virginia.edu

Textbook(s): (Student to purchase)

No formal text

There will be numerous notes and handouts from various sources.

Reference(s):

(1) B.D. Cullity, " Introduction to Magnetic Materials", Addison-Wesley (1972).
(2) D. Jiles "Introduction to Magnetism and Magnetic Materials", Chapman& Hall (1996).
(3) N. Spaldin, "Magnetic Materials" Cambridge (2003).

Computer Needs:

Computer Capability:

Software required:
Provided?

Other:

MSE 614 Magnetism and Magnetic Materials
Department of Materials Science and Engineering/ University of Virginia

This is a fundamental course on the principles governing the behavior of modern magnetic materials employed in technology from transformer materials to permanent magnets and magnetic recording including such new areas as nanomagnetism. The approach integrates the basic physics of magnetism with the materials science and the subject matter is developed at a level to enable students to understand magnetism and magnetic materials at the forefront of the field and to readily read the current research and technological literature.

Course Outline

Basic Concepts and Definitions
Magnetic Poles; Magnetic Field, Field Intensity
Magnetic Moment; Magnetic Dipoles
B, H, M; $B = H + 4\pi M$
CGS and MKS Units
Varieties of Magnetism
Diamagnetism; Paramagnetism
Ferromagnetism; Ferrimagnetism; Antiferromagnetism
Magnetization Curves; M-H Loops, B-H Loops
Hysteresis
Experimental Methods; Magnetic Measurements
Demagnetizing Fields

Atomic Origin of Magnetism
Magnetic Moments of Atoms, Molecules and Ions
Molecular Field Theory
Neel's Theory of Ferrimagnetism and Antiferromagnetism
Ferromagnetism; Weiss Theory; Band Theory
Exchange Interactions
Magnetic Domains

Magnetic Domains and the Magnetization Process: Magnetization Reversal
Magnetic Anisotropy; Magnetocrystalline Anisotropy
Domain Wall Energetics; Exchange and Anisotropy Energies; Wall Energies and Widths
The Observation of Magnetic Domains
Single Domain Behavior
Coercivity Mechanisms; Wall Processes and Rotation
Fine Particles and Thin Films
Superparamagnetism
Nanomagnetism

Magnetization Dynamics
Magnetic Resonance

(cont.)

Soft Magnetic Materials
The Physics and Metallurgy of Electrical Steels
Soft Ferrites
Amorphous Materials

Hard Magnetic Materials
Permanent Magnets
Rare Earth Magnetism
Nanocomposites

Magnetic Recording; Heads and Media

Magneto-optical Materials
Magnetic Semiconductors
Spintronics

The Magnetic Properties of Superconductors

High Magnetic Fields; Trends in Science and Technology

Text: No Formal Text

Major References/ (1) B.D. Cullity, " Introduction to Magnetic Materials", Addison-Wesley (1972). (2) D. Jiles "Introduction to Magnetism and Magnetic Materials", Chapman& Hall (1996). (3) N. Spaldin, "Magnetic Materials" Cambridge (2003).
Numerous Notes and Hand-outs from various sources.

Prerequisites: MSE 209 or equivalent recommended; B.S. Chemistry, Physics or Engineering or Permission of Instructor.

Course Requirements/Grading:
Approximately Eight (8) Problem Sets (15%)
Mid-Term Exam (35%)
Final Exam (50%)
Exams are Out of Class/ Take-Home Assignments

Alternative Instructors: Professors Wolfe and Zangari