SYLLABUS for Fall 2005

Processing II
RU-NB 14:635:305

SERC 207
Tuesdays & Fridays 10:20-11:30 am

Description: This course is for undergraduates to learn about powder processing fundamentals as it pertains to particle characteristics, particle manipulation, colloid and interface chemistry and its impact on the flow behavior of suspensions and resultant particle packing. The course integrates lessons from Laboratory I and II as well as from Processing I.

Course Projects: Students will prepare 6 assignments consisting of problems sets that contain about 10 problems requiring quantitative and analytical reasoning. 1-3 extra credit assignments are given out that require the students to search the archival literature on subjects directly related to the course but go beyond the scope of the assigned readings.

Grading: Grades will be based on the following formula:, Homework and Extra Credit 10%, Exam 90% (30% hourly 1, 30% hourly 2 and 30% Final)

Instructor: Richard E. Riman, CCR106 (Tel) 732.445.4946

Text: J. Reed, Principles of Ceramic Processing, 2nd edition, John Wiley and sons, 1995, R. Hunter, Introduction to Modern Colloid Science, Oxford University Press, 1993.

WebCT: All material will be posted on-line (WebCT) including syllabus, homework, and relevant literature

Contribution of Course to Meeting the Professional Component of ABET:
Upon completion of the course the students will be equipped with a knowledge of how particle science and technology can be applied to ceramic, metallic and polymer systems. This will be achieved by a series of lectures, homework and exams. The course fulfills the following ABET criteria:

(a) an ability to apply knowledge of mathematics, science, and engineering
(c) an ability to design a system, component, or process to meet desired needs
(e) an ability to identify, formulate, and solve engineering problems
(j) a knowledge of contemporary issues
(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.
(l) Graduates will understand the fundamental principles underlying and connecting structure, properties, processing and performance related to the material systems utilized in ceramic engineering.

Relationship of Course to Program Objectives:
This is a core course that teaches students how to apply the principles of powder science and technology to the processing of materials for a wide range of materials. It builds on the knowledge of engineering that the students have obtained during their preceding years as an undergraduate.

Date		Subject
9/2 (Fri)	9/6 (Tue)	Overview (Introduction to Powder Processing), Definition of Powder Characteristics/Sampling, Characterization Cycle, Error (Reed Ch. 5-8/Hunter Ch. 3)
9/9 (Fri)		Particle Size Statistics, PSD Functions, PSD Conversions/Particle Diameter Defns., Particle Sizing Methods, Morphology Descriptors, Shape Factors (Reed Ch.. 5-8/Hunter Ch. 3)
9/13 (Tue)	9/16 (Fri)	Powder Characteristics—microstructure relationship, microstructure—property relationship
9/20 (Tue)	9/23 (Fri)	Washing, Reactivity of Powders (Reed Ch. 19, Hunter pp. 8, 12, 216)
9/27 (Tue)	9/30 (Fri)	Batching/Mixing (Reed Ch. 18, Ch. 14 (Consistency), Ch. 15 (particle contacts, flow))
10/4 (Tue)	10/7 (Fri)	Mixing Mechanisms, Mixedness, Mixedness Characterization (Reed Ch. 18)/Review Lectures and Problems, Begin Particle Dispersion (What is a colloid? Hunter Ch. 1)
10/11 (Tue)	**10/14 (Fri)**	**Hourly Exam 1 (Open book, Open notes)**/Dispersion of Ceramic Powders (Introduction, Mechanisms for Colloid Stabilization, Colloid Nomenclature)
10/18 (Tue)	10/21 (Fri)	Dispersion of Ceramic Powders (Overview of Methods, Dispersion Technology, Colloid Preparation methods, Nucleation and Growth concepts) (Reed, Ch. 3 & 4, Hunter Ch. 1)
10/25 (Tue)	10/28 (Fri)	Dispersion (Nucleation and Growth)/Dispersion – Microscopic Colloidal Behavior (Sedimentation, Brownian motion) (Hunter Ch. 3)
11/1 (Tue)	11/4 (Fri)	Dispersion (Microscopic Colloidal Behavior (light scattering)/ Microscopic Colloidal Behavior (association structures, coagulation, pH for Charged particles, heterocoagulation, homocoagulation, indifferent electrolytes, polymer flocculation, interactions, experimental examples)) (Hunter Ch. 3) (definitions of chemical and physical adsorption)
11/8 (Tue)	11/11 (Fri)	Dispersion (surface tension, surface energy, Gibbs Adorption isotherm, Langmuir Adsorption) (Hunter Ch. 5 & 6)
11/15 (Tue)	**11/18 (Fri)**	Dispersion (Generation of Surface Charge, Adsorption of Charged Species, Structure of the Electrical Double Layer) (Hunter Ch. 7 & 8 Reed Ch. 9 & 10)/Dispersion, Review of Problem sets. **Hourly Exam II (Open book, Open Notes)**
11/22 (Tue) No Class Wed. Sched.	11/25–no class Thanksgiving	
11/29 (Tue)		Surface Potential Functions, Characterization methods for

		Surface Potential (ZPC), Zeta Potential (IEP), methods for calculation (Hunter Ch. 7 & 8, Reed Ch. 9 & 10)
	12/2 (Fri)	Rheology/Rheometry: Definitions, Methods, Applications (Reed Ch. 16, Hunter Ch. 4)
12/6 (Tue)	12/9 (Fri)	Dispersion (DLVO Theory for Electrostatic Stabilization, interaction energies, attractive repulsive, flocculation kinetics, concept of stability)/Steric Stabilization, Electrosteric Stabilization (Hunter Ch. 9, Reed Ch. 9 & 10),
12/13 (Tue) Last Class		Particle Packing: Models and Methods (Reed Ch. 13), Furnas,Andreasen/Review
12:00-3:00	**12/23 (Fri)**	**Hourly Exam III (Open book, Open Notes)**

Tentative Due Dates for Problem Sets

1. 9/27
2. 9/30
3. 11/1
4. 11/11
5. 12/2

Problem sets are handed out 2 weeks in advance of due date. Rigorous quantitative approaches are encouraged; expect to send a few hours to complete. Work may be graded at my option on a point scale or excellent, good, fair scale.

Exams

Open book, open notes

For best performance during an exam, use these materials to avoid memorization, but do not use these materials as learning materials during the exam.