Course: EMA 6448 CERAMIC PROCESSING, Sections 018H (in-class); 0180 (online); 08BB (EDGE in-state); 1H64 (EDGE out of state)

Syllabus Fall 2018

1. Catalog Description – *Credits: 3.*
   Introduction to the science of ceramic processing, with emphasis on theoretical fundamentals. Examples of state-of-the-art industrial processes discussed.
   Building on the knowledge of the technology and science of processing of modern technical ceramics students learn to critically analyze the literature and discuss fundamentals. Topics include the nature of fine particles, forming methods and consolidation by heat.
2. Prerequisites – None
3. Course Objectives – At the end of this course the students will
   - understand and apply basic and advanced principles of ceramic processing, including characterization techniques, colloid and surface science, sol-gel techniques, particle mechanics, ceramic forming and sintering, and processing property relationships.
   - know how to retrieve and critically read literature in science and engineering.
   - have improved communication and presentation skills.

4. Instructor -
   Dr. Wolfgang Sigmund.
   Office location: 225 Rhines Hall
   Telephone: 352-846-3343 (office)
   E-mail address: sigmund@ufl.edu
   Web site: http://sigmund.mse.ufl.edu/
   Office hours: T 9:30 - 11:30 am
5. Teaching Assistant –
   TBA
   Phone
   Email @ufl.edu
   Office
   Hours:
6. Meeting Times – M, W, F 6th period 12:50 pm - 1:40 pm
7. Class schedule - Three hours of class time each week.
8. Meeting Location – CSE TR01C
9. Material and Supply Fees - None.
10. Textbooks and Software Required –
    Ceramic Processing, by M.N. Rahaman, CRC, Taylor and Francis, 2017. ISBN 1498716415
    You must have access to a computer and the following software to complete course assignments: word processing software, such as Word; spreadsheet software, such as Excel; Pdf writer.
    This course will use e-learning as an electronic course management system. The course website will have reading and homework assignments, updated grades, and course announcements. You can access e-learning at http://elearning.ufl.edu/ and log in with your Gatorlink and password.

11. Recommended Reading –
    Supplementary reading and links to various other websites are provided and updated throughout the semester.
12. Homework - Homework will be assigned and is usually due back the following week. The purpose of homework is to give students an opportunity to evaluate and apply their knowledge. Students may collaborate on homework; however, the actual submitted assignment must represent their own work and preparation.
    Note: Homework in its entirety must be word processed on your computer. For some problems you will require a suitable math package with graphing capability (e.g., Excel, MatLab, or others). Picture files (jpg, etc.) are not accepted. Files have to pdf, doc, docx, or pptx.
    Homework has to be submitted online on e-learning. Email is not acceptable for submission of homework. Hard copies are also not accepted.

    Homework will be evaluated on the following basis:
    - Excellent work: 100
    - Assignment acceptable: 85
    - Homework submitted (showing effort): 70
    - Homework submitted no or small effort: 0
    - Note - late homework is not accepted: 0

13.Course Outline –
    Class starts August 22, 2018. No classes on the following days: 9/3; 11/2; 11/21; 11/23. Last class December 5. All course materials must have been completed at that time.
    Exams 9/17; 10/10; 11/5; 11/30.

#	**Topics**	**Estimated # of lectures**
1	**Introduction to Ceramic Fabrication Processes (Chapter 1, pages 1-17)** Overview of ceramic materials and processing; definition of ceramics and the distinctions between ceramic, metals, polymers; ceramic materials and products; classification by function; modern materials needs; steps in ceramic processing. Societal needs, impacts from global community on ceramic markets. Job market, outlook on ceramics in the future.	3
2	**Synthesis and Preparation of Powders - mechanical methods (Chapter 2, pages 19-32)** Terminology; desirable powder characteristics; preparation techniques by mechanical methods; oxide and non-oxide powders.	2

3	**Synthesis and Preparation of Powders - chemical methods (Chapter 3, pages 19-75)** Terminology; preparation techniques by chemical methods; oxide and non-oxide powders.	3
4	**Synthesis of Ceramic Nanoparticles (Chapter 4, 79-87)**	2 Exam 1
5	**Powder Characterization (Chapter 5, pages 89-131)** Physical characterization; chemical and phase composition; surface characterization.	3
6	**Science of Colloidal Processing (Chapter 6, pages 133-172)**	3
7	**Rheology of colloidal suspensions (Chapter 7, pages 175-190)** Particle mechanics and particle rheology**.**	3 Exam 2
8	**Processing Additives (Chapter 8, pages 193-212)**	3
9	**Granulation, Mixing and Packing of Particles (Chapter 9, pages 213-240)** Beneficiation and processing additives, comminution, batching, mixing, and granulation.	1
10	**Forming of Ceramics (Chapter 10, pages 241-282)** Powder consolidation and forming of ceramics, colloidal forming methods: drained techniques, direct casting and solid freeform fabrication. Pressing, extrusion, injection molding.	5 Exam 3
11	**Additive and subtractive manufacturing of Ceramics (Chapter 11, pages 285-297)** Powder consolidation and forming of ceramics, colloidal forming methods: drained techniques, direct casting and solid freeform fabrication. Pressing, extrusion, injection molding.	3
12	**Drying, Debinding and Microstructural Characterization of Green Articles (Chapter 12, pages 299-328)**	1

