

EMSE 405 — Fall 2004

Dielectric, Optical, and Magnetic Properties of Materials

M-W 4:00-5:15; 322 White

		<u>office</u>	<u>telephone</u>	<u>e-mail</u>	<u>office hours</u>
Instructor:	Prof. De Guire	506 White	368-4221	mrd2@case.edu	2:00-3:30 M W
Grader:	Sebastian Birceanu	113 White	368-4652	sxb104@case.edu	2:00-3:00 T R

Text: A. J. Moulson & J. M. Herbert, *Electroceramics*, 2nd ed. John Wiley, New York, 2003. (ISBN 0-471-49748-7)

<i>Workload</i>	number	each	%
Homework assignments	4-5	7-10%	35%
Term paper	1	15%	15%
Mid-term test	1	20%	20%
Final exam	1	30%	30%
TOTAL			100%

Grading

(80-100%)=A; (70-80%) = B; (60-70%)=C; (50-60%)=D; (0-50%)=F. In the event that the final class average falls below 70%, a curved scale will be used, with the B-C borderline set at or near the average, and the range for each letter grade being about 1 standard deviation wide.

Homework

Due dates for homework will be announced when they are assigned. Late homework will be subject to a penalty of 10% per day unless an extension has been arranged with the instructor prior to the due date. **No late homework will be accepted after a solution set has been made available.**

Students may consult with one another on the homework, but **what is handed in must be each student's original, individual work.** Homework assignments (or portions thereof) from different students that appear to have been copied or that otherwise appear to be identical may be returned to the submitter with zero credit.

Exams

The mid-term test and final exam will be closed-book, closed-notes. Questions will be similar in style, but not necessarily in content, to the homework problems. The final exam will essentially consist of a mid-term test's worth of questions on the material from the second half of the course, with the remainder being comprehensive.

Term paper

A 15-page term paper on a topic of the student's choice in the subject areas of the course will be due Wednesday, November 24. A title, abstract, outline, and bibliography will be due Wednesday, November 3. Details will be spelled out in a forthcoming handout.

Reserve books – Kelvin Smith Library

- Donald M. Smyth, *The Defect Chemistry of Metal Oxides*, Oxford University Press, Oxford, 2000.
- Relva C. Buchanan (ed.), *Ceramic Materials for Electronics: Processing, Properties, and Applications*, 2nd Ed. Chapters 1, 2, 4, 8. Marcel Dekker, New York, 1991.
- Lionel M. Levinson (ed.), *Electronic Ceramics: Properties, Devices, and Applications*. M. Dekker, New York, 1988.
- W. D. Kingery, H. K. Bowen, and D. R. Uhlmann, *Introduction to Ceramics*, 2nd ed. Chapters 17, 18, 19, 20. John Wiley and Sons, New York, 1976.
- B. D. Cullity, *Introduction to Magnetic Materials*. Addison-Wesley Publishing Co., Reading, Mass., 1972.

Topics, reading assignments, and homework dates are subject to change. Test dates are firm.

Week of	Topic	Chapter
8/23	Overview. Introduction to point defect chemistry.	2.5
8/30	Point defect chemistry: Brouwer/Kröger-Vink diagrams. (9/1: HW1 assigned.)	2.6.2
9/6	9/6: No Class (Labor Day). 9/8: Defect chemistry (conclusion). Point defects as color centers. (9/8: HW1 due.)	
9/13	Linear dielectrics (start): Polarization mechanisms. (9/15: HW2 assigned)	2.7.1-2.7.2
9/20	Dielectric loss. (9/22: HW2 due.)	skim 5.5-5.7
9/27	Linear dielectrics (end): Capacitors; Microwave ceramics. Multilayer capacitors. (9/29: HW3 assigned)	5.1-5.4; 5.6.4-5.6.5
10/4	Optical properties (start): Dispersion; Group index. Absorption; Color. (10/6: HW3 due.)	lecture notes
10/11	10/11 – MID-TERM TEST 10/13: No Class	
10/18	Ligand field theory. Classical optics; Fresnel equations. (Class meets during fall break!) (10/20: Term paper assigned.)	lecture notes
10/25	Nonlinear dielectrics: Ferroelectrics. Piezoelectricity. (10/27: HW4 assigned.)	2.7.3; 5.7.1-5.7.2; 6
11/1	PTCR thermistors. Non-linear optics: Electro-optic materials. (11/3: Title, abstract, outline, & references due; HW4 due.)	8 2.6.5; 4.4.2
11/8	Origins of magnetic phenomena. Diamagnetism. Paramagnetism.	9.1.1-9.1.5; others (to be assigned)
11/15	Ferromagnetism: Exchange; Magnetocrystalline anisotropy. (11/17: HW5 assigned.)	9.1.6-9.1.10; lecture notes
11/22	Ferrimagnetism: ferrites. (11/24: Term paper due.)	9.2
11/29	Categories and applications of magnetic materials. (12/1: HW5 due.)	9.3, 9.5
	Monday, 12/13, 12:30-3:30 p.m. — FINAL EXAM	