

**Electroceramics
EMA 6445 (All Sections)**

Class Periods: M (3) 9:35 – 10:25 am, W (3&4) 9:35 – 11:15 am

Location: CSE E112

Academic Term: Spring 2017

Instructor:

Professor Juan Claudio NINO

- a) Office location: **166 Rhines Hall**
- b) Telephone: **(352) 846 3787**
- c) E-mail address: **jnino@mse.ufl.edu**
- d) Office hours: **Open door policy; T 10:30-11:30 am; via e-mail or by appointment**

Teaching Assistants:

- None

Course Description

The basic crystallographic, physical, chemical and mathematical principles of ceramic conductors, dielectrics and ferroelectrics and their applications are discussed. Emphasis is placed on structure-processing-microstructure property relationships. (3 Credit Hours).

Course Pre-Requisites / Co-Requisites

- None

Course Objectives

At the end of the course the students should be familiar with the important fundamental material science and engineering concepts in electroceramics and will be able to apply these concepts when addressing and analyzing general and critical problems in materials science and engineering. In addition, the student should be able to discuss the physical, chemical and mathematical principles governing the observed property behavior of electroceramic compounds. Ultimately, based on the analysis of their own experimental data (from the student's current research project), the student should be able to postulate structure-property relationships and utilize them as the basis for tailoring and improving the performance of electroceramic materials.

Materials and Supply Fees

- None

Required Textbooks and Software

Required (e-book)

- a. Title: **ELECTROCERAMICS**
- b. Author: **A.J. Moulson & J.M. Herbert**
- c. Publication date and edition: **2003 Second Edition (Wiley) e-book**
- d. ISBN: **978-0-471-49748-6**

Required (e-book)

- a. Title: **ADVANCED CERAMIC TECHNOLOGIES & PRODUCTS**
- b. Author: **THE CERAMIC SOCIETY OF JAPAN**
- c. Publication date and edition: **2012 e-book**
- d. ISBN: **978-4-431-54108-0**

Recommended Materials

- a. Title: **FUNDAMENTALS OF CERAMICS**
- b. Author: **M.W. Barsoum**
- c. Publication date and edition: **2003 Second Edition (IoP)**
- d. ISBN: **0-7503-0902-4**

On the Web: This course will use CANVAS extensively as a communication and archival tool. The students can access all relevant course information (course notes, homework, problem sets, solutions, announcements, grades, etc.) via the CANVAS entry link: [https:// http://elearning.ufl.edu//](https://http://elearning.ufl.edu//)

Course Schedule

Below is the tentative schedule of topics to cover

Date	Topic
Jan	
	Introduction and Review of Conceptual Prerequisites
4	Course Description, Objectives and Methodology, AMP 1 Review
9	AMP1 Review (Crystallography, Density, Ceramic Structures...)
	Defect Equilibria
11-18	Defect Reactions, Defect Equilibria, Brouwer Diagrams
23-25	Exercises and Applications
30	Exam 1 due before class - 15% (Solution discussed in Class)
Feb	Electrical Conductivity
1	Generalized Equations - From Defects to Conductivity
6	Ionic Conductivity
8	Exercises and Applications
13	Journal Review Exercise 1 (5%)
15	Electronic Conductivity, Intrinsic Semiconductors
20	Extrinsic Semiconductors, Non-stoichiometric Semiconductors
22	Exercises and Applications
27	Exam 2 due before class - 20% (Solution discussed in Class)
Mar	Dielectric Ceramics
1	Journal Review Exercise 2 (5%)
13	Macro- and Microscopic Behavior, Polarization Mechanisms
15	Electronic Polarization, Ionic Polarization
20	Dipolar Polarization, Dielectric Spectrum
22	Journal Review Exercise 3 (5%)
27	Impedance Spectroscopy and Related Analyses
29	Exam 3 due before class - 25% (Solution discussed in Class)
Apr	Ferroelectrics and Piezoelectrics
3	Ferroelectric Phenomena, Crystallographic Considerations
5	Ferroelectric Domains and Hysteresis
10	Piezoelectric Ceramics
12	Lead-Free Piezoelectrics (BT, PZT, KNN, etc.)
17	Journal Review Exercise 4 (5%)
19	Exam 4 due before class - 20% (Solution discussed in Class)

