

FLORIDA ATLANTIC UNIVERSITY™

Graduate Programs—NEW COURSE PROPOSAL

UGPC APPROVAL _____
 UFS APPROVAL _____
 SCNS SUBMITTAL _____
 CONFIRMED _____
 BANNER POSTED _____
 CATALOG _____

DEPARTMENT: CHEMISTRY & BIOCHEMISTRY

COLLEGE: CES COS

RECOMMENDED COURSE IDENTIFICATION:

PREFIX CHM COURSE NUMBER 5716 LAB CODE (L or C)

(TO OBTAIN A COURSE NUMBER, CONTACT RSHIMAN@FAU.EDU)

COMPLETE COURSE TITLE: MATERIALS CHEMISTRY

EFFECTIVE DATE

(first term course will be offered)

SPRING 2013

CREDITS: 3

TEXTBOOK INFORMATION: "SOLID STATE CHEMISTRY: AN INTRODUCTION" BY LESLEY E. SMART AND ELAINE A. MOORE, THIRD EDITION

GRADING (SELECT ONLY ONE GRADING OPTION): REGULAR X SATISFACTORY/UNSATISFACTORY

COURSE DESCRIPTION, NO MORE THAN 3 LINES:

AN INTRODUCTION TO SOLID-STATE AND INORGANIC MATERIALS CHEMISTRY. PREPARATIVE TECHNIQUES AND METHODS OF CHARACTERIZATION ARE DISCUSSED, PARTICULARLY X-RAY DIFFRACTION. SEMICONDUCTORS, CARBON-BASED ELECTRONICS, NANOMATERIALS, ETC. ARE DISCUSSED IN CONTEXT WITH THEIR STRUCTURES AND OPTICAL, MAGNETIC, AND CONDUCTIVE PROPERTIES. A CRYSTALLOGRAPHY WORKSHOP IS INCLUDED.

PREREQUISITES*:

COREQUISITES*:

REGISTRATION CONTROLS (MAJOR, COLLEGE, LEVEL)*: ANY GRADUATE STUDENT IN GOOD STANDING IN THE COLLEGE OF SCIENCE OR THE COLLEGE OF ENGINEERING.

* PREREQUISITES, COREQUISITES AND REGISTRATION CONTROLS WILL BE ENFORCED FOR ALL COURSE SECTIONS.

MINIMUM QUALIFICATIONS NEEDED TO TEACH THIS COURSE: A PHD IN INORGANIC CHEMISTRY, MATERIALS CHEMISTRY, MATERIALS SCIENCE, OR PHYSICS.

Faculty contact, email and complete phone number:
 Dr. Daniel T. de Lill, SE 127, ddelill@fau.edu,
 7-3819

While this course is open to graduate students in the COS or College of Engineering, this course really only affects the Chemistry Department since they will be responsible for the teaching and implementation of the course. The course has already been approved by the UUPC as CHM 4716. This course will be a dual numbered course to be taught to both undergraduate and graduate students, if approved.

Approved by:

Department Chair: _____
 College Curriculum Chair: _____
 College Dean: _____
 UGPC Chair: _____
 Graduate College Dean: _____
 UFS President: _____
 Provost: _____

Date:

ATTACHMENT CHECKLIST

♦ **Syllabus** (see guidelines for requirements:
http://www.fau.edu/provost/files/course_syllabus.2011.pdf)

♦ **Written consent** from all departments affected by new course

Email this form and syllabus to UGPC@fau.edu one week before the University Graduate Programs Committee meeting so that materials may be viewed on the UGPC website prior to the meeting.

CHM 5716 Materials Chemistry – Spring 2013

Meeting Time and Location: E.g., TR, 9:30-10:50 AM, GS 107, plus the Crystallography Workshop, 3 credits

Course Instructor: Dr. Daniel T. de Lill, office: 561- 297-3819, email: ddelill@fau.edu

Office Hours: Tuesdays 11AM-1PM, SE 138 or by appointment. I have an open door policy; if my door is open even a crack and I am not busy with another individual, you may knock and ask if I have time to speak with you. If I do not, we will set up a better time.

Course Web-Site: Course materials and grades will be uploaded to <http://blackboard.fau.edu>.

Student Responsibilities: All students must read and understand the contents of this syllabus. It is the responsibility of the student to check their *FAU email addresses* on a **daily** basis and blackboard on a weekly basis. All communication in this course will be through blackboard and your FAU email addresses only!

Required Textbook: "Solid State Chemistry: An Introduction" by Lesley E. Smart and Elaine A. Moore, 4th Edn, 2012, CRC Press Taylor & Francis Group, ISBN: 0-203-61063-6. A simple scientific calculator is required (suggested: **Texas Instruments TI-30XA**). Graphing/programmable calculators will **NOT** be permitted during exams.

