SUMMARY REPORT

CHEMICAL ENGINEERING THERMODYNAMICS

A mini-session presented at the

Annual Meeting

American Institute of Chemical Engineers

Los Angeles, California

November 18, 1982

COURSE LEVEL AND FORMAT

Chemical engineering majors take two three-hour courses in thermodynamics in their degree program.

Table 7 shows that about 2/3 of the colleges offer two [redacted] offer only one course. Seven colleges

INTRODUCTION

This is the third survey on the teaching of undergraduate chemical engineering thermodynamics which has been conducted by the Chemical Engineering Education Projects Committee since 1971. The survey in 1973 received 59 replies, while the 1976 survey showed 80 replies. The present survey showed 123 replies, the most received on any survey within the past twelve years.

The attached questionnaire was sent in May, 1982 to the chairman of each chemical engineering department in the United States and Canada (170 departments) together with a cover letter asking him to give the questionnaire to the appropriate faculty member for completion. A follow-up letter was mailed in early September to schools which had not replied.

Some universities offer a core thermodynamics course

TABLE 1

CHEMICAL ENGINEERING

THERMODYNAMICS COURSE LEVEL

Semester Basis

	Number of Courses	
	First Course	Second Course
Sophomore Year		
Semester 1	10	0
Semester 2	14	8
Junior Year		
Semester 1	37	13
Semester 2	10	31
Senior Year		
Semester 1	4	4
Semester 2	0	1
Total Courses	75	57

Students use the computer to solve more than 10% of the homework problems in 46 of 123 schools replying.

Self-paced instuction is used in only 2 of the 219 courses surveyed.

Each of the thermodynamics courses at colleges on the semester system meets 3 hours per week. However, 34 of the courses on the quarter system meet hours per week while 22 meet 4 hours per week.

About half of the courses have three tests per semester while one-fourth have four tests.

ENGINEER-IN-TRAINING EXAMINATION

Only one of the schools replying to the questionnaire requires taking the E.I.T. examination as a condition for graduation. Fifty-four schools reported both the number of graduates and the number of persons taking the E.I.T. test. On

TABLE 3

[redacted]

No. of Sections	Number of Schools	
	[redacted]	Course 2
1-2	65	69
3-4	14	11
5-6	5	1
7+	1	0
Total	85	81

TABLE 4

STUDENT ENROLLMENTS

PER SECTION

No. of Students	Number of Courses	
	Course 1	Course 2

TABLE 2

CHEMICAL ENGINEERING

THERMODYNAMICS COURSE LEVEL

Quarter Basis

	Number of Courses	
	Course 1	Course 2
Sophomore Year		
Quarter 1	1	-
Junior Year		
Quarter 1	6	4
Quarter 2	4	9
Quarter 3	-	5
Senior Year		
[redacted]	[redacted]	[redacted]
Total Courses	17	20

TABLE 6

CORE

THERMODYNAMICS COURSE LEVEL

	No. of Colleges
Sophomore Year	
Semester 1	11
Semester 2	12
Junior Year	
Semester 1	6
Semester 2	1

TABLE 7

NUMBER OF TESTS

	Number of Colleges	
Number of Tests	Semester Basis	Quarter Basis
1	3	3
2	19	16
3	71	24
4	46	12

TABLE 5

CORE COURSES

ANNUAL SECTIONS

Number of Sections Annually	No. of Colleges
1-2	6
3-4	6
5-10	6
10+	2

STUDENT ENROLLMENT

PER SECTION

No. of Students	No. of Courses
< 20	1
21-50	11
51-100	5
101-150	2
151+	1

Sections of core thermodynamics were reported by 30 colleges.

TABLE 9

TEXTBOOKS

Chemical Engineering Courses	No. of Courses
Smith and Van Ness	122
Sandler	16
Balzhiser et. al.	14
Others	11
Total	177

Core Courses

Van Wylen and Sonntag	15
Reynolds and Perkins	5
Others	
No Reply	6
Total	30

TABLE 8

COURSE DESIGNATION

AND QUANTITY

	No. of Colleges	
One ChE courses	31	
[redacted]		
Three ChE courses	6	
One core course	5	
Core + ChE courses	25	
[redacted]		
One course	36	29.7%
[redacted]		
Three courses	6	5.0%

QUESTIONNAIRE ON THE TEACHING OF UNDERGRADUATE THERMODYNAMICS

INSTRUCTOR_____ UNIVERSITY_____

COURSE NO.	TITLE
1.	_____
2.	_____
3.	_____

Answers to the following questions should be based on conditions for the 1981-82 academic year.