Attendance Policy, Class Expectations, and Make-Up Policy

Attendance is **strongly** recommended as the actual emphasis given to each of the topics and course flow will be heavily influenced by the students attending class. Proper behavior in class is always important and leads to a relaxed and productive educational environment. Thus, **eating, drinking, texting, reading of newspapers or other activities that are not part of the class are not allowed.** Students who do not comply with these requirements or who behave **disorderly or disrespectfully WILL be asked to leave the classroom.** Leaving your cell phone on, leaving early or arriving late can be VERY distracting, you should avoid it. **All electronic devices should be turned off or in silent mode.** If your cell phone rings during class, it will be confiscated for the remainder of the class period. Use of smartphones, laptops, tablets or similar personal computers is not allowed unless explicitly requested by the individual student the first day of class and for note taking purposes only.

How to Ensure a Response to Your E-mail: ONLY e-mail me at jnino@mse.ufl.edu. DO NOT USE CANVAS MAIL. Furthermore, because of the volume of e-mails I receive, you always need to identify yourself and the course. **In the subject line you should always include the course number (EMA6445) and your first and last name.** Please begin your e-mail with a salutation. [I know that personal e-mails and texts are often sent without even a name to address the recipient at the opening of the communication, but professionally that is unacceptable]. Close your e-mails by typing your name. Check your e-mail for grammar and spelling. Be concise. If I have to sift through what you have written, my response time drops significantly. All of these guidelines are to promote professionalism. If you need help with writing, please visit UF's The Writing Studio.

Grading: **Exams.** There will be four take home exams totaling 80% of the course grade (see the breakdown on the schedule above). The other 20% comes from at home and in-class journal article review exercises. For the take home exams are you can consult the course notes and you can consult other sources you deem appropriate (books, internet, etc.). However, as part of your consultation process during the exam you are not allowed to communicate with other human beings (besides the instructor), as this will be considered cheating and will be result in disciplinary action. **There will be no final exam.**

Grading of Exams: Each exam will normally consist of a number of problems with a numerical/symbolic answer. Each problem will be graded according to the following criteria when applicable (**examples will be given in class to further clarify the grading criteria**):

- Interpretation of problem situation and utilization of appropriate concept(s) and strategy towards solution (total 10%): Short statement describing the situation and indicating what you plan to do so solve the problem.
- Concept translation into equation(s) and mathematical or symbolic manipulation (total 20%): Writing the appropriate equation(s) to be used and algebraically solve for the variable(s) in question.
- Variable/constant value replacement and usage within equation(s) (total 30%): Manipulation of the variables and constants for direct replacement in equations and the replacement itself.
- Numerical/symbolic answer (total 30%): Calculation of the final answer including the appropriate units and/or symbols in the correct notation.
- Final comment (total 10%): Comment on the validity and/or meaning of the answer obtained.

Details of the format and grading of the Review Exercises will be given in class.

Make-up Exam Policy: No make-up of the exams will be given since they are take home. Students who do not turn in the exam session by the scheduled deadline will receive a score of zero points in that exam. Exceptions will be made only in extraordinary circumstances (verified personal emergency, conflict with **previously** scheduled activities, etc., that occur throughout the entire exam period). In such cases an additional exam will be scheduled during the finals week. This exam will be comprehensive and will replace the grade of the missed exam.

In all cases, excused absences must be consistent with university policies in the Graduate Catalog (<http://gradcatalog.ufl.edu/content.php?catoid=10&navoid=2020#attendance>) and require appropriate documentation.

Evaluation of Grades

Assignment	Total Points	Percentage of Final Grade
Journal Reviews (4)	20 (5 each)	20%
Take home Exams (4)	80 (20 each)	80%
	100	100%

Grading Policy

The final grade of the course will be calculated based on the percentage of maximum course score as follows:

Percentage	≥92	≥88	≥84	≥80	≥76	≥72	≥68	≥65	≥62	≥59	≥56	<56
Letter Grade	A	A-	B+	B	B-	C+	C	C-	D+	D	D-	E
Grade Points	4.0	3.67	3.33	3.0	2.67	2.33	2.0	1.67	1.33	1.0	0.67	0

