SUMMARY REPORT

TEACHING OF UNDERGRADUATE HEAT TRANSFER AND FLUID FLOW

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INTRODUCTION

A preliminary survey was made in 1976 to estimate classroom time allocations to those topics generally referred to as the unit operations. This survey indicated that 1/4 of the total time was devoted to heat transfer, 1/4 to fluid flow, 3/8 to mass transfer and the remaining 1/8 to all other topics. The 1977 survey deals with one-half of unit operations; namely, heat transfer and fluid flow. Mass transfer will be surveyed next year.

The questionnaires consist of three sheets. The first two apply to both heat transfer and fluid flow. The third sheet requests time allotments to subject areas for each respective course. The two questionnaires were sent in April, 1977 to the Chairman of each Chemical Engineering Department in the United States and Canada, together with a cover letter asking that the appropriate faculty members complete and return the questionnaires. A follow-up letter was sent in August to those schools which had not responded by then. Of the 156 universities contacted, 92 sent replies. Six schools replied too late for inclusion in this report.

SI SYSTEM OF UNITS

The American Chemical Society requires SI units in all papers submitted to its journal. AIChE will follow this practice in 1979. The trend to SI units suggested by the actions of these two organizations is confirmed in the present survey. Only one-fourth of the courses use English units as the principal system of dimensions; about 2/3 use both systems. However, over 80% of the professors surveyed expect the trend to SI units to continue over the next five years.

Several instructors mentioned a need in the near future for textbooks using SI units. It will be interesting to notice the action of the authors of present textbooks to this trend. Will the first text using SI dimensions have a significant advantage in competing for future course adoptions?

Unit Systems Used in Present Courses

English Units	27%
SI Units	5%
Both Units	68%

Trend Toward SI Units in the Next 5 Years?

Yes	83%
No	17%

TEXTBOOKS

Seventeen textbooks are used in the heat transfer and fluid flow courses surveyed. Eleven titles were used in heat transfer and thirteen in fluid flow. Four texts were prominently named in both courses. Looking ahead to next year's survey, each of these books also deals with mass transfer. One heat transfer book and one fluid flow book also received significant mention. The complete list of texts is given in the bibliography.

The first edition of McCabe and Smith dates from 1956, while Bird, Stewart and Lightfoot was published in 1960. There seems to be a trend for later texts to blend important features of both the unit operations and transport theory approaches. Several instructors mentioned the need for a text which adequately combines (to their individual taste) these approaches. The popularity of the texts by Bennett, et al and Welty, et al, both relatively recent, seems to reflect this need.

PERCENT OF COURSES USING RESPECTIVE TEXTS

Authors (Publication Year)		Heat Transfer	Fluid Flow
McCabe and Smith	(1967)	32%	30%
Bird, Stewart and Lightfoot	(1960)	14%	16%
Bennett and Myers	(1974)	15%	20%
Holman	(1972)	13%	-
Welty, Wicks and Wilson	(1969)	13%	7%
Streeter and Wylie	(1975)	-	7%
Others		13%	20%

COURSE ORIENTATION

Unit Operations and Transport Theory have enjoyed strong but cyclic popularity over the past two decades. The present situation is a coexistence of these two approaches, with unit operations being only a slight favorite. A number of instructors have indicated that their course uses both approaches. In fluid flow, several instructors chose to describe their course as fluid mechanics as distinguished from transport or unit operations orientation.

Course Orientation	Heat Transfer	Fluid Flow
Unit Operations	40%	38%
Transport Theory	35%	30%
Both of the Above	25%	15%
Fluid Mechanics	-	18%

COURSE LEVEL AND CLASSTIME

Both heat transfer and fluid flow are junior level courses at over 80% of the universities surveyed. The replies also indicate that generally fluid flow is taught before heat transfer.

One fourth of the courses in heat transfer and in fluid flow include laboratory work as part of the course credit. An average of 2.2 hours per week is devoted to the laboratory.

Course Level - Semester Basis	Heat Transfer	Fluid Flow
Sophomore Year	3%	18%
Junior, Semester 1	53%	56%
Junior, Semester 2	32%	15%
Senior Year	12%	11%

Course Level - Quarter Basis	Heat Transfer	Fluid Flow
Sophomore Year	0	7%
Junior, Quarter 1	33%	46%
Junior, Quarter 2	39%	17%
Junior, Quarter 3	14%	23%
Senior Year	14%	7%

STUDENT REACTIONS

Student reactions in general appear to be considerably milder than toward other chemical engineering courses, such as thermodynamics. The student appreciates the practical orientation of the course. A few representative comments are quoted below:

"Very useful course."

