3B

SUMMARY REPORT

TEACHING OF UNDERGRADUATE

INTRODUCTION

The attached questionnaire was sent in May, 1976 to the chairman of each Chemical Engineering Department in the United States and Canada, together with a cover letter asking that the appropriate faculty member complete and return the questionnaire. A follow-up letter [illegible] these schools (about 110) which

TABLE 1

THERMODYNAMICS COURSE LEVEL

Sophomore Year

Quarter 2: 1.7%	Semester 2: 4.3%
Quarter 3: 3.5%	

Junior Year

Quarter 1: 3.7%	Semester 1: 25.2%
Quarter 2: 9.6%	Semester 2: 28.7%
Quarter 3: 4.3%	

Senior Year

Quarter 1: 5.2%	Semester 1: 7.8%
Quarter 2: 3.5%	Semester 2: 2.6%
Quarter 3: 3.0%	

Silver, R. S. and Nydahl, J., "Introduction to Engineering Thermodynamics", West Publishing Co., 1976.

Smith, J. M. and Van Ness, H. C., "Introduction to [illegible]

Sontag, R. E. and Van Wylen, G. J., "Introduction to Thermodynamics", Wiley, 1971.

Zemansky, M. W. and Van Ness, H. C. "Engineering Thermodynamics", McGraw-Hill, 1966.

COURSE LEVEL AND FORMAT

Chemical Engineering Thermodynamics is a three-hour course offered in the junior year. This is the conclusion from the 1976 survey (Table 1). Seventy-one percent of the courses are offered in the junior year, with a slight tendency toward the second semester. Only 19% are given in the senior year, while 10% occur during the sophomore year.

In 64% of the courses, three hours of lectures are given each week. Although 21% offer four hours lecture weekly, there appeared little relationship between lecture hours and the quarter or semester system. Nine percent of the courses hold class meetings twice weekly, while the remaining 5 percent meet 5 times a week. The average lecture time was 3.22 hours per week.

... is required in only 16% of the

DIFFICULT CONCEPTS

Over a dozen topics of thermodynamics were mentioned as being conceptually difficult. Entropy and fugacity head the list, with entropy cited on 59% of the question- [redacted] mentioned on 20% of the replies. Other areas mentioned on 5% or more of the replies are:

Partial molar quantities	13%
Chemical potential	11%
Reversibility	9%
Phase equilibria	6%
Partial derivatives	6%
Standard states	5%
Free energy	5%
Unsteady-state flow	5%

USE OF THE COMPUTER

Computers are extensively used in the engineering applications of several areas of thermodynamics, particularly multi-component equilibria and PVT behavior. In contrast, 53% of the schools replying indicate that the computer is not required in their thermodynamics course. Thirty-six percent require 1 to 2 computer problem solutions per course, while the remaining 11% require 3 to 4 solutions. A few schools indicated that the use of the computer was optional, rather than required, in their courses. It appears that the academic emphasis in these [redacted]

"Students find thermodynamics hard to comprehend."

"Relief" (Mentioned in 15% of the replies)

"A little confused." (Mentioned in 10% of the replies)

"They found it difficult but did understand the material."

"He feels that he has learned a great deal. He wishes more time were availabile to concentrate on thermo problems. He is anxious to use his thermo in later courses such as mass transfer."

"All the way from excellent to ugh!"

"They seem to find it interesting and challenging. Many of them prefer the first term where more emphasis is placed on concepts and ideas to the second term where more emphasis is placed on practical applications."

"Students seem pleased with their accomplishments."

"Like leaving the dentist after a thorough cleaning."

"Relief when it is over and shock when it comes back the next year in design."

The most frequently mentioned reactions generally included:

a. The conceptual difficulty of thermodynamics.
b. The hard work demanded by the course.
c. A sense of accomplishment, tempered by a varying degree of uncertainty and confusion.

UNIVERSITY OF ALBERTA

TX: Smith and VanNess, 3rd ed.

UNIVERSITY OF CALIFORNIA-LOS ANGELES

TX: Zemansky, Abbott & VanNess

UNIVERSITY OF COLORADO

TX: Smith & VanNess, 3rd ed.

UNIVERSITY OF KANSAS	UNIVERSITY OF LOUISVILLE

UNIVERSITY OF MICHIGAN

TX: Balzhiser, et al
(Jr, Sem 1 & 2) 3/0

DIFFICULT CONCEPTS
Energy itself. Free energy and

UNIVERSITY OF NEW BRUNSWICK

TX: Smith & VanNess, 3rd ed.
(Soph, Sem 2) 3/0
Denbigh
(Jr, Sem 2) 3/0

NORTHWESTERN UNIVERSITY

TX: Balzhiser, et al
(Soph, Qtr 3) 5/0

DIFFICULT CONCEPTS
Unsteady-state flow processes
entropy; irreversibility.

[illegible]

VANDERBILT UNIVERSITY

TX: Balzhiser, et al
(Jr, Sem 2) 3/0

DIFFICULT CONCEPTS
Entropy, activity, activity coefficient, partial molar properties, chemical potential.

VILLANOVA UNIVERSITY

TX: Smith & VanNess, 3rd ed.
(Sr, Sem 1) 4/0

WIDENER COLLEGE

TX: Sonntag & VanWylan, "Introduction to Thermodynamics"
(Jr, Sem 1) 4/0

DIFFICULT CONCEPTS
Entropy

CHALLENGES
1. The subject is basically difficult to comprehend.
2. Thermodynamics is very comprehensive; therefore good practical examples are needed

QUESTIONNAIRE ON TEACHING OF
THERMODYNAMICS

Instructor________________________________

University________________________________

1. To what extent is the digital computer required in your course?

Are laboratory experiments or demonstrations used to reinforce

...lation of

7. Course Title(s) | Class Hr/Week | Lab Hr/Week

1. ____________________ ________ ________

2. ____________________ ________ ________

8. Level of Course

Course 1 (Circle 2): Jr/Sr 1st/2nd Semester 1st/2nd/3rd Quarter

Course 2 (Circle 2): Jr/Sr 1st/2nd Semester 1st/2nd/3rd Quarter

9. Text(s) and Resources (Author/Title)

Course 1 ____________________
Circle chapters usually covered 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15

Course 2 ____________________

10. Students

Class Size: Course 1 ________ Course 2 ________

Major (ChE, ME): Course 1 ________ Course 2 ________

11. How long is your quarter or semester?

________ weeks per semester/quarter (circle 1)

12. Is there a need for a better textbook in Thermodynamics? In what

PRELIMINARY SURVEY ON UNIT OPERATIONS

The CEEP Subcommittee on Shared Teaching Experiences will conduct a survey over the next few years on the teaching of

NORMALIZED CLASS HOURS

Basis: 117 Hours

	Hours	Reporting
Mass Transfer		
Gas Absorption	9.5	69
Distillation	15.5	69
Liquid Extraction	7.1	67
Total	44.0	

	Hours	Reporting
Heat Transfer		
Conduction	7.9	69
Radiation	4.6	69
Natural Convection	3.5	69
Forced Convection	7.8	68
Heat Exchangers	6.3	69
Evaporation*	1.3	15