In the event that the class average is below 72%, the distribution will be shifted so that the average equals 72%. In order to graduate, graduate students must have an overall GPA and an upper-division GPA of 3.0 or better (B or better). Note: a B- average is equivalent to a GPA of 2.67, and thus, it does not satisfy this graduation requirement. More information on UF grading policy may be found at: <http://gradcatalog.ufl.edu/content.php?catoid=10&navoid=2020#grades>

Students Requiring Accommodations

Students with disabilities requesting accommodations should first register with the Disability Resource Center (352-392-8565, <https://www.dso.ufl.edu/drc>) by providing appropriate documentation. Once registered, students will receive an accommodation letter which must be presented to the instructor when requesting accommodation. Students with disabilities should follow this procedure as early as possible in the semester.

Course Evaluation

Students are expected to provide feedback on the quality of instruction in this course by completing online evaluations at <https://evaluations.ufl.edu/evals>. Evaluations are typically open during the last two or three weeks of the semester, but students will be given specific times when they are open. Summary results of these assessments are available to students at <https://evaluations.ufl.edu/results/>.

University Honesty Policy

UF students are bound by The Honor Pledge which states, "We, the members of the University of Florida community, pledge to hold ourselves and our peers to the highest standards of honor and integrity by abiding by the Honor Code. On all work submitted for credit by students at the University of Florida, the following pledge is either required or implied: "On my honor, I have neither given nor received unauthorized aid in doing this assignment." The Honor Code (<https://www.dso.ufl.edu/sccr/process/student-conduct-honor-code/>) specifies a number of behaviors that are in violation of this code and the possible sanctions. Furthermore, you are obligated to report any condition that facilitates academic misconduct to appropriate personnel. If you have any questions or concerns, please consult with the instructor or TAs in this class.

Software Use

All faculty, staff, and students of the University are required and expected to obey the laws and legal agreements governing software use. Failure to do so can lead to monetary damages and/or criminal penalties for the individual violator. Because such violations are also against University policies and rules, disciplinary action will be taken as appropriate. We, the members of the University of Florida community, pledge to uphold ourselves and our peers to the highest standards of honesty and integrity.

Student Privacy

There are federal laws protecting your privacy with regards to grades earned in courses and on individual assignments. For more information, please see: <http://registrar.ufl.edu/catalog0910/policies/regulationferpa.html>

Campus Resources:

Health and Wellness

U Matter, We Care:

Your well-being is important to the University of Florida. The U Matter, We Care initiative is committed to creating a culture of care on our campus by encouraging members of our community to look out for one another and to reach out for help if a member of our community is in need. If you or a friend is in distress, please contact umatter@ufl.edu so that the U Matter, We Care Team can reach out to the student in distress. A nighttime and weekend crisis counselor is available by phone at 352-392-1575. The U Matter, We Care Team can help connect students to the many other helping resources available including, but not limited to, Victim Advocates, Housing staff, and the Counseling and Wellness Center. Please remember that asking for help is a sign of strength. In case of emergency, call 9-1-1.

Counseling and Wellness Center: <http://www.counseling.ufl.edu/cwc>, and 392-1575; and the University Police Department: 392-1111 or 9-1-1 for emergencies.

Sexual Assault Recovery Services (SARS)

Student Health Care Center, 392-1161.

University Police Department at 392-1111 (or 9-1-1 for emergencies), or <http://www.police.ufl.edu/>.

Academic Resources

E-learning technical support, 352-392-4357 (select option 2) or e-mail to Learning-support@ufl.edu.
<https://lss.at.ufl.edu/help.shtml>.

Career Resource Center, Reitz Union, 392-1601. Career assistance and counseling. <https://www.crc.ufl.edu/>.

Library Support, <http://cms.uflib.ufl.edu/ask>. Various ways to receive assistance with respect to using the libraries or finding resources.

Teaching Center, Broward Hall, 392-2010 or 392-6420. General study skills and tutoring.
<https://teachingcenter.ufl.edu/>.

Writing Studio, 302 Tigert Hall, 846-1138. Help brainstorming, formatting, and writing papers.
<https://writing.ufl.edu/writing-studio/>.

Student Complaints Campus: https://www.dso.ufl.edu/documents/UF_Complaints_policy.pdf.

On-Line Students Complaints: <http://www.distance.ufl.edu/student-complaint-process>.