"Satisfactory to excellent."

"They generally understand the course."

"Generally satisfied with level and workload."

"We have learned alot."

"Tough, demanding but worthwhile course which uses all of their background in mathematics and basic science."

"He has learned some real engineering."

CLASSROOM TEACHING SUPPLEMENTS

A recent project of the Chemical Engineering Education Projects Committee was the preparation of a list of audio-visual aids available for chemical engineering instruction. Just over 50% of the schools replying indicated that neither audio-visual aids nor demonstrations were used in the classroom. It may be assumed that student experience with equipment is relegated to the laboratory. Several instructors mentioned the use of personally made slides of different types of equipment, such as venturi and orifice meters, heat exchangers and heat transfer equipment. About 37% of the instructors in fluid flow use films to supplement textbook instruction. The films produced by Shapiro at M.I.T. were often mentioned. Some sources of visual aids mentioned on the questionnaire are listed below:

Film Sources

National Science Foundation
Encyclopedia Brittanica
Mixing Equipment Corporation
National Committee for Fluid Mechanics Films
Massachusetts Institute of Technology
C. F. Braun Company

COURSE STRUCTURE

Approximately two dozen topics were selected from textbooks frequently used in heat transfer and fluid flow courses. Instructors were asked to show the number of class sessions spent on the respective topics and to other topics. The results were added and normalized to a 40-session course plan. This is equivalent to a 15-week course meeting three times a week, with 5 sessions for quizzes. Replies to this

section of the questionnaire were received on 70% of the heat transfer responses and 79% of the fluid flow responses. The Topic Time Allocations are given on the following pages. Approximately 8-10% of the classtime is devoted to topics other than those listed.

REPLIES TO QUESTIONNAIRES

The replies to the heat transfer and fluid flow questionnaires received from each school are summarized on the following pages. The following form is used:

NAME OF UNIVERSITY

TX:	Authors of text(s). Complete listings are given in the bibliography. (Year/Semester/Class hours - lab hours) Jr/S2/3-0 indicates a course with 3 hours classroom, 0 hours lab given in the second semester of the junior year.
Dimensions:	English, SI or both systems.
Trend to SI:	Is there a significant trend to SI expected in the next 5 years?
Orientation:	Unit operations or transport theory.
CHE Lab:	Number of courses and number of experiments.
Difficult Topics:	What subject areas seem most difficult for the students to grasp.
Text Comments:	Comments on strength and weaknesses of the text.

HEAT TRANSFER

TOPIC TIME ALLOCATIONS

Dimensional Analysis	1.6	1.6
Steady State Conduction in One Dimension		6.6
Plane Systems	2.2	
Radial Systems	1.8	
Heat Source Systems	1.2	
Fins	1.4	
Steady State Conduction in Two Dimensions		1.2
Curvilinear Squares	0.6	
Relaxation	0.6	
Unsteady State Conduction		2.6
Lumped Heat Capacity	1.4	
Heisler Charts	0.8	
Schmidt Plot	0.4	
Boundary Layer Theory	1.8	1.8
Forced Convection Correlations		5.4
Pipes/tubes	3.0	
Cylinders/spheres	1.4	
Tube banks	1.0	
Natural Convection Correlations		3.3
Flat Plates	1.2	
Cylinders/spheres	1.1	
Combined Natural & Forced Convection	1.0	
Radiation		5.2
Mechanism	1.7	
Shape Factors	1.6	
Gray Bodies	1.2	
Gas Radiation	0.4	
Solar Radiation	0.3	
Phase Change		2.9
Condensation	1.6	
Boiling	1.3	
Heat Exchangers		6.2
Overall Coefficient	2.6	
Fouling Factors	1.1	
Shell Side Coefficients	1.6	
Pressure Drops	0.9	
Other Topics	3.2	3.2
TOTAL	40.0	40.0