	Course Number 1	Course Number 2	Course Number 3
1. Is your school on the semester or quarter system (S or Q?)	_____	_____	_____
2. In which year do most students take this course?(Soph.,Jr.?)	_____	_____	_____
3. In which semester/quarter do most students take this course (1,2,3)?	_____	_____	_____
4. How many sections of this course were offered in [illegible]			
5. What was the average enrollment in each section?	_____	_____	_____
6. In what department was the [illegible] ChE, ME,..)	_____	_____	_____
7. Did graduate teaching assistants present any lectures in this course(Yes/No)?	_____	_____	_____

REPLIES TO QUESTIONNAIRES

The following pages summarize specific replies from the various schools. The entry after "TEXT" is the reply to "In

1. In what ways do you feel the textbook for the ChE Thermodynamics course (not the core course) can be improved?

2. Which concepts do you feel are particularly difficult for the student to grasp?

2. What explanations of these concepts have you found

	Course Number 1	Course Number 2	Course Number 3
9. Is the course required of most engineers (core) or ChE only?			
10. How many of laboratory hours per week are part of this course?			
11. Do students use the computer to solve more than 10% of the homework problems in this course? (Yes/No)			
12. How many 50-minute lectures are given each week?			
13. How many weeks are there in your semester/quarter?			
14. How many major tests, excluding final exam, do you give in the course?			
15. Does the course use formal self-paced instruction?			

QUESTIONNAIRE ON THE TEACHING OF UNDERGRADUATE THERMODYNAMICS

Course No. TEXT (AUTHOR, TITLE) (Circle chapters covered)

1. [redacted]

