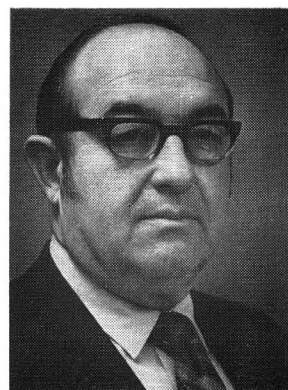


UNDERGRADUATE CURRICULA In Chemical Engineering (1969-70)

C. W. BALCH,
The University of Toledo
Toledo, Ohio 43606



UNDERGRADUATE CURRICULA IN Chemical Engineering were surveyed most recently for 1957, 1961, and 1970. It was the original intention of the Education Projects Committee of AIChE to survey on a regular basis so that trends in programs could be detected. This report compares the curricula of the survey as of 1970 with the earlier reports of Thatcher, "Chemical Engineering Education," September, 1962, and Schmidt, "Journal of Engineering Education," Volume 50, October, 1959.

This survey was done by mail and covered the schools listed in "Chemical Engineering Faculties" for the 1968-69 academic year. Eighty-eight usable replies are incorporated in the data compiled as Table I.* The item numbers at the left of the table are identical to those of the previous surveys. The data are presented in the same format so that comparisons can be made and trends can be detected. The table shows hours and range of semester hours for each heading using the three surveys. For continuity, the percentage of schools offering the work and the average number of credits when the material was offered by those schools has been included.

In addition to the data tabulated, recent changes in programs indicate curricular activity.

	Recent Changes	Planning Changes
1 year	34	30
2 years	13	9
3 years	12	4
4 years	13	4

Almost half of the schools teaching ChE had either made an overhaul or were planning an overhaul in their program within one year.

*The figure under the column "Average Number of Credits, 1970"—Item 37 "Total Math, Chemistry, Physics," should be 52.6.

Clyde W. Balch received his BS and MS degrees from the University of Maryland. He worked with the U.S. Naval Research Laboratories in Washington, D. C. in Confidential Research until 1939 and then went to duPont. In 1946 he was one of the founders of the Maumee Chemical Company in Toledo, Ohio and served as Treasurer and Vice-President until 1964.

Following the founding of the chemical company, he taught Engineering Mechanics at the University of Toledo from 1947 to 1951. He received his MSES from the University of Toledo in 1958 and in 1964 became a Professor in and Chairman of the Department of ChE at TU where he has served until the present time. Professor Balch introduced a doctoral program in the department and successfully enlarged the department and its programs. He was most recently (1967) made Dean of Adult and Continuing Education, Director of Evening Sessions and Coordinator of Summer Sessions at the University of Toledo.

RESULTS OF SURVEY

Careful analysis of the table as it applies to each individual will probably reveal more than these observations and results, however, the following comments seem pertinent.

1. While the gross number of hours was down by 9.4 from the last survey, the net was down by only 3.9 hours—the difference between gross and net being those courses devoted to physical and military education, review math, and religious training. The difference between net and gross of 10 hours in 1957 to 2.5 hours in this survey suggests that there is a reduction in credit allowed in remedial work and military service towards graduation.

2. Communications skills, written and oral, continue to decline showing shorter courses in written work and considerably less emphasis on oral communications with only 29 per cent of the schools offering oral work.

3. The total cultural courses have increased by two hours despite the efforts over the past decade to increase this group. The total of all nontechnical electives shows a drop of 3.6 hours,

