ChE curriculum

A SURVEY OF PROCESS CONTROL EDUCATION IN THE UNITED STATES AND CANADA*

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IN FEBRUARY, 1978 a questionnaire on process control education was distributed to the 158 chemical engineering departments in the United States and Canada. Completed questionnaires were returned by 143 schools, or 90% of the 158 departments. This response compares quite favorably with the 59-101 replies that were received in recent AIChE surveys of undergraduate curricula [1, 2]. The large number of replies is probably due to two factors: 1) the questionnaire was kept very brief, and 2) copies of the final report were promised to those departments which submitted completed questionnaires.

SURVEY RESULTS

THE SURVEY RESULTS indicate that process control is firmly established in the undergraduate curriculum since only 7 of the 143 respondents (5%) do not offer undergraduate courses. By contrast, 108 schools (75%) have required courses and an additional 28 schools (20%) offer elective courses. Interestingly enough, 4 of the 7 schools which do not offer undergraduate courses in process control do offer graduate courses. Thus only 3 schools of the 143 respondents do not offer any process control courses.

Process control courses are also firmly established at the graduate level. Seventy-two schools (50%) offer graduate courses while an additional 15 schools (10%) offer courses which are open to both graduate students and advanced undergraduate students. Tables 1 and 2 list the process control textbooks which have been adopted for undergraduate and graduate courses, respectively.

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TABLE 1
Textbook Selection for Undergraduate and Undergraduate/Graduate Courses

TEXT	NUMBER OF DEPTS.
Coughanowr and Koppel	69
Luyben	21
Weber	9
Harriott	6
Douglas	6
Perlmutter	3
Smith, Cecil	2
Ogata	2
Others (one each)	17
Total	135

The most striking result here is the continuing popularity of the book by Coughanowr and Koppel which has been selected as an undergraduate text by 69 departments and as a graduate text by 7 departments. The dominant position of this 15 year old text is quite remarkable in view of the significant developments which have occurred since 1965 in both computer control hardware and

TABLE 2
Textbook Selection for Graduate Courses

TEXT	NUMBER OF DEPTS.
Smith, Cecil	10
Coughanowr and Koppel	7
Luyben	4
Douglas	2
CACHE Monographs	2
Lapidus and Luus	2
Other (one or two each)	17
Total	44

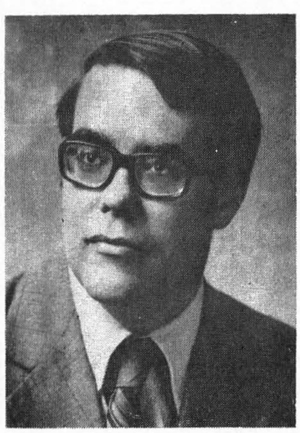
*A preliminary version of this paper was presented at the Miami Beach AIChE Meeting.

TABLE 3
Laboratory Control Experiments in Undergraduate Courses

NUMBER OF EXPERIMENTS/COURSE	NUMBER OF DEPTS.
0	43
1-2	30
3-4	26
5+	37
Some experiments (number not available)	7
Total	143

in control theory. The results in Table 1 agree quite well with a 1975 survey on undergraduate process control courses [1]. It should be noted that the numbers in Tables 1 and 2 are reported on the basis of individual departments rather than on the basis of courses offered. For example, if a particular department offers two undergraduate process control courses which use the same textbook, this was counted only once in Table 1 rather than twice. By contrast, if two textbooks were required for a particular course, they both were included. Many of the 17 textbooks included in the "Other" category in Tables 1 and 2 were written for mechanical or electrical engineers and are used in classes taken by both chemical engineering students and other engineering students.

One hundred departments (70% of the respondents) indicated that their curriculum in-



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cludes one or more laboratory experiments in process control. Table 3 shows that 63 departments offer courses that contain at least three control experiments and 30 departments have one or two experiments, usually as part of a unit operations laboratory.

In compiling these statistics, each department was included in only a single category. Thus if a particular department offers two process control

TABLE 4
Use of Real-Time Computers or Micro-Processors in Control Experiments

	NUMBER OF DEPTS.
Currently have a real-time system	48
Equipment on order or being installed	19
No equipment (but have tentative plans to add equipment)	22
No equipment (and no plans for future equipment)	53
Total	143

courses which include three and five experiments, respectively, this department was included in the tally for the "5+" category in Table 3.

