New Course EFD Template

PURDUE UNIVERSITY | College of Engineering

Engineering Faculty Document
No.: EFD 52-24
December 18, 2023

TO: The Engineering Faculty

FROM: The Faculty of the Agricultural and Biological Engineering Department

RE: New graduate course – **ABE 50300 - Microparticulate Surface Props**

The Faculty of the Agricultural and Biological Engineering Department has approved the following new graduate course. This action is now submitted to the Engineering Faculty with a recommendation for approval.

FROM (IF ALREADY OFFERED WITH TEMPORARY NUMBER)**:**

ABE 59100

Spring and Fall 2023

3.00 total credits; LEC/50/2/16 and LAB/100/1/16

No pre-requisites

Spring 2023 – 5 grad students; Fall 2023 – 3 grad students, 1 undergrad

TO:

ABE 50300

Fall

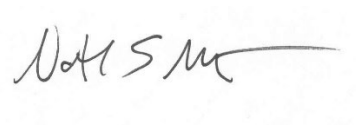
3.00 total credits; LEC/50/2/16 and LAB/100/1/16

No pre-requisites

Material Surface Science is the study of properties that occurs at the interface of two phases. Surface phenomena needs to be addressed to understand and manipulate the behavior of particulate materials. Probing particulate surface properties at the nano- and micro-level helps to relate these to the macroscale powder performance. The main focus of this course is on the application of surface analytical techniques for assessing the physical and chemical factors that dictate particulate interactions in various food, pharmaceutical, biological, mineral, environmental (soil and water) and aerosol systems. This course will provide the student both a broad overview of the state-of-the art analytical tools available to assess particulate surfaces and a fundamental insight into the characteristic behavior of system of particles. This course is unique because the student will learn and articulate how surface, physical, chemical and bulk properties are relevant in the performance of microparticulate systems of his/her interest.

RATIONALE:

The scope, applications and case studies will be beneficial to various disciplines where materials are in the solid form (microparticulates, powders) and films. Materials have different properties at the nano- and micro-scale that need to be understood in order to recognize their behavior at the macro-scale and begin to manipulate them to control the performance. Probing particulate surface properties with emphasis on composition, interactions and morphology assists to relate those to powder adhesion/cohesion, mixing, agglomeration caking, powder flowability, entrainment. Surface phenomena occurs (but not limited) to food, biopharmaceutical, biologics, minerals, explosives, soil, environmental, and aerosol materials. This course is unique because the student will learn and articulate how surface, physical, and bulk properties are relevant in the behavior of material systems of his/her interest.



Head of the Department

Link to Curriculog entry: https://purdue.curriculog.com/proposal:26791/form

Tentative Syllabus for Course: ABE 503?

MicroParticulate Surface Properties

Long title: Surface Properties and Powder Performance of Microparticulate Systems

Class Meeting days and times: M & W 10:30 – 11:45 am Classroom ABE B061 (Lectures); and, ABE 4087 & FLEX 3001 (Lab workshops)

First eleven weeks will be for lectures; last four weeks will be dedicated to lab work.

Week	Day	Class Topic
1	M	Course Introduction
	W	Lecture Review Solid-State Properties
2	M	Physical Principles of Materials
	W	Overview Particle Characterization
3	M	Particle and Powder Properties
	W	Assignment 1 - Discussion Particle and Powder Properties
4	M	Case Study: Dust Explosion
	W	Introduction to Surface Characterization Techniques
5	M	Surface Characterization Technique – Morphology
	W	Surface Characterization Technique – Composition
6	M	Surface Characterization Technique – Interactions 1
	W	Surface Characterization Technique – Interactions 2
7	M	Surface Characterization technique - Water adsorption solid interactions 1 - Fundamentals
	W	Surface Characterization technique - Water adsorption solid interactions 2 - Effects and consequences: Adsorption, Capillary, Agglomeration, Caking, Flow
8	M	Assignment 2 – Discussion Surface Composition, Interactions & sorption
	W	Case Study: Surface Interactions and Energetics
9	M	Surface Characterization Technique – Electrostatics
	W	Aerosols 1 – Basics, surface properties, formulation & deposition
10	M	Aerosols 2 - Environmental & Hazardous
	W	Case Study: Pollutant solid collection, charact and impact on the environment
11	M	Critique DUE and Lab tour & Demo XPS
	W	Powder Processing: Flow, Drying, Milling Powder, Mixing and Segregation Granulation, Fluidization, Spray drying, Pneumatic Transport, HME
12	M	Discussion - Combining attributes structure-property and process-performance
	W	Workshop – Physical properties: particle size distribution and morphology

13	M W	Workshop – semi-solid Rheology studies 1 Workshop – powder Rheology studies 2
14	M W	Workshop – Water sorption isotherms 1 Workshop – Water sorption isotherms 2
15	M W	Workshop – Surface energetics & Interactions 1 Workshop – Surface energetics & Interactions 2
16	M W	PROJECT PRESENTATIONS AND REPORT DUE

Course Materials:

Textbooks: No specific textbook will be required; several overall books will be suggested. Below are some examples:

Adamson, A.W, Physical Chemistry of Surfaces. Wiley (ISBN 0-471-07877-8).

Israelachvili, J. Intermolecular & Surface Forces. Second Edition. Academic Press (ISBN 0-12-375181-0).

Podczeck, F. Particle-particle Adhesion in Pharmaceutical Handling. Imperial College Press (ISBN 1-86094-112-5).

Ganderton, D., Jones, T., and McGinity, J., eds., Advances in Pharmaceutical Sciences, Vol. 7, Academic Press. (ISBN 0-12-032307-9)

Rhodes, M., Introduction to Particle Technology, 2nd ed., Wiley. (ISBN 978-0-470-01428-8)

Rhodes, M.J., ed., Principles of Powder Technology, Wiley. (ISBN 0-471-92422-9)

Hiestand, E.N., Mechanics and Physical Principles for Powders and compacts, 2nd ed., SSCI Inc., West Lafayette, IN. (ISBN 978-0-96706-712-4)

Rumpf, H., Particle Technology, Chapman and Hall. (ISBN 0-412-35230-3)

Svarovsky, L., Powder Testing Guide Methods of Measuring the Physical Properties of Bulk Powders, Kluwer. (ISBN 1-85166-137-9)

Reist, P.C. Aerosol Science and Technology. Second Edition. McGraw-Hill, Inc. (ISBN 0-07-051882-3).

Other Resources: A set of course notes will be available at least 24 hr. before the lecture. The notes for each unit/module will consist of objectives, learning goals and bibliography. Additional resources, links will be posted.

Assignments: Discussion in class of one to three publications (provided in advance as homework) related to the class topic that was previously covered in class. The students have to come prepared for the discussion.

Critique: Students will do a literature search of the topic/module of their interest, choose one or two and discuss it with me for approval prior to begin the review/assessment of the chosen publication.

Team Project*:* Students will work in teams of two, three or four, depending on the enrollment. The project will consist on realistic examples, using concepts covered in the course. The outline of the project will involve problem definition, background/introduction, experimental planning and data treatment (but not lab work), oral presentation and written report.