

SUMMARY REPORT

THE TEACHING OF UNDERGRADUATE
CHEMICAL ENGINEERING ELECTIVES

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INTRODUCTION

This survey is the eighteenth in a series on undergraduate chemical engineering courses that began in 1971. Each survey attempts to present the current text materials, course credits, curriculum placement, student enrollments, topical content and special features of one of about nine standard chemical engineering courses. The first cycle began with Mass and Energy Balances in 1971 and ended with Chemical Engineering Electives in 1980. Mass and Energy Balances was again surveyed in 1981, and this survey on Chemical Engineering Electives concludes the second cycle.

A two-page questionnaire was mailed to the chairman of each chemical engineering department in the United States and Canada in April, 1979. A follow-up letter was sent in August to those departments which had not yet replied. Of the 174 departments contacted, 140 returned replies (80%). This was the largest number of replies ever. There were 132 replies to the 1988 survey on the Capstone Design Course and 122 replies to the 1987 survey on Mass Transfer.

Results of the survey are presented at the Undergraduate Free Forum at the Annual Meeting of AIChE. A copy of the Survey is mailed to each chemical engineering department submitting a completed questionnaire. A copy of the questionnaire is included in this report.

The results from this survey will be compared with the 1980 survey on Electives as appropriate.

CRITERIA FOR COURSES

Most university catalogs include more courses than are taught regularly. In order to have the questionnaire reflect current teaching practices, the following criteria were set for reporting courses.

1. The course must be listed in the college catalog as a chemical engineering department course.
2. The course must have been taught during the 1987-88 or 1988-89 academic years.
3. The course could have been taught by either full-time or adjunct faculty.
4. Courses in defined "options" in the curriculum are not reported unless the courses can be taken separately as an elective.

The second restriction eliminates courses that are taught less frequently than once every two years. Actually, this restriction eliminates courses which are rarely if ever taught but which have not been deleted from the catalog.

CLASSIFICATION OF ELECTIVES

Respondents were asked to classify electives into one of 17 named categories plus "others." As in 1980, the "others" category was the largest. There were enough responses to justify five additional categories. A number of courses had catch-all titles such as "Special Problems," "Research" and "Senior Project." Courses in Food Processing and the Pulp and Paper Industry appeared several times.

The categories are ranked in Table 1 according to the per cent of the total replies in each category for the 1989 survey. Percentages for the 1980 survey are also listed. Stoichiometry had so few responses in 1980 that it was not offered as a category in 1989. Eight of the ten most popular 1989 categories were also in the top ten in 1980. In 1980 seven categories had more than 5% of the courses each; in 1989 only five had more than 5% each.

The changes in these percentages are ranked in Table 2. The change is defined as the 1989 percent minus the 1980 percent. Categories with the largest decreases are listed first while those with the highest increases are listed last. Note that these are changes in percentages, not per cent changes.

The largest decrease is in design electives. This may be due to the incorporation of more design as required, rather than elective courses in the curriculum, or it may reflect a shortage of faculty qualified by experience to teach design.

The major increases in electives are in two new areas of chemical engineering. The per cent of polymer science and engineering courses has doubled while the percentage of biochemistry and biochemical engineering courses has tripled since 1980.

TOTAL CURRICULUM HOURS

Table 3 lists the distribution of total hours in the chemical engineering curriculum on a semester basis. The average is 135.0 semester hours. There were too few replies from schools on the quarter system to draw valid conclusions on total hours.

ELECTIVE HOURS

The distribution on hours of electives on a semester basis is given in Table 4. The average is 10.3 hours. Both in 1980 and in 1989, five departments had no elective hours. In 1980, 41% of the departments offered 9 or fewer hours of elective. In 1989, 58% had 9 or fewer hours.

COURSE PARAMETERS

About 85% of the chemical engineering elective courses carry three semester hours credit (Table 5). Most have small to modest enrollments (Table 6). Half of the courses have ten or fewer students and 78% have 15 or fewer students.

Most electives are taught in the senior year. About 85% of the electives in departments on a semester basis and 88% of the electives in departments on a quarter system offer electives in the senior year. For both systems, about 45% of the courses are in the last quarter or semester of the senior year.

CATEGORY SUMMARIES

Summary sheets are available for courses in each of the 23 categories studied in this report. These sheets list the University, course number, title, hours of lecture, laboratory and credit, class size and text book if any. The entire set is about 30 pages long. Reproduction costs prevent including these pages with this summary report. If you would like copies of these category summaries for any category, please send a request to:

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T A B L E 1

CATEGORY PERCENTAGES

SUBJECT	REPLIES	1989 %	1980 %
Others	182	21.46	21.23
Biochemistry/Biochemical Engineering	101	11.91	4.11
Polymer Science/Engineering	89	10.50	5.53
Environmental Science/Engineering	71	8.37	10.27
Mathematics/Modeling	68	8.02	8.06
Process Dynamics and Control	40	4.72	6.64
Chemistry	34	4.01	5.21
Design	31	3.66	8.69
Kinetics/Catalysis/Reactor Design	30	3.54	2.53
Electronic Materials	28	3.30	
Transport Phenomena/Theory	24	2.83	
Thermodynamics	23	2.71	2.53
Mass Transfer	21	2.48	3.48
Biomedical Engineering	17	2.00	3.16
Nuclear Engineering	17	2.00	2.37
Corrosion	17	2.00	
Petroleum Engineering	13	1.53	
Electrochemical Engineering	10	1.18	
Unit Operations	9	1.06	4.27
Fluid Flow	8	0.94	3.79
Economics	7	0.83	3.16
Project Management	6	0.71	
Heat Transfer	2	0.24	3.48
Stoichiometry			1.42

