Engineering Faculty Document No. 22-01
February 25, 2004

To: Faculty of the Schools of Engineering

From: Faculty of the School of Chemical Engineering

Subject: Conversion of CHE 597S to a permanent course number CHE 536

The Faculty of the School of Chemical Engineering approved the conversion of CHE 597S to CHE 536 on February 24, 2004.

CHE 536 Particulate Systems Sem. 2, Class 3, Credit 3
Prerequisite: ChE 377 or equivalent or consent of instructor

A broad overview of the fundamental concepts in particulate systems including particle characterization, particle size measurement, sedimentation, fluidization, gas and liquid conveying, particle storage, fluid-particle separation, particle size enlargement and reduction, particle mixing and hazards associated with the handling of particulate solids. Practical applications are emphasized, with a focus on how particles behave differently than fluids.

REASON

Particulate systems pervade the chemical, pharmaceutical, agricultural, food, mining and process industries. Practicing chemical engineers are just as likely to work with processes involving particulate solids as liquids. Nevertheless, the required chemical engineering curriculum contains little to no information on how to produce, characterize or handle particulates. Thus an elective course focusing on particulate solids is an important part of the chemical engineering curricula at the undergraduate and graduate levels.

This course has been offered yearly in the spring semester since 1998. The course was offered in 1999 and 2001 as a part of Continuing Engineering Education. The typical enrollment has been 40 or 50 undergraduate students with 10 first year graduate students from chemical engineering, mechanical engineering, industrial pharmacy, material science engineering, and agricultural and biological engineering.

A. Varma, Head
School of Chemical Engineering
Date: 2/25/04

SUPPORTING DOCUMENTATION for **EFD 22-01**, change CHE 597S to permanent course number CHE 536.

1. **Justification**

Particulate systems pervade the chemical, pharmaceutical, agricultural, food, mining and process industries. Practicing chemical engineers are just as likely to work with processes involving particulate solids as liquids. Nevertheless, the required chemical engineering curriculum contains little to no information on how to produce, characterize or handle particulates. Thus an elective course focusing on particulate solids is an important part of the chemical engineering curricula at the undergraduate and graduate levels.

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2. **Level:** This course is intended to be a dual-level course

3. **Prerequisites:** CHE 377 or equivalent or consent of the instructor

4. **Course Instructor:** Professor Jennifer Sinclair Curtis, Professor Michael Harris

5. **Course Outline:**

Topics	**#Lectures**
Particle Characterization	3
Particle Size Measurement	2
Sedimentation	2
Packed Beds	1
Fluidized Beds	2
Pneumatic Conveying	3
Slurry Flow	1
Gas-Particle Separation	2
Bin/Hopper Design	3
Mixing & Segregation	1
Size Enlargement	1
Size Reduction	1
Dust Hazards	1

6. **Text:** Introduction to Particle Technology 1st Edition (1998) M. Rhodes, Wiley

CHE 536 Particulate Systems
Spring Semester

Proposed Course Description: CHE 536 Particulate Systems Sem. 2, Class 3, Credit 3
Prerequisite: ChE 377 or equivalent or consent of instructor

A broad overview of the fundamental concepts in particulate systems including particle characterization, particle size measurement, sedimentation, fluidization, gas and liquid conveying, particle storage, fluid-particle separation, particle size enlargement and reduction, particle mixing and hazards associated with the handling of particulate solids. Practical applications are emphasized, with a focus on how particles behave differently than fluids.

Textbook: Introduction to Particle Technology, 1st Edition (1998) M. Rhodes, Wiley

Instructors: Professor Jennifer Sinclair Curtis, Chemical Engineering; Professor Michael Harris, Chemical Engineering

Prerequisites by Topic: The student should be of advanced undergraduate or graduate standing. The student should have had experience at the undergraduate level with the fundamentals of fluid mechanics.

Computer Usage: Microsoft Excel; Matlab experience would be helpful but not necessary

Laboratory Projects: No lab projects

Nature of the Design Content:
Students work on open-ended problems in their regular homework - such as the design of a pneumatic conveying system and a fluidized bed. The capstone project involves a design component in that the students must propose a new design or a research project based on their findings in the literature.

Assessment Methods: Grades will be based on three tests (60%), homework assignments (15%), and course project (25%).

ABET category content as estimated by faculty member who prepared this course description:
Engineering Science: 2.4 credit or 80%
Engineering Design: 0.6 credit or 20%

COURSE SCHEDULE
CHE 536, Particulate Systems

Period	Topic	Reading*	Comments
01	Intro; Particle Characterization	xi - xiii	
02	Particle Characterization	Chap. 3	
03	Particle Characterization	Chap. 3	
04	Particle Size Measurement	Chap. 3	HMK 1 DUE
05	Particle Size Measurement	Chap. 3	
06	Sedimentation	Chaps. 1,2	
07	Sedimentation	Chaps. 1,2	HMK 2 DUE
08	Packed Beds	Chap. 4	
09	**NO CLASS**		
10	Fluidization, **Exam #1**	Chap. 5	Covers Lectures 1-7
11	Fluidization	Chap. 5	Project Abstracts Due
12	**NO CLASS**		HMK 3 DUE
13	Pneumatic Conveying	Chap. 6	
14	Pneumatic Conveying	Chap. 6	
15	Pneumatic Conveying	Chap. 6	HMK 4 DUE
16	Slurry Flow	Notes	
17	Gas-Particle Separation	Chap. 7	
18	Gas-Particle Separation, **Exam #2**	Chap. 7	Covers Lectures 8-16
	Spring Break – NO CLASS		
	Spring Break – NO CLASS		
19	Hopper and Bin Design	Chap. 8	
20	Hopper and Bin Design	Chap. 8	HMK 5 DUE
21	Hopper and Bin Design	Chap. 8	
22	Mixing & Segregation	Chap. 9	
23	Size Reduction	Chap. 10	HMK 6 DUE
24	Size Enlargement	Chap. 11	
25	Dust Hazards	Chap. 12	
26	**Exam #3**		Covers Lectures 17-25
27	GROUP PRESENTATIONS		
28	GROUP PRESENTATIONS		
29	GROUP PRESENTATIONS		
30	GROUP PRESENTATIONS		

* Reading assignments are from *Introduction to Particle Technology* (M. Rhodes), Wiley, 1998.

PROJECT GUIDELINES
CHE 536, Particulate Systems

Description:

1. The course project involves investigating a specialized topic related to particle technology. This investigation will primarily involve background research (80% of the report), but some of the project should involve taking an additional step from what is currently known (20% of the report). This additional step can take the form of a research proposal, new design, new insight based on current information, new calculations, new data, etc.

2. Each group will consist nominally of four team members.

3. In addition to working on a project, each project group will also be required to evaluate the oral presentations of the other groups and evaluate the performance of members within their own group.

Deliverables:

1. The results of the investigation will be presented to the instructor in the form of a written report of no more than 10 pages (not including title page, references, or tables and figures).

2. Each group is required to give a 25 minute presentation (20 minute talk with 5 minutes for questions). Each group member should participate in the presentation.

3. Each group member will evaluate the other members of their project group. The instructor will provide these evaluation forms.

4. The course project grade also involves evaluating the oral presentations of the other groups. The instructor will also provide these evaluation forms.

Schedule:

1. A short abstract (1 typed page) of each group's project topic is to be submitted to the course instructor by Tuesday, February 17.

2. Written reports are to be submitted to the course instructor on the day of the group's oral presentation.

3. All project evaluation forms are to be submitted to the course instructor by Monday, May 3.