

To: Engineering Curriculum Committee

EFD# 103-19

FROM: David F. Bahr, Head School of Materials Engineering

DB

Date: February 15, 2019

Subject: Proposal for New Graduate Course

Contact for information if questions arise:

Name: Carlos Martinez

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Proposed Course Number: MSE 56200

Course Title: Soft Materials

Short Title: Soft Materials

Previously taught as: MSE 59700: 2013, 2015, 2016, 2017, 2018

Course: 3 credit hour. Lecture

Proposed offering: Fall semester

Course Description: Soft materials are an important and diverse class of materials that share the common traits of being easily deformable by external stresses, electric or magnetic fields or even thermal fluctuations. These materials are the foundation of important technologies that are used in everyday life including ceramic and pharmaceutical processing (tablet formation), cosmetics (hand creams), cleaning products, foods (milk, mayonnaise) and bio-technologies (drug delivery). The aim of this class is to gain a fundamental understanding of the physical and chemical underpinnings of common soft materials systems and how they are used to engineer technologically relevant materials and structures.

MSE 56200 Soft Materials (Syllabus)
Spring 2019
Tu/Thu 10:30 am to 11:45 am ARMS B071

Instructor: Prof. Carlos Martinez

Email: (cjmartinez@purdue.edu)

Phone: 4-3271

Office: ARMS 2327

Office Hours: Thursday from 2:30 pm to 3:30 pm and by appointment

Prerequisite: Junior standing in MSE or at least 2nd year chemistry and physics

Course Description:

Soft materials are an important and diverse class of materials that share the common trait of being easily deformable by external stresses, electric or magnetic fields or even thermal fluctuations. These materials are the foundation of important technologies that are used in everyday life including ceramic and pharmaceutical processing (tablet formation), cosmetics (hand creams), cleaning products, foods (milk, mayonnaise) and bio-technologies (drug delivery). The aim of this class is to gain a fundamental understanding of the physical and chemical underpinnings of common soft materials systems and how they are used to engineer technologically relevant materials and structures.

Goals:

1. Gain a fundamental understanding of the physical and chemical underpinnings of common soft material system.
2. Learn how soft materials are used to engineer and fabricate common and advanced technologies.
3. Learn techniques used to characterize soft materials.

Grading:

| | | | |
|-----|---------|-----|----------|
| 70% | 3 exams | 30% | Homework |
|-----|---------|-----|----------|

Final Grading Scale

| | |
|---|----|
| A | 90 |
| B | 80 |
| C | 70 |
| D | 60 |
| F | 50 |

Note: I reserve the right to make alterations in the scale downward based on class performance.

Textbook:

NOTE: All the necessary reading material for the course will be provided on Blackboard in PDF format.

J. N. Israelachvili, *Intermolecular and Surface Forces, Second Edition: With Applications to Colloidal and Biological Systems*, Academic Press; 2 edition, 1992 or 3rd edition 2011 (either edition is fine).

Supplementary Textbooks:

1. R. J. Hunter, *Introduction to Modern Colloid Science*, Oxford Science Publication, 1993.
2. P-G. de Gennes, F. Brochard-Wyart and David Quere, *Capillarity and Wetting Phenomena, Drops, Bubbles, Pearls, Waves*, Springer, 2002.
3. I. D. Morrison and S. Ross, *Colloidal Dispersions, Suspensions, Emulsions and Foams*, Wiley-Interscience, 2002.
4. J. Goodwin, *Colloids and Interfaces with Surfactants and Polymers: An Introduction*, Wiley-Interscience, 2004.

Website:

We will use **Blackboard Learn** to distribute lecture notes, homework assignments, supplementary information and reading material.

Homework:

A homework will be assigned every two to three weeks depending on the material. Homeworks will be submitted via Blackboard. An assignment will be posted on Blackboard with a submission deadline of 10:30 am one week after the homework was assigned. Any late submission will receive an initial 20% grade reduction and an extra 10% per day beyond the first day. See Blackboard for a file containing instructions on how to submit your homework. Consultation with other students and the instructor are encouraged, but the homework must reflect your own work.

Make-up Exams, can be arranged only for the following verifiable reasons: serious illness, family emergencies, direct conflict with another scheduled activity (minimum two weeks prior notice required and permission of the instructors), or official university absence. Arrangements need to be made in advance and are at the discretion of the instructors.

2019 Tentative Lecture, Homework and Exam Schedule.
Subject to change during the semester.

| | Day | Date | Class Content | Homeworks and Tests |
|----|----------|-------------------|--------------------------------------|---------------------|
| 1 | Tuesday | 01/08/2019 | Introduction/Class Description | |
| 2 | Thursday | 01/10/2019 | Particles and Sedimentation | |
| 3 | Tuesday | 01/15/2019 | van der Waals | Homework 1 |
| 4 | Thursday | 01/17/2019 | Electrostatics | |
| 5 | Tuesday | 01/22/2019 | DLVO | Homework 1 Due |
| 6 | Thursday | 01/24/2019 | Depletion Forces | |
| 7 | Tuesday | 01/29/2019 | Colloidal Suspensions | |
| 8 | Thursday | 01/31/2019 | Colloidal Assembly | |
| 9 | Tuesday | 02/05/2019 | Colloidal Characterization/Rheology | Homework 2 |
| 10 | Thursday | 02/07/2019 | Surfactants | |
| 11 | Tuesday | 02/12/2019 | Micelles | Homework 2 due |
| 12 | Thursday | 02/14/2019 | Vesicles | |
| 13 | Tuesday | 02/19/2019 | Biomembranes | |
| 14 | Thursday | 02/21/2019 | | Exam 1 |
| 15 | Tuesday | 02/26/2019 | Single Emulsions | |
| 16 | Thursday | 02/28/2019 | Multiple Emulsions | |
| 17 | Tuesday | 03/05/2019 | Bubbles and Foams | Homework 3 |
| 18 | Thursday | 03/07/2019 | Porous Materials (Ceramics/Polymers) | |
| | Tuesday | 03/12/2019 | Spring Break | |
| | Thursday | 03/14/2019 | Spring Break | |
| 19 | Tuesday | 03/19/2019 | Microfluidic Techniques | Homework 3 Due |
| 20 | Thursday | 03/21/2019 | | Exam 2 |
| 21 | Tuesday | 03/26/2019 | Microfluidic Techniques | |
| 22 | Thursday | 03/28/2019 | Polyelectrolytes Films/Capsules | |
| 23 | Tuesday | 04/02/2019 | Hydrogels | Homework 4 |
| 24 | Thursday | 04/04/2019 | Microgels | |
| 25 | Tuesday | 04/09/2019 | Liquid Crystals | Homework 4 Due |
| 26 | Thursday | 04/11/2019 | Liquid Crystals | |
| 27 | Tuesday | 04/16/2019 | Cellulose Nanocrystals | Homework 5 |