FLUID FLOW

TOPIC TIME ALLOCATIONS

Properties/Definitions		1.8
Viscosity; Mass, Force Units	1.8	
Fluid Statics		3.0
Manometers	1.3	
Buoyancy, Flotation	0.6	
Plane Surfaces	0.8	
Curved Surfaces	0.3	
Flow Equations		7.6
Continuity	2.3	
Bernoulli	2.7	
Conservation of Momentum	2.6	
Incompressible Flow		11.8
Laminar/Turbulent Flow	3.8	
Friction Factors	2.0	
Equivalent Length of Fittings	1.0	
Boundary Layer, Velocity Distribution	2.5	
Piping Systems	2.5	
Compressible Flow		2.3
Isothermal	0.8	
Isentropic	0.7	
Non-isothermal	0.5	
Sonic Velocity	0.3	
Ideal Fluid Flow	1.6	1.6
Dimensional Analysis	2.0	2.0
Non-Newtonian Fluids	1.0	1.0
Fluid Measurement		2.8
Orifice, Venturi	1.9	
Pitot tube, others	0.9	
Fluid Machinery		2.2
Pumps	1.8	
Turbines	0.4	
Other Topics	3.9	3.9
TOTAL	40.0	40.0

UNIVERSITY OF [illegible]

TX: McCabe & Smith (Jr/Q1/2-3)

Dimensions: Both
Trend to SI: Yes
Orientation: Unit Op.
CHE Lab: No

ARIZONA STATE UNIVERSITY

TX: Sisson & Pitts "Elements of Transport Phenomena" (Jr,Sr/S1,S2/4-0)

Dimensions: Both
Trend to SI: Yes
Orientation: Transport
CHE Lab: 1 course, 12 experiments

Text Comments: Present text has many errors, and does not have good definitions of macroscopic balances.

UNIVERSITY OF ARKANSAS

TX: McCabe & Smith (Jr/S1/3-0)

Dimensions: English
Trend to SI: Yes
Orientation: Unit Op.
CHE Lab: 2 courses

BRIGHAM YOUNG UNIVERSITY

TX: Holman (Jr/S1/3-0)

Dimensions: Both
Trend to SI: Yes
Orientation: Unit Op.
CHE Lab: 2 courses, 10 experiments

Difficult Topics: Differential balances.

UNIVERSITY OF CALIFORNIA (SANTA BARBARA)

TX: Bennett & Myers (Jr/Q1/3-0)

Dimensions: Both
Trend to SI: Yes
Orientation: Both
CHE Lab: 2 courses, 8 experiments

Difficult Topics: Concept of a convective heat transfer coefficient.

CALIFORNIA UNIVERSITY

TX: Bennett & Myers (Jr/S2/3-0)

Dimensions: Both
Trend to SI: Yes
Orientation: Transport
CHE Lab: 2 courses, 21 experiments

Difficult Topics: Unsteady state conduction; condensation; analogies

Text Comments: Need for a text half-way between transport phenomena and unit operations coverage.

UNIVERSITY OF CINCINNATI

TX: Holman (Jr/Q2/4-0)

Dimensions: English
Trend to SI: No
Orientation: Transport
CHE Lab: 3 courses, 20 experiments

Difficult Topics: Convective theory.

CLARKSON COLLEGE

TX: Bennett & Myers (Jr/S1/3-0)

Dimensions: Both
Trend to SI: Yes
Orientation: Transport
CHE Lab: 1 course, 10 experiments

Difficult Topics: Relationship between mathematical developments and the physical applications.

CLEMSON UNIVERSITY

TX: McCabe & Smith (Jr/S1/3-0)

Dimensions: English
Trend to SI: Yes
Orientation: Unit Op.
CHE Lab: 2 courses, 10 experiments

Text Comments: Old edition of McCabe & Smith seems better than new.

COLORADO SCHOOL OF MINES

TX: McCabe & Smith; Bird, Stewart & Lightfoot (Jr/S1/3-0)

Dimensions: English
Trend to SI: Yes
Orientation: Both
CHE Lab: 1 course, 14 experiments

Difficult Topics: Mathematical modeling of physical problems.

UNIVERSITY OF DAYTON

TX: Bird, Stewart & Lightfoot (Jr/S2/3-0)

Dimensions: Both
Trend to SI: Possible
Orientation: Transport Phenomena
CHE Lab: 1 course, 5 experiments

UNIVERSITY OF DELAWARE

TX: Bird, Stewart & Lightfoot; Forest (Jr/S1/3-0)

Dimensions: Both
Trend to SI: No
Orientation: Both
CHE Lab: 2 courses

Difficult Topics: Fundamental understanding of physics behind convective transport equations.