Total Replies	848		

T A B L E 2

CHANGE IN CATEGORY PERCENTAGES

SUBJECT	CHANGE	1989 %	1980 %
Design	-5.03	3.66	8.69
Heat Transfer	-3.24	0.24	3.48
Unit Operations	-3.21	1.06	4.27
Fluid Flow	-2.85	0.94	3.79
Economics	-2.33	0.83	3.16
Process Dynamics and Control	-1.92	4.72	6.64
Environmental Science/Engineering	-1.90	8.37	10.27
Biomedical Engineering	-1.16	2.00	3.16
Chemistry	-1.20	4.01	5.21
Mass Transfer	-1.00	2.48	3.48
Nuclear Engineering	-0.37	2.00	2.37
Mathematics/Modeling	-0.04	8.02	8.06
Thermodynamics	0.18	2.71	2.53
Others	0.23	21.46	21.23
Kinetics/Catalysis/Reactor Design	1.01	3.54	2.53
Polymer Science/Engineering	4.97	10.50	5.53
Biochemistry/Biochemical Engineering	7.80	11.91	4.11

T A B L E 3

CHEMICAL ENGINEERING CURRICULUM
(Semester Hours)

Semester Hours	Departments
128 -	10
129	2
130	3
131	1
132	8
133	3
134	7
135	8
136	11
137	6
138	7
139	5
140	4
141 +	9

T A B L E 4

ELECTIVE HOURS IN CURRICULUM

Semester Hours	Departments
0	5
1-2	2
3	7
4-5	1
6	18
7-8	5
9	18
10-11	2
12	13
13-14	5
15	4
16-17	1
18	5
19 +	10

T A B L E 5

ELECTIVE COURSE CREDIT

Semester Hours	Departments
2	44
3	599
4	61

T A B L E 6

ELECTIVE COURSE ENROLLMENT

Enrollment	Departments
1 - 5	104
6 - 10	228
11 - 15	169
16 - 20	37
21 - 25	48
26 - 30	43
31 - 40	20
40 +	22

T A B L E 7

ELECTIVE COURSE LEVEL

Semester	Courses
Junior, Semester 1	27
Junior, Semester 2	49
Senior, Semester 1	204
Senior, Semester 2	240

Quarter	Courses
Junior, Quarter 1	12
Junior, Quarter 2	2
Junior, Quarter 3	3
Senior, Quarter 1	25
Senior, Quarter 2	39
Senior, Quarter 3	64

QUESTIONNAIRE ON TEACHING OF
CHEMICAL ENGINEERING ELECTIVES

Instructor _____ University _____

Course ID	Catalog NO.	Course Title	HRS/WEEK		Credit	Class Size	Classif. Code*
			Lec.	Lab.			
1	_____	_____	_____	_____	_____	_____	_____
2	_____	_____	_____	_____	_____	_____	_____
3	_____	_____	_____	_____	_____	_____	_____
4	_____	_____	_____	_____	_____	_____	_____
5	_____	_____	_____	_____	_____	_____	_____
6	_____	_____	_____	_____	_____	_____	_____
7	_____	_____	_____	_____	_____	_____	_____
8	_____	_____	_____	_____	_____	_____	_____
9	_____	_____	_____	_____	_____	_____	_____
10	_____	_____	_____	_____	_____	_____	_____

* CLASSIFICATION CODES

- | | |
|---------------------------|----------------------------|
| 1. Mass Transfer | 11. Biochemistry |
| 2. Fluid Flow | 12. Electronic Materials |
| 3. Heat Transfer | 13. Environmental Science |
| 4. Thermodynamics | 14. Biomedical Engineering |
| 5. Kinetics | 15. Economics |
| 6. Unit Operations | 16. Nuclear Engineering |
| 7. Design | 17. Project Management |
| 8. Process Dynamics | |
| 9. Mathematics/Statistics | |
| 10. Chemistry | 20. Other |

Please complete the other side

COURSE LEVEL

Course ID

(Check one in each group)

	<u>Jr.</u>	<u>Sr.</u>	<u>1st</u>	<u>2nd</u>	<u>3rd</u>	<u>Semester</u>	<u>Quarter</u>
1	_____	_____	_____	_____	_____	_____	_____
2	_____	_____	_____	_____	_____	_____	_____
3	_____	_____	_____	_____	_____	_____	_____
4	_____	_____	_____	_____	_____	_____	_____
5	_____	_____	_____	_____	_____	_____	_____
6	_____	_____	_____	_____	_____	_____	_____
7	_____	_____	_____	_____	_____	_____	_____
8	_____	_____	_____	_____	_____	_____	_____
9	_____	_____	_____	_____	_____	_____	_____
10	_____	_____	_____	_____	_____	_____	_____

* How many weeks in your [semester quarter] (circle one) : _____

TEXTS

Course ID

(Author/Title)

1	_____
2	_____
3	_____
4	_____
5	_____
6	_____
7	_____
8	_____
9	_____
10	_____

How many hours of electives (excluding options) does your curriculum permit? _____

Total hours in ChE curriculum _____

Please complete the other si