Course Description: An introduction to solid-state and inorganic materials chemistry. Preparative techniques and methods of characterization are discussed, particularly X-ray diffraction. Semiconductors, carbon-based electronics, nanomaterials, etc. will be discussed in context with their structures and optical, magnetic, and conductive properties. A crystallography workshop is included.

Course Objectives: This 3 credit course serves as an introduction to solid state and materials chemistry. Students will be expected to have a detailed understanding of basic solid-state chemistry and how structure-property relationships are important in materials chemistry. Graduate students will augment this course through out-of-class and in-class projects designed to provide the student with critical skills to conduct research in materials chemistry. While a focus will be on inorganic materials, purely organic and hybrid materials will be introduced, as well as the basic concepts of nanochemistry. Students will have a foundation in crystal structures and crystallography, synthetic strategies, physical methods of characterizing solids, bonding and properties (optical, electronic, conduction, magnetism) in solids, and nanomaterials.

1. Crystal Structures and Crystallography
2. Physical Methods for Characterizing Solids
3. Review of Basic Bonding (Valence Bond/Molecular Orbital)
4. Bonding in Solids
5. Electronic, Optical, and Magnetic Properties
6. Carbon Based Materials
7. Basic Preparative Methods
8. Introduction to Nanochemistry and Nanoscience

Course Outline:

Dates	Topic	Chapter
1/10	Introduction to Materials Chemistry	none
1/12, 17, 19, 24	Basic Crystal Structures and Crystallography	1
1/26, 31	Physical Methods (instrumentation)	2
2/2, 7	Defects and Non-Stoichiometry	5
2/9	Exam I	
2/14, 16	Preparative Methods	3
2/21	Basic Bonding Review	none
2/23, 28	Bonding in Solid State Compounds (Band Theory)	4
3/1	Solid State Electronics and Conduction – paper topic due	4
3/13, 15	Carbon-Based Electronics; Intro to Zeolites	6, 7
3/20	Exam II	
3/22, 27	Optical Properties of Solids - paper outlines due 3/27	8
3/29, 4/3	Magnetic and Dielectric Properties	9
4/5	Superconductivity	10
4/10	Nanochemistry	11
4/12, 4/17, 19	Graduate Student Presentations	none
4/24	Exam III	
4/26	Final Exam, 7:45 AM – 10:15 AM	

Exams: There will be three exams plus one final exam for the course. All exam problems will be modeled after the lecture notes and consist of multiple-choice, short answers, and/or calculations. Graduate students will have additional exam problems that will test their ability to critically evaluate and use the theoretical background they receive in lecture. The final exam will be an analysis of a journal article as it pertains to this course. The student will read the article, answer a series of questions based on the article, and be asked to develop their own experimental procedures to augment the studies presented. It will be designed specifically to challenge the student and to have them critically think about the course material. There may be “pop quizzes” given at any point of lecture based on previous class’ lecture notes or the assigned chapter reading in preparation for class. These quizzes are for extra credit only and there are absolutely no make-up quizzes allowed.

If you miss an exam for an excused absence as outlined in FAU policy, read below: medical emergency/problem; death in immediate family; participation at an FAU-sponsored academic or athletic event; required appearance in a civil/criminal court; religious holiday. Written documentation is **required** with notification no later than **two days** after the exam. *If you fail to notify the instructor with the supporting documentation in this given time frame or if you miss the exam for any other reason than those stipulated above, then you will receive a 0 on the exam.* If the excuse is valid, then you may make up the exam. Make-up exams are not the same as those given in class and will be more difficult. It is my expectation that graduate students will only miss exams under extreme circumstances and will not be looked upon positively.

Course Grade: The course grade is based on the total points actually earned from the following assessment exercises:

Exam 1	= 100 points
Exam 2	= 100 points
Exam 3	= 100 points
Oral Presentation	= 100 points
Workshop	= 100 points
Final	= 100 points
Total	= 600 points

The following percentages are the cut-off for letter grades. The +/- system will generally not be used in this course, but its use is left to the discretion of the instructor. These ranges may be lowered based on class performance, but will never be raised.

- A = 90%
- B = 80%
- C = 70%
- D = 60%

F = <60%

All grades will be calculated to two decimal places with no rounding up. Exams grades posted on blackboard are the adjusted exam grades (i.e., after the “curve.”) Since exams are “curved” each time, there will be no “final curve” at the end of the semester.

Crystallography Workshop: Graduate students will be expected to attend a series of seminars (Crystallography Workshop) given by the instructor to augment course material. These seminars will focus on information needed in order to complete your out of class assignments. (Day and Time will be scheduled after consultation with the graduate students.) Attendance is expected at all sessions of this workshop; if you do not attend each session, you will not have the information necessary nor time with the computer programs to complete the assigned summary (below).