13	**Principles of Sintering and Microstructure Development (Chapter 13, pages 331-394)** Classification of sintering; importance of sintering; sintering property relationship; driving forces for sintering; diffusion; defects and defect chemistry. Mechanisms of sintering; models and sintering equations; densification; grain growth. Effects of heterogeneities; anisotropic densification; sintering; liquid-phase sintering; hot pressing; hot isostatic pressing.	3
14	**Sol-Gel Processing (Chapter 15, pages 437-479)** **Acid/base catalysis; controlled drying agents; powders; fibers; monoliths.**	2 Exam 4

Class presentations for graduate students on chapters 14 and 16 are scheduled from November 14 through December 4. Dates may shift depending on number of students. December 5: wrap up of course

14. Attendance and Expectations -All students are expected to attend class. Attendance also requires participation in class by solving problems in small groups and presenting the solutions in front of the class. Cell phones should be turned to silent. You will need a cell phone, computer or tablet to take part in some of the quizzes. Reading of newspapers, work on assignments for this or other classes, or other activities that are not part of the class are not allowed during class time.

15. Grading -

Section 018H in-class

3 of 4 exams (25% each)	75%	
Class presentation		15%
Homework	10%	
Total	100%	

Online and EDGE students

3 of 4 exams (25% each)	75%
Term paper	15%
Homework	10%
Total	100%

Grading Scale %	≥92	≥90	≥87	≥84	≥80	≥77	≥74	≥71	≥67	≥63	≥60	<60
Letter	A	A-	B+	B	B-	C+	C	C-	D+	D	D-	E

Grades are not curved. There is no final exam in this class.

"Graduate students need an overall GPA of 3.00 truncated and a 3.00 truncated GPA in their major (and in the minor, if a minor is declared) at graduation." For more

information on grades and grading policies, please visit:
http://gradcatalog.ufl.edu/content.php?catoid=4&navoid=907#grades

16. *Requirements for class attendance and make-up exams, assignments, and other work are consistent with university policies that can be found at:*
http://gradcatalog.ufl.edu/content.php?catoid=10&navoid=2020#attendance
Homework is due online in e-learning, no late homework will be accepted. If you have trouble with on time submission on e-learning you need to get a trouble ticket from the UF help desk before the deadline and also send an email alerting the instructor about the problem. Late submissions without trouble ticket and email alert will not be considered.
Make-up Exam Policy – there are no make-up exams.
17. There is no extra credit available.
18. *Honesty Policy – All students admitted to the University of Florida have signed a statement of academic honesty committing themselves to be honest in all academic work and understanding that failure to comply with this commitment will result in disciplinary action. This statement is a reminder to uphold your obligation as a UF student and to be honest in all work submitted and exams taken in this course and all others.*
Note that failure to comply with this commitment will result in disciplinary action compliant with the UF Student Honor Code Procedures.
See https://www.dso.ufl.edu/sccr/process/student-conduct-honor-code/
19. *Accommodation for Students with Disabilities – Students Requesting classroom accommodation must first register with the Dean of Students Office. That office will provide the student with documentation that he/she must provide to the course instructor when requesting accommodation.*
20. *UF Counseling Services –Resources are available on-campus for students having personal problems or lacking clear career and academic goals. The resources include: UF Counseling & Wellness Center, 3190 Radio Rd, 392-1575, psychological and psychiatric services.*
Career Resource Center, Reitz Union, 392-1601, career and job search services.
21. *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.*
22. *Software Use – All faculty, staff and student 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.*

23. Record keeping - all materials from this class that students did not pick up (graded exams, etc.) within 1 year of the end of class will be shredded on or after December 31, 2019.
24. Syllabus Changes – I reserve the right to make changes in the syllabus as needed. Any changes will be clearly announced on canvas and in class.

Sections in italics are from the UF catalog or from the Herbert Wertheim College of Engineering suggested syllabus.