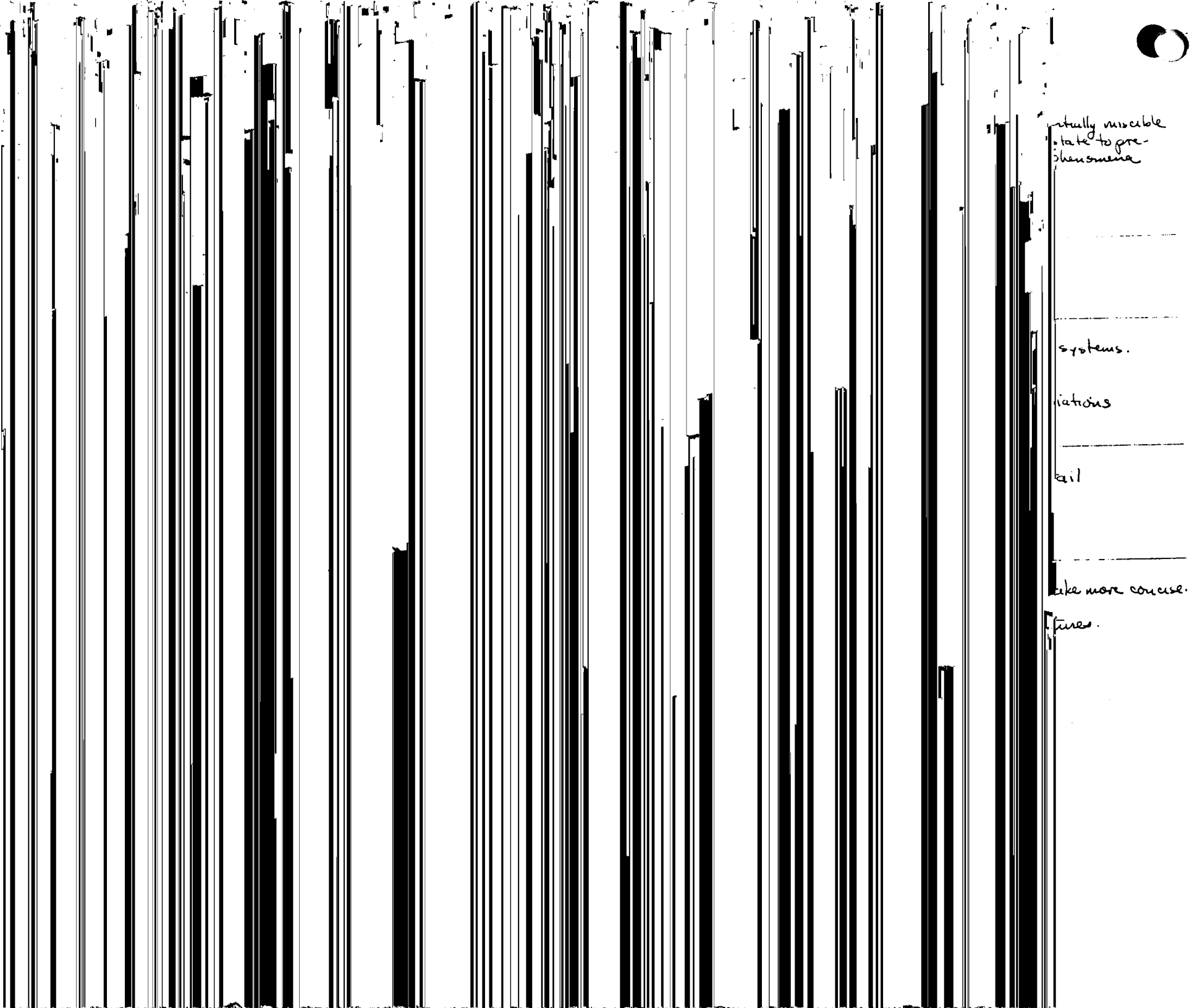
1 2 3 4 5 6 7 8 9 10 11 12 13 14

3.

1 2 3 4 5 6 7 8 9 10 11 12 13 14

Survey on the Engineering in Training Examination

Most states require two 8-hour written examinations plus a number of years of experience before issuing a Professional Engineer license. The first test, called the EIT exam, is often taken during the senior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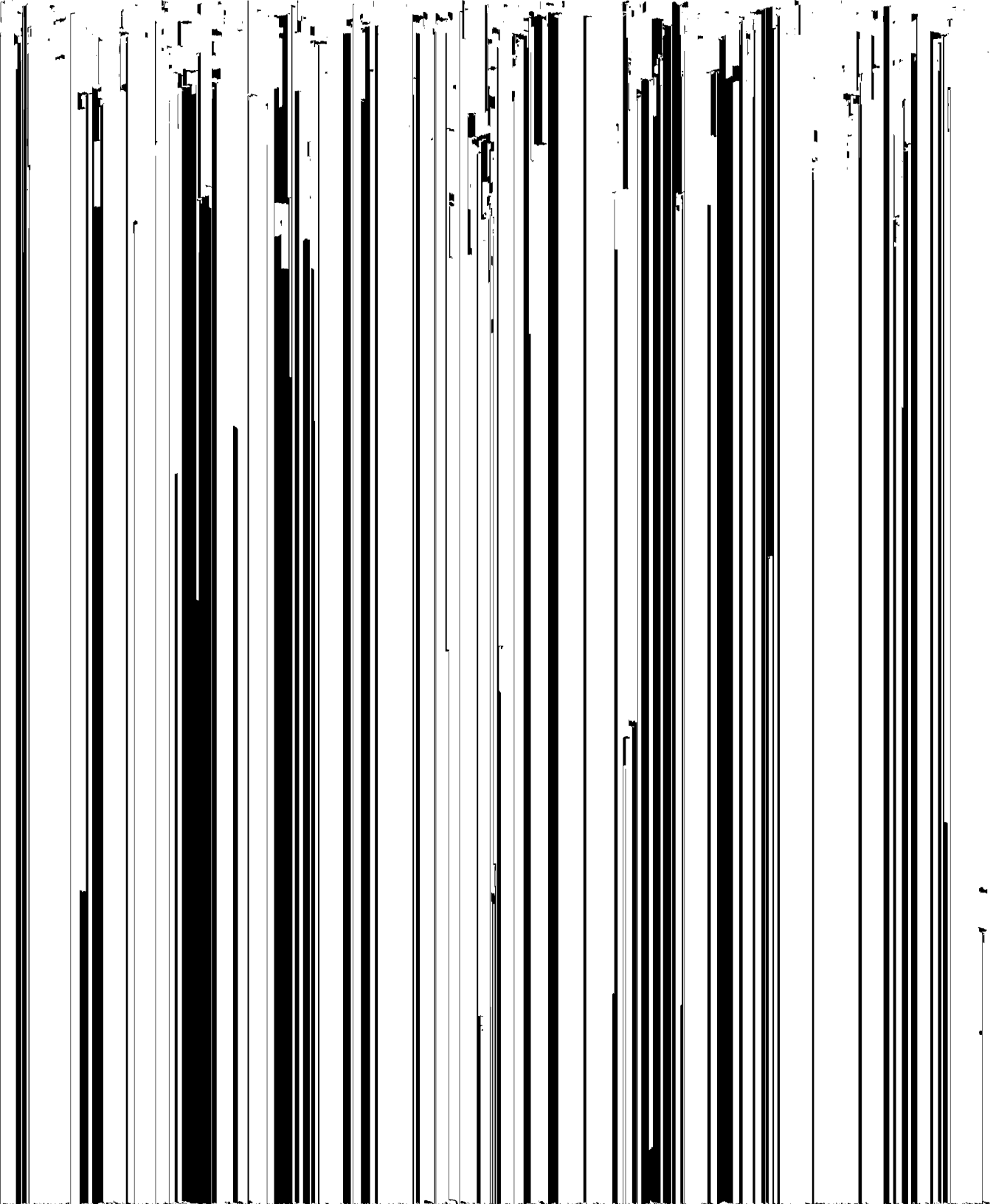
Second law