During the past decade there has been considerable interest in "real-time computing," that is, in digital computers which are used for data acquisition and control. Both industrial and academic personnel in the process control field have maintained an active interest in the field of real-time computing for the following reasons:

- The widespread availability of inexpensive minicomputers and microprocessors;
- Changing process control objectives in industrial plants due to energy and environmental considerations;
- The realization that the application of most advanced control strategies will inevitably require an on-line digital computer.

The results in Table 4 indicate that 48 departments (34%) currently have control experiments which involve a real-time computer while an additional 19 departments (13%) have computer systems on order or being installed.

Table 4 includes only those departments which use real-time computers in conjunction with undergraduate control experiments. It does not include

TABLE 5
Real-Time Computers or Microprocessors Currently Installed (53) or On Order (19)

EQUIPMENT AND VENDOR	NUMBER OF DEPTS.
Minicomputers	
Digital Equipment Corp.	24
Data General Corp.	8
Hewlett Packard	5
IBM	5
Texas Instruments	3
Foxboro	2
Interdata	2
Miscellaneous (one each)	6
Not specified	7
Microprocessors	10
Total	72

other departments which use minicomputers or microprocessors exclusively in research laboratories. The 22 departments in the third category in Table 4 typically are in a preliminary planning stage or are seeking funds to purchase a real-time system. Thus the results of this survey indicate a continuing trend for incorporating a real-time computer system in the undergraduate curriculum.

Table 5 presents a summary of the 62 minicomputers and 10 microprocessors which are currently operating in chemical engineering departments or on order. The numbers in Table 5 do not correspond directly to those in Table 4 since several chemical engineering departments use more than one real-time computer in the undergraduate curriculum.

CONCLUSIONS

THE RESULTS OF THIS survey indicate that the topic of process control has become firmly established in the chemical engineering curriculum. Only 3 of the 143 departments surveyed do not teach any courses in process control. One hundred and eight schools (75% of the respondents) have required undergraduate courses while 87 schools (61%) teach graduate level courses in process control. Laboratory experiments in process control are now available at 100 schools (70%). There is a continuing trend toward providing students with exposure to real-time computer systems in conjunction with process control experiments; 67 departments currently have such a system operating or on order while an additional 22 departments have tentative plans for such a system.

Fifteen years ago, process control was generally regarded as a new, specialized topic which was not part of mainstream chemical engineering. The present survey demonstrates that this situation no longer exists. Process control has joined the more traditional topics such as transport phenomena, thermodynamics and reactor analysis in playing a central role in the chemical engineering curriculum. □

REFERENCES

1. Eisen, E. O., "Teaching of Undergraduate Process Dynamics and Control," paper presented in a mini-session at the 68th Annual AIChE Meeting, Los Angeles (November, 1975).
2. Barker, D. H., "Undergraduate Curriculum 1976," *Chem. Eng. Educ.*, Vol. XI, No. 2, (Spring, 1977).

BOOK REVIEW: Contact Catalysis

Continued from page 12.

hope of being able to reproduce catalysts of a given type in different laboratories is rapidly becoming a reality.

As one might infer from the variety of topics and extent of treatment, these volumes are not exactly for the beginner. One might have wished some discussion of homogeneous catalysis, at least in terms of analogs to heterogeneous systems, and a more general inclusion of the concepts of coordination chemistry as they relate to catalysis. In all, however, some balance must be struck between coverage and length and the editor has done an admirable job. The English translation of the original Hungarian edition of 1966 is excellent and the text has been updated. The dust jacket states that "the book will be useful to workers studying catalysis in industrial and university laboratories." The present reviewer feels this is a correct statement and commendable for its modesty. □

ChE news

ART HUMPHREY HONORED

Arthur E. Humphrey, dean of Penn's School of Engineering and Applied Science, became the eighth honoree to receive the James M. Van Lanen Distinguished Service Award for his "life long dedication and service to fermentation science and the fermentation industry.

The award is named for a pioneer in fermentation technology and was established in 1976 as the foremost award and citation of the ACS Division of Microbial and Biochemical Technology.