THE TEACHING OF UNDERGRADUATE

KINETICS / REACTOR DESIGN

A Survey Prepared by the
Chemical Engineering Education Projects Committee
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I. COURSE MECHANICS

This section of the report summarizes administrative factors. These include student enrollments and the time allocated to the course.

Course Length.

About 22% of the departments responding operate on the quarter system. The quarter lasts just over 10 weeks while the semester is less than 15 weeks long. Both time periods exclude final examinations.

COURSE LENGTH
(Quarter Basis)

Length	Departments
9 weeks	1
10 weeks	17
11 weeks	3
15 weeks	1
Average	9.9 weeks

COURSE LENGTH
(Semester Basis)

Length	Departments
12 weeks	2
13 weeks	7
14 weeks	18
15 weeks	44
16 weeks	10
Average	14.3 weeks

Number of Courses

Most departments offer one course in kinetics/reactor design. 97% of the departments on the semester system and 85% of the departments on the quarter system offer one course.

Course Level.

The Kinetics/Reactor Design course is usually taught at the senior level. Within in the senior year, there is a preference for the first semester and the second quarter.

COURSE LEVEL
(Semester Basis)

Semester	Courses
Junior, Semester 1	11
Junior, Semester 2	22
Senior, Semester 1	50
Senior, Semester 2	5

(Quarter Basis)

Quarter	Courses
Junior, Quarter 1	2
Junior, Quarter 2	1
Junior, Quarter 3	3
Senior, Quarter 1	15
Senior, Quarter 2	3

Class Sessions.

In 79% of the departments, the course meets for three hours lecture per week. In 14% there are two hours per week. Over three-fourths (78%) of the departments offer no "laboratory" hours. 9 departments have 1 laboratory hour and 7 departments have two laboratory hours each week. Questionnaire responses show that the laboratory sessions are devoted to problem sessions.

LECTURE HOURS PER WEEK
(Based on 50-minute periods)

Hours	Departments
1	3
2	5
3	81
4	14
Average	3.42

LABORATORY HOURS PER WEEK
(Based on 50-minute periods)

Hours	Departments
0	78*
1	9
2	7
3	5
4	1
Average	1.91

*excluded from average

Class Sections and Enrollment.

81% of the departments offer one section of Kinetics/Reactor Design annually. 19% offer two sections. 38% of the sections have enrollments of 20 to 40 students.

NUMBER OF SECTIONS
(1990-91)

Sections	Departments
1	83
2	20
3	1
4	1

COURSE ENROLLMENT
(1990-91)

Enrollment	Courses
1 - 10	10
11 - 20	26
21 - 40	40
41 - 60	13
60 -100	9
100+	3

II. BACKGROUND

This section examines the technical background of students enrolled in Kinetics/Reactor Design.

Prerequisites.

The position of Kinetics/Reactor Design in the first semester or second quarter of the senior year is reflected in the courses student have taken during their junior year. Most students have completed organic chemistry and physical chemistry. Many have completed differential equations, heat transfer and fluid mechanics.

PREREQUISITE COURSES

Course	Departments
Differential Equations	70
Organic Chemistry	44
Heat Transfer	56
Physical Chemistry	54
Fluid Mechanics	56
Other	22

Computer Preparation.

Three questions in the questionnaire dealt with the computer skills of the students. About three-quarters of the departments offer a course in computers, usually in the freshman year. This usually includes a high level programming language such as FORTRAN or BASIC, spreadsheets and word processing.

What computer languages/programs do students use in this course?

	Departments
FORTRAN	71
Lotus	36
Basic	30
Pascal	5
Flowtran	4
Other	

III. COURSE CONTENT

This section deals with several aspects of the course content. These include textbook selection, problem solving and design content.

Textbook.

In almost every survey conducted over the past 20 years, one textbook is used in a majority of the courses. This survey was no exception. The text by Fogler was used in 53 courses. Four other texts were mentioned. The usage by chapters for Fogler is given below.

TEXTBOOKS

Fogler, H. Scott: Elements of Chemical Reaction Engineering,, 2nd ed., Prentice-Hall, New Jersey, 1992.

Levenspiel, O.:Chemical Reaction Engineering,, 2nd ed.,

TEXTBOOK SELECTION

Author(s)	Courses
Fogler	57
Levinspiel	23
4 other texts	26

CHAPTERS COVERED IN FOGLER

Chapter	Courses	Chapter	Courses
1	53	9	40
2	53	10	27
3	53	11	31
4	53	12	7
5	51	13	17
6	45	14	14
7	34	15	1
8	53	16	0

STRENGTHS AND WEAKNESSES OF THE TEXTBOOK

Strengths:

Clarity
Example problems
Realistic
Comprehensive
Computer Problems

Weaknesses:

Needs more numerical methods

Some topics for inclusion in future textbooks were mentioned by several respondees.

ADDITIONAL TEXTBOOK TOPICS

Case Studies
Economics
Multi Steady State Dynamics
Reactor Safety Conditions

Most departments (76%) require their students to use the computer in solving assignments in this course. Most courses (71%) utilize the computer for 10% to 30% of the askkkkkkkksignments. PC ownership is increasing among chemical engineering students. 65% of the departments report that 10% to 30% of their students own PC's.

Do you encourage students to use the computer in their homework assignments?

	Departments
Yes	80
No	25

What percent of assignments were done with the computer?

Percent	Departments
0	7
10	33
20	23
30	17
40	5
50+	18

What percent of the students own a PC?

Percent	Departments
0	13
10	29
20	20
30	18
40	6
50+	17

The English system is more widely used than the SI system in solving problems. Many departments (75%) would like to use the SI system over 50% of the time.

What percent of the problems you assign <u>are</u> solved in the SI system?

Percent	Departments
0	13
10	29
20	20
30	18
40	6
50+	17

What percent of the problems <u>would you like to see</u> solved in the SI system?

Percent	Departments
0	20
10	3
20	2
30	4
40	0
50+	80

The inclusion of design in the Kinetic/Reactor Design course was examined through the next three questions. Most departments (59%) would use design problems occasionally if present in the text. 33% assign projects lasting one month or longer. 20% of the departments claim no ABET design credit for the course. 48% claim 1/2 or 1 credit and 32% claim 1 1/2 or more credit.

If open-ended design problems were included in the text would you assign them?

	Departments
Occasionally	60
Often	35
Never	7

Do you assign a project lasting one month or longer in this course?

	Departments
Yes	34
No	68

How many ABET design credits do you assign to this course?

Credits	Departments
0.0	22
0.5	18
1.0	36
1.5	14
2.0	16
3.0	6