[redacted]



re is worse than before. Currently the
and reaction equilibria are complex
Material on flow, refrigeration & power
sometimes wrong.

quilibria

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ons for shaft work of ideal gases are
enough. Much of chapter 10 should be
hapter 2. Concept of availability should
hapter 5

gy, availability, lost work.

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of chapters should be 1-6, 10-12, 7-9, 13

y. Development of fundamental property

Law, fugacity.

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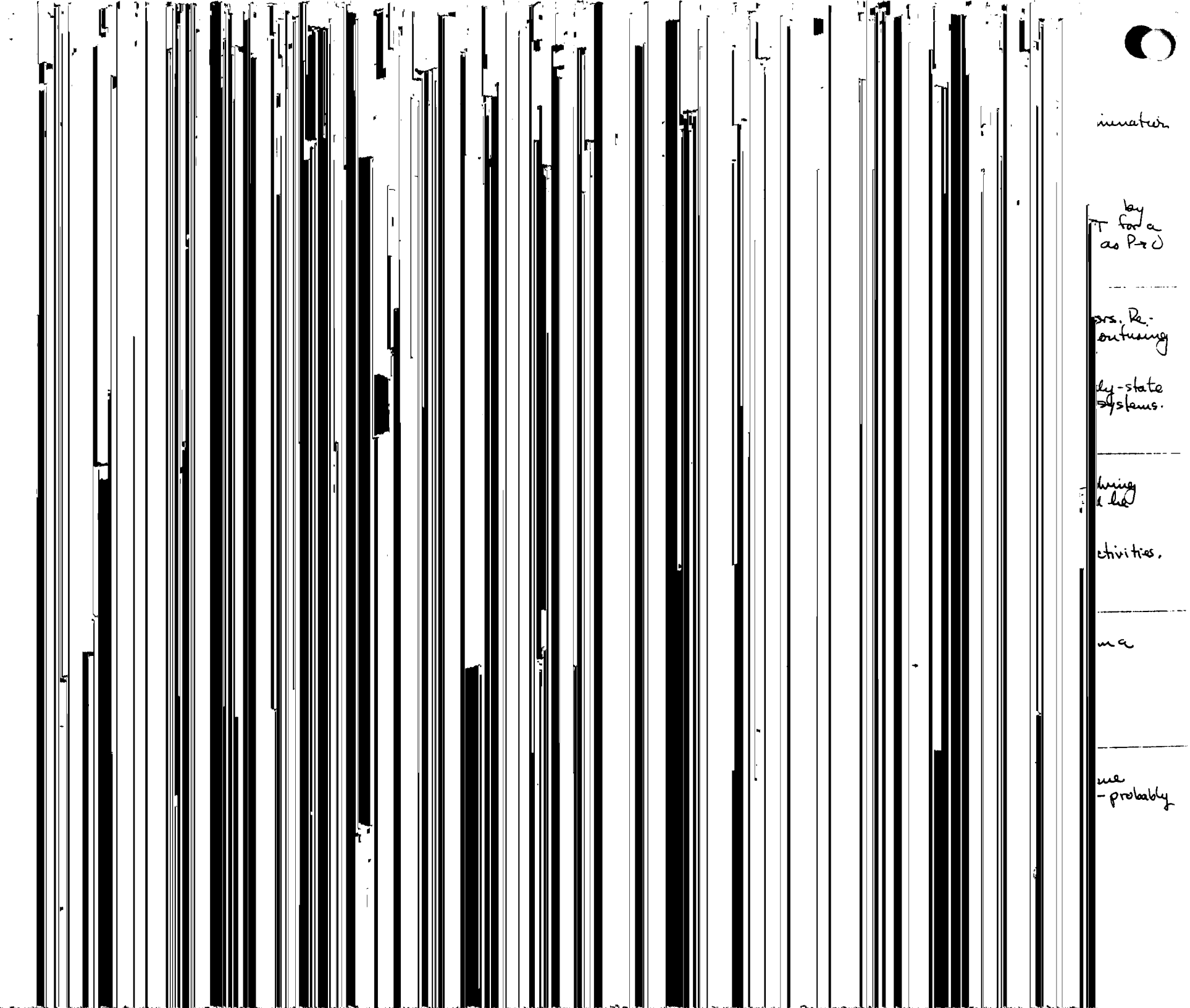
ive derivations. Too many different
ols. Too many archaic equations of
l examples

