

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

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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

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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



Dee Barker is Professor of ChE at Brigham Young University. Dee earned the BS and PhD ('51) degrees from the University of Utah. His industrial experience includes several years with duPont in nuclear engineering and with Hercules Inc. in atmospheric pollution, heat transfer, and materials development. He has served foreign assignments at Provo Institute of Technology and Science at Pilani, Rajasthan, India and Birla Institute of Technology and Science. Dee's fields of interest include nuclear engineering, fluid dynamics, heat transfer, process control and environmental control.

the same basis as the previous surveys. In some cases it was necessary to interpret the course content from the descriptive material furnished. It was not possible in all cases to identify the items in each category. As an example, materials and communications may be somewhat in error.

Two surveys have been conducted^{2,3} since 1957 by the AIChE committee on undergraduate curricula. The present survey is not as comprehensive as the past surveys and is limited to looking at the broad categories rather than a detailed analysis of the changes within a category. The results are shown in Table 1. This table presents a comparison of the "average" curricula for 1957, 1961 and for the present survey, 1970 (the intended curricula for 1970-71). The gross hours represent the total hours required while the net hours exclude physical education, precalculus math and military classes. This presents a problem since many schools have introduced a category, "free electives" which can, at student option, be used for military classes. The free electives were not included in the net hours.

Of the 93 schools included in the analysis, 32 (35%) indicated a change in hours either in 1969-70 or 1970-71.

As can be seen, there has been a decrease of 5.3 hours in the number of net hours since 1957. Table 2 presents the change in the number of hours in each category using 1957 as a base.

TABLE 1.—Comparison of Average Curricula

Category	1957	1961	1971
Gross	147	146.2	133.5
Net	136.9	138.2	131.6
Communicative Skills	8	7	5.0
Humanities	13	17	18.3
SUBTOTAL	21	24	23.3
Mathematics	13	15	16.7
Chemistry	31	29	23.8
Physics	11	11	9.7
SUBTOTAL	55	55	50.2
Mechanics	7	6	5.2
Electrical Engineering	5	5	3.7
Materials	2	2	1.4
SUBTOTAL	14	13	10.3
Chemical Eng (Required)	33	33	33.8
Chemical Eng (Elective)			2.3
SUBTOTAL	33	33	36.1
Graphics	5	4	1.4
Economics	3	3	.8
Technical Electives	4	5	6.4
Computer	--	--	1.2
Life Science	2	1	.2
Other	--	--	--
SUBTOTAL	14	13	11.8
TOTAL, hrs.	137	138	131.7

Chemical engineering and the humanities have increased while all other categories have decreased. The increase in chemical engineering hours may be caused by the failure to recognize the materials course in the chemical engineering categories.

The decrease in chemistry is caused primarily by the merging of the first chemistry course with analytical chemistry. Several schools indicated an interrelationship between physics, mechanics, and electrical engineering. In some cases, the schools reduced the physics and in others the electrical engineering and/or mechanics were reduced in hours.

Although no attempt was made to separate the various areas within chemical engineering subjects, several trends were noted. There is a tendency to reduce some hours in traditional unit operations with the addition of hours in transport. In addition, 35% of the schools indicated an elective in chemical engineering. The average, over 93 schools, was 2.3 hours.

The "average curricula" cannot present the entire story of the change taking place. Therefore, the material in Table 3 is presented. The percentage of schools offering course work in

TABLE 2.—Change in Course Content
Basis 1957 = 0

Category	1961	1971
Gross	-0.8	-13.5
Net	1.3	-5.3
Communicative Skills	-1	-3.0
Humanities	4	5.3
SUBTOTAL	3	2.3
Mathematics	2	3.7
Chemistry	-2	-7.2
Physics	0	-1.3
SUBTOTAL	0	-4.8
Mechanics	-1	-1.8
Electrical Engineering	0	-1.3
Materials	0	-0.6
SUBTOTAL	-1	-3.7
Chemical Engineering	0	3.1
SUBTOTAL	0	3.1
Graphics	-1	-3.6
Economics	0	-2.2
Technical Electives	1	2.4
Computer	-	1.2
Life Science	-1	-1.2
Other	-1	-0.2
SUBTOTAL	-1	-2.2
TOTAL, hrs.	1	-5.3

each category is shown in this table. Only the categories in which less than 100% of the schools offer the course are noted. The remaining categories had 100% of the schools reporting. The largest changes have occurred in communications and precalculus math. This takes into account the better preparation of the incoming high school student. The increase in humanities requirements shows the effect of the accreditation procedures.

None of the schools replying indicated they were planning on adopting the "Goals Report" in regards to the B.S.—M.E. degree sequence. In fact, those who expressed themselves were very much opposed to the proposal. However, a reduction in hours is being made. Other than students with better preparation, no reason is given for this decrease.

The letter requesting information from the department did not specifically ask for the details of the introduction of common years into the curricula. However, this information was included in the catalog and other material submitted for analysis. One or two schools are examining a common undergraduate engineering degree. Others are looking at a common two-year pro-

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gram with the aim of facilitating the transfer of students from junior colleges. Of the schools surveyed, 47% indicated a program with some years common to the other branches of engineering. The average, based on 42 schools, was 1.2 years. The primary problem of common years lies in the chemistry course taken by chemical engineers. In almost all cases, the chemistry taken by chemical engineers was different from the chemistry taken by the other engineers. The chemical engineers take chemistry with the chemists, while the remaining engineers take a terminal chemistry course.

As pointed out by Corcoran⁴ chemical engineering is set apart by its "preoccupation with chemical change." The solution to the introduction of common years to all branches of engineering lies in the recognition of the other engineering branches of importance of chemistry to their particular branch. The solution does not lie in decreasing the chemistry content of chemical engineering. The recommendations made by Corcoran would greatly aid in the problem of introducing common years. □

TABLE 3.—Percentage of Schools Offering Course Work
In Selected Categories
(all others 100 per cent)

Category	1957	1971
Communicative Skills	99	83
Humanities	63	100
Precalculus Math	79	3
Mechanics	100	89
Electrical Engineering	99	82
Materials	68	43
Chemical Eng Electives	—	35
Graphics	98	47
Physical Education	51	35
Military	48	11

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