All students will be given a set of single crystal X-ray diffraction data, along with accompanying powder data. The students will be expected to refine the data and produce a crystal model of their compound. The students will examine the powder data to determine phase purity, and will be expected to draw their structure in a crystal drawing program, as well as do a literature search for the compound and related structures. The students will write a 3-5 page summary of the refinement details and crystal structure, including an assessment of the powder data, structural description, and a search for this compound and related compounds in the Cambridge Structural Database. Instruction on how to use these programs and databases will be arranged through Dr. de Lill and be conducted in his research laboratory, either under his direct supervision or that of a trained senior graduate student. Details will be discussed during the evening seminars.

Oral Presentation: Students will select a short article from the recent literature (must be approved by instructor). Their assignment is to relate the research in the paper to concepts learned in class. This will serve the dual purpose of reviewing concepts for the undergraduate students in the class, as well as correlate research to learning. The course instructor will prepare a sample lecture beforehand so that students know what to expect. A detailed outline must be provided to and approved by the instructor. Details concerning this project will follow in a separate handout. Students will turn in a CD or DVD with PDFs of all their lecture notes and a copy of any handouts or powerpoint slides, as well as physical copies of all these notes/hand-outs. These will be evaluated along with the oral presentation to provide the overall grade on this project.

Code of Academic Integrity: Students at Florida Atlantic University are expected to maintain the highest ethical standards. Academic dishonesty is considered a serious breach of these ethical standards, because it interferes with the University mission to provide a high quality education in which no student enjoys an unfair advantage over any other. Academic dishonesty is also destructive of the University community, which is grounded in a system of mutual trust and places high value on personal integrity and individual responsibility. Harsh penalties are associated with academic dishonesty. For more information, see the Code of Academic Integrity in the University Regulations at: http://www.fau.edu/regulations/chapter4/4.001_Code_of_Academic_Integrity.pdf

Attendance Policy: Attendance will be taken with a sign-in sheet at random for record keeping purposes only. There is no positive or negative impact on your final grade in the course based on lecture attendance. However, you are urged to attend lecture as you may miss certain announcements, extra-credit quizzes, etc. Lecture notes will serve as your primary source of course information and all exams will be based on these notes. I augment lecture notes with material not presented in the text. If you miss class, you may be missing critical information.

ADA Statement: In compliance with the Americans with Disabilities Act (A.D.A.), students who require special accommodation due to a disability, to properly execute course work must register with the Office for Students with Disabilities (OSD) located in SU 133 (561-297-3880) and follow all OSD procedures.

Class Room Etiquette: You are expected to be in your seat and ready for lecture *before* class begins! You should have already done the textbook reading. We go through lectures quickly, so it is imperative that you read your text before class or you may quickly become lost. Please do **NOT** come to lecture late and **TURN OFF** all cell phones. These interruptions are inconsiderate and counterproductive to a learning environment. If you do not come to class fully prepared to focus only on the class material, then you should not come to class.

Validity of a “Materials Chemistry” Course in the Study of Chemistry

Materials chemistry is a subfield in the area of chemistry concerned with studying structure-property relationships in a large variety of compounds ranging from simple inorganic oxides to semiconducting organic polymers and nanomaterials. Many universities with active graduate programs offer this as a course, particularly for those studying Inorganic and/or Solid-State chemistry. Additionally, many universities are beginning to offer this as an advanced undergraduate course.

In the field of chemistry, there are two primary publishers of scientific publications: The American Chemical Society and the Royal Society of Chemistry based in the UK. Each of these publishers have a journal devoted entirely to this field, *Chemistry of Materials* (ACS) and *Journal of Materials Chemistry* (which has recently been expanded to three separate journals, *Journal of Materials Chemistry A*, *B*, and *C*) (RSC). These journals are published biweekly and weekly (respectively) with 2011 impact factors of 7.286 and 5.97. These impact factors are amongst the highest for chemistry publications. There are additional journals through these publishers that are related to materials chemistry such as *Crystal Growth & Design*, *CrystEngComm*, and *ACS Nano*. In addition, the *Nature* publishing group has a journal devoted to materials science in general entitled *Nature Materials*, impact factor of 32.841.

Below is a list of textbooks that are suitable for such a course:

Introduction to Materials Chemistry, Harry R. Allcock
Solid State Chemistry: An Introduction, 4th Ed., Lesley E. Smart and Elaine A. Moore
Basic Solid State Chemistry, 2nd Ed., Anthony R. West
Principles of Inorganic Materials Design, John N. Lalena and David A. Cleary
Materials Chemistry, Bradley D. Fahlman