g. Multicomponent phase equilibria



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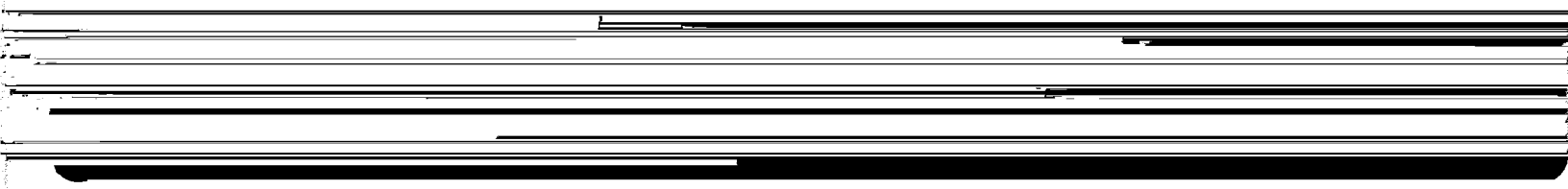

VILLANOVA U.

TEXT (SVN): Improvements in example and homework problems.

Diff Concepts: Entropy, Reversibility, Fugacity.

VIRGINIA, U. of

TEXT: No text is really (a) readable (b) has good example problems (c) has good homework problems.

Diff Concepts: Equilibrium in reacting systems.

Explanations: Use fuel cell examples and other practical examples.

WASHINGTON U.

TEXT (SVN): Better organization of material in chapter 7.

Diff. Concepts: Solution thermodynamics.

WATERLOO, U. of

TEXT (SVN): Consistency of notation & conventions. Abolishing some prejudices of the authors.

Diff Concepts: All the abstract functions are anathemas for most students.

WEST VIRGINIA, U. of

TEXT (Syndler): More computer examples, especially in phase and chemical equilibria (chapters 8 and 9). More homework problems.

Diff Concepts: fugacity, second law, combined phase and chemical equilibria.

WISCONSIN-MADISON, U. of.

TEXT (SVN): Use consistent nomenclature. Chapter 10 could be moved up to near chapter 3. No mention of K_y and the like in chemical reaction equilibria

Diff. Concepts: Excess and mixing property. Reference states Infinite dilution properties