TABLE 1. AVERAGE AMERICAN B.Ch.E. CURRICULUM OF 1969-70 COMPARED WITH 1956-57 AND 1960-61

	Range of ECPD Credits, SH			Avg. Number of SH			Schools Offering, %			Avg. SH when Offered		
	1957	1961	1970	1957	1961	1970	1957	1961	1970	1957	1961	1970
6. Gross Credits, SH	130-160	125-162	122-154	147.0	146.2	136.8	-	-	100.0	-	-	136.8
7. Net Credits, SH	118-160	123-154	110-148	136.9	138.2	134.3	-	-	100.0	-	-	134.3
8. NON-TECHNICAL SUBJECTS												
9. Written Communication	0-16	0-12	2-10	6.5	5.9	4.9	98.8	97.8	92.8	6.6	6.0	5.3
10. Oral Communication	0-4	0-3.3	1-7	1.1	1.0	0.8	43.2	45.6	28.9	2.4	2.3	2.7
11. Subtotal Items 9-10	0-16	0-15	2-12	7.6	6.9	5.6	98.8	97.8	92.8	7.7	7.1	6.0
12. Humanities, Required	0-24	0-20	2-17	4.0	5.4	4.9	63.0	72.7	66.3	6.3	7.6	7.5
13. Social Studies, Req.	0-14	0-12	1-14	3.1	2.7	2.5	59.1	55.4	39.8	5.9	4.8	6.2
14. Other Req. Soc-Hum.	0-18	0-27.3	1-19	1.3	1.5	1.5	22.2	20.7	22.9	5.7	7.3	6.7
15. Non-technical Electives	0-24	0-30	2-33	6.4	7.6	9.8	76.5	82.6	79.5	8.3	9.2	12.3
16. Subtotal, Items 12-15	3-30	5.7-30.7	6-34	14.7	17.2	19.1	100.0	100.0	100.0	14.7	17.2	19.1
17. Physical Education, etc.	0-8	0-8	1-4	1.8	1.9	1.2	50.6	51.6	44.6	3.5	3.7	2.8
18. Military Studies	0-12	0-20	2-8	3.1	2.9	0.8	48.1	49.0	18.1	6.5	6.0	4.4
19. Other non-technical	0-4	0-6.7	1-7	0.3	0.3	0.4	23.5	14.1	19.3	1.3	2.0	2.2
20. Subtotal Items 17-19	0-16	0-24	1-8	5.2	5.2	2.0	84.0	77.2	54.2	6.2	6.6	3.7
21. Total Items 11, 16, 20	16-43	15-49	12-46	27.5	29.6	25.8	100.0	100.0	96.4	27.5	29.6	26.8
22. MATHEMATICS, CHEMISTRY, AND PHYSICS												
23. Intro. & Review Math.	0-10	0-10	2-3	4.4	2.6	0.2	79.0	53.3	6.0	5.6	4.9	2.8
24. Anal. Geom. and Calc.	8-16	6-22	6-15	11.6	11.7	11.3	100.0	100.0	100.0	11.6	11.7	11.3
25. Diff. Eq. & Other	0-6	0-14	2-15	1.3	3.6	6.3	44.4	81.5	98.8	2.8	4.3	6.3
26. Subtotal Items 23-25	12-22	12-26	11-26	17.3	17.9	17.7	100.0	100.0	100.0	17.3	17.9	17.7
27. General Chemistry	4-10	4-10	3-18	8.0	7.8	7.4	100.0	100.0	97.6	8.0	7.8	7.5
28. Physical Chemistry	6-13	0-13	3-12	8.5	8.1	7.7	100.0	98.9	97.6	8.5	8.2	7.9
29. Organic Chemistry	5-11	3-11	3-35	8.5	7.8	7.4	100.0	98.9	98.8	8.5	7.8	7.5
30. Quantitative Analysis	0-8	0-8	1-8	4.2	3.5	1.2	98.8	94.6	36.1	4.2	3.7	3.3
31. Qualitative Analysis	0-4	0-5	1-5	1.3	1.3	0.6	44.4	39.2	25.3	3.0	3.3	2.3
32. Other Chemistry	0-5	0-14	1-5	0.3	0.5	0.5	9.9	9.8	18.0	3.3	5.5	2.8
33. Subtotal Items 27-32	24-37	21-38	12-31	30.8	28.9	24.1	100.0	100.0	98.8	30.8	28.9	24.4
34. General Physics	8-18	5.3-16	2-14	10.8	10.2	8.5	100.0	100.0	98.8	10.8	10.2	8.6
35. Modern Physics	0-3	0-6	1-8	0.2	1.0	1.4	8.6	38.0	38.6	2.6	2.7	3.7
36. Subtotal Items 34-36	8-20	5.3-19	5-50	11.1	11.3	10.5	100.0	100.0	100.0	11.1	11.3	10.5
37. Total Items 26, 33, 36	49-68	49-70	36-66	59.2	57.9		100.0	100.0	85.5	59.2	57.9	52.2
38. ENGINEERING GRAPHICS												
39. Total Graphics	0-9	0-9	1-6	4.7	3.8	2.0	97.5	94.6	67.5	4.8	4.0	3.0
40. ECONOMICS, BUSINESS LAW, BUSINESS ADMINISTRATION AND ALLIED												
41. Economics, Princ. of	0-6	0-7.3	2-6	2.2	2.1	1.5	55.6	58.7	39.8	3.9	3.5	3.9
42. Economics, Engineering	0-6	0-3	1-3	0.7	0.5	0.6	23.5	22.8	27.7	2.8	2.2	2.0
43. Bus. Law, - Admin., etc.	0-6	0-8	2-7	0.5	0.3	0.1	18.5	8.7	2.4	2.9	3.0	4.5
44. Total Items 41-43	0-11	0-12.5	1-9	3.4	2.7	2.2	70.4	68.5	55.4	4.8	4.1	3.9
45. MECHANICS OF SOLIDS												
46. Mechanics	0-7	0-10	2-9	3.7	3.9	4.1	97.8	97.5	90.4	3.8	4.0	4.5
47. Mechanics of Materials	0-5	0-6	2-7	3.1	2.5	1.4	97.5	80.4	47.0	3.2	3.1	3.0
48. Total Items 46-47	2-10	0-10	2-10	6.8	6.4	5.1	100.0	97.8	90.4	6.8	6.6	5.7
49. ELEMENTARY ELECTRICAL ENGINEERING												
50. Elementary El. Eng.	0-8	0-10	1-6	4.7	4.0	2.8	98.8	93.5	77.1	4.8	4.3	3.6
51. Elementary Electronics	0-3	0-4.5	1-4	0.3	0.9	1.5	9.9	38.0	49.4	2.6	2.5	3.0
52. Total Items 50-51	0-9	0-10	2-9	5.0	5.0	4.3	100.0	95.7	88.0	5.0	5.2	4.8
53. NATURE AND PROPERTIES OF MATERIALS, CATEGORY A AND CATEGORY B												
54. Physical Metallurgy	0-4	0-6	2-4	1.2	0.6	0.4	40.7	20.6	13.3	2.9	3.1	3.1
55. Other Category A Courses	0-3	0-4	1-7	0.1	0.3	1.7	5.0	11.9	57.8	2.0	2.6	3.0
56. Metallurgy	0-5	0-6	3-3	0.4	0.6	0.1	12.7	21.7	2.4	2.9	3.0	3.0
57. Other Category B Courses	0-5	0-4	1-3	0.6	0.3	0.3	28.4	11.9	10.8	2.1	2.6	2.3
58. Total Items 54-57	0-8	0-8	2-7	2.3	1.9	2.4	67.9	55.4	71.1	3.4	3.4	3.4
59. SUPPLEMENTARY SCIENCES AND PRACTICES												
60. Biology and Geology	0-8	0-8	3-7	0.2	0.2	0.3	4.9	4.3	6.0	3.8	4.0	4.4
61. Heat Power	0-6	0-4.7	4-4	0.8	0.2	0.0	23.5	8.7	1.2	3.4	2.3	4.0
62. Shop Practice	0-3	0-2	1-1	0.4	0.1	0.0	23.5	8.7	1.2	1.7	1.3	1.0
63. Other	0-4	0-6	1-8	0.4	0.3	0.5	13.6	15.2	18.1	2.8	2.2	3.0
64. Total Items 60-63	0-8	0-8	1-8	1.8	0.8	0.8	45.7	29.3	24.1	3.9	2.8	3.3
65. CHEMICAL ENGINEERING												
66. Material & Energy Bal.	0-8	0-8	1-8	3.8	3.1	3.1	98.8	91.3	91.6	3.9	3.3	3.3
67. Thermodynamics	2-10	1-9	2-8	4.8	5.0	4.5	100.0	100.0	98.8	4.8	5.0	4.6
68. Chemical Kinetics	0-5	0-4	1-6	0.5	1.2	2.6	18.5	53.2	89.2	2.5	2.3	3.0
69. Subtotal Items 66-68	5-17	2.7-17	1-13	9.1	9.2	5.0	100.0	100.0	75.9	9.1	9.2	6.6
70. Unit Operations Theory	4-13	0-16	2-10	7.6	8.2	4.3	100.0	97.8	73.5	7.6	8.4	5.9
71. Unit Operations Lab.	2-7	0-8	1-6	4.1	3.9	2.7	100.0	98.9	81.9	4.1	4.0	3.3
72. Subtotal Items 70-71	8-16	0-20	1-15	11.7	12.1	7.0	100.0	98.9	91.6	11.7	12.2	7.7
73. Ch.E. Design	0-12	0-8.7	2-8	3.7	3.5	3.6	90.1	86.9	90.4	4.1	4.0	4.0
74. Chemical Technology	0-7	0-7	1-6	2.7	1.8	0.6	75.3	53.2	19.3	3.6	3.3	3.0
75. Investigational Skills	0-12	0-8	1-10	2.5	1.5	0.8	70.4	50.0	24.1	3.5	3.1	3.5
76. Intro. to Ch.E.	0-4	0-10	1-5	0.8	0.9	0.6	38.3	39.1	30.1	2.0	2.3	1.8
77. Instrumentation	0-5	0-4	2-6	0.7	1.1	2.3	32.1	41.3	71.1	2.3	2.5	3.3
78. Unit Processes	0-3	0-7.5	1-6	0.6	0.7	0.2	27.2	23.9	7.2	2.2	3.0	3.2
79. Trips	0-3	0-8	1-2	0.3	0.3	0.1	21.0	17.4	7.2	1.5	1.7	1.2
80. Fuels and Lubricants	0-4	0-3	1-1	0.3	0.1	0.0	13.6	4.3	2.4	1.9	1.5	1.0
81. Other	0-8	0-20	1-27	0.6	1.7	4.1	19.8	42.3	61.5	2.9	3.9	6.6
82. Subtotal Items 73-80	5-23	0-25	3-40	12.1	11.5	12.3	100.0	98.9	98.8	12.1	11.6	12.5
83. Total Items 69, 72, 82	23-45	20-53	19-62	32.9	32.8	33.4	100.0	100.0	98.8	32.9	32.8	33.8
84. TECHNICAL ELECTIVES												
85. Total Tech. Electives	0-12	0-24	3-30	3.6	5.2	6.2	65.4	75.0	72.3	5.5	7.0	8.6

probably attributable to a slight gain in humanities and a drop in communications and physical education.

4. The number of hours in mathematics is essentially the same over the past three surveys, but the distribution of material has changed. Very few schools are given any work in introductory mathematics. This is compensated for by an increase in differential equations and other math background. This advanced material doubled since the last survey and had doubled between the first and second surveys. The amount of math has remained essentially constant, but the level of math has increased.

5. Chemical engineers still require chemistry background, although there is a decrease of almost five hours in the amount of chemistry required. The most telling reduction is in quantitative analysis, which is probably being incorporated in other courses. It is most interesting to note organic, physical, and general chemistry still hold their own.

6. The amount of physics required has decreased slightly. The indication of a slight increase in courses in modern physics and slight

... The requirements in ChE continue to be rigid. The total number of hours is practically equal to previous surveys.

decrease in the semester hours of general physics.

7. Graphics continues to decline dropping two hours to almost half of the previous requirements. Mechanical and electrical engineering background hold their own, but drop slightly, while materials seems to have increased.

8. The requirements in ChE continue to be rigid. The total number of hours is practically equal to the previous surveys. Three things stand out. There is an increase in the amount of kinetics. This is more than doubled. A decrease in the amount of unit operations, and a decrease in "other", which is probably mathematics and advanced chemical engineering. The total number of hours holds constant at 33.

9. The total electives in the technical field increased by only one semester hour confirming the rigidity of most curricula. □

UNDERGRADUATE CURRICULA In Chemical Engineering (1970-71)

... chemical engineering and the humanities have increased while all other categories have decreased

....

DEE H. BARKER
Brigham Young University
Provo, Utah 84601

The "Goals of Engineering Education" report has caused a great deal of discussion and examination of the curricula of engineering schools. The administrations in many schools have been bringing pressure to bear to effect some of the changes suggested. The American Institute of Chemical Engineers, while agreeing with some of the "Goals," is opposed to others of them. In order to determine the current plans of the various Chemical Engineering Departments, the author conducted a survey of all schools listed in the "Directory of Chemical Engineering Faculties"¹.

The letter written to each department asked for the course outline which would be used in 1970-71 school year. The letter also asked for comments on an integrated five-year program with the Master of Engineering degree being the first professional degree, the Bachelor of Science degree not being considered professional.

A total of 93 schools replied and the following analysis is based on these replies. The information was taken from bulletins, course outlines, and other material submitted by each school. Since this was a survey conducted by a single individual, no attempt was made to use the format and questionnaire used in previous surveys.^{2,3} This was done to lessen the burden on the already overworked department chairman and with the hope that the number of replies would be thereby increased. The analysis was made, however, on