[illegible]RSITY OF DETROIT

TX: Bennett & Myers (Jr/S2/4-0)

Dimensions: Both
Trend to SI: Yes
Orientation: Unit Op.
CHE Lab: 1 course, 15 experiments

Difficult Topics: Boundary layer theory, gas radiation.

Text Comments: I would like to see a new version of McAdams brought out.

GEORGIA INSTITUTE OF TECHNOLOGY

TX: Bird, Stewart & Lightfoot (Jr/Q1/3-0)

Dimensions: Both
Trend to SI: Yes
Orientation: Transport
CHE Lab: 4 courses, 18 experiments

GROVE CITY COLLEGE

TX: Holman (Jr/S1/3-0)

Dimensions: Both
Trend to SI: Yes
Orientation: Unit Op.
CHE Lab: None

UNIVERSITY OF IDAHO

TX: Thomson & Scheldorf "The Rates of Transport Processes" (Sr/S1/4-2)

Dimensions: Both
Trend to SI: No
Orientation: Both
CHE Lab: No

Difficult Topics: Relating physical phenomena to mathematical models.

IOWA STATE UNIVERSITY

TX: McCabe & Smith; Bennett & Myers (Jr/Q2/3-0)

Dimensions: Both
Trend to SI: No
Orientation: Unit Op.
CHE Lab: 2 courses, 8 experiments

UNIVERSITY OF KENTUCKY

TX: Holman (Jr/S2/3-0)

Dimensions: SI
Trend to SI: Yes
Orientation: Unit Op.
CHE Lab: 2 courses, 8 experiments

LAMAR UNIVERSITY

TX: Holman (Jr/S1,S2/3-0)

Dimensions: SI
Trend to SI: Yes
Orientation: Unit Op.
CHE Lab: None

Difficult Topics: Radiation

UNIVERSITY OF CALIFORNIA-L[illegible]

TX: Bird, Stewart & Lightf[illegible] McCabe & Smith (Sr/Q1/4-0)

Dimensions: Both
Trend to SI: Yes
Orientation: Both
CHE Lab: 2 courses, 16 experiments

Difficult Topics: Diffusive mass transfer theory.

LOUISIANA STATE UNIVERSITY

TX: Bird, Stewart & Lightfoot; (Jr/S1/4-0)
McCabe & Smith (Sr/S1/4-0)

Dimensions: English
Trend to SI: Yes
Orientation: Both
CHE Lab: 3 courses, 12 experiments

Difficult Topics: Partial differential equations.

UNIVERSITY OF LOUISVILLE

TX: McCabe & Smith (Sr/S1/3-4)

Dimensions: English
Trend to SI: Yes
Orientation: Unit Op.
CHE Lab: None

UNIVERSITY OF LOWELL

TX: McCabe & Smith (Jr/S1/3-0)

Dimensions: Both
Trend to SI: No
Orientation: Unit Op.
CHE Lab: 2 courses, 8 experiments

Difficult Topics: Unsteady state heat flow.

UNIVERSITY OF MARYLAND

TX: Bennett & Myers (Jr/S2/3-0)

Dimensions: English
Trend to SI: Yes
Orientation: Transport
CHE Lab: None

MASSACHUSETTS INSTITUTE OF TECHNOLOGY

TX: Bird, Stewart & Lightfoot (Jr/S1/4-0)

Dimensions: Both
Trend to SI: No
Orientation: Transport
CHE Lab: 3 courses, 20 experiments

MC NEESE STATE UNIVERSITY

TX: Holman (Jr/S1/3-0)

Dimensions: English
Trend to SI: Yes
Orientation: Unit Op.
CHE Lab: 1 course, 10 experiments

MICHIGAN STATE UNIVERSITY

TX: Bennett & Myers (Jr/S2/5-0)
Orientation: Transport

MICHIGAN TECH UNIVERSITY

TX: McCabe & Smith; Bird, Stewart & Lightfoot (Jr/Q2/3-0)
Dimensions: Both
Trend to SI: Yes
Orientation: Both
CHE Lab: 3 courses
Difficult Topics: Transport Phenomena
Text Comments: Need a junior level transport phenomena text.

UNIVERSITY OF MICHIGAN

TX: Tek & Wilkes, "Fluid Flow and Heat Transfer" (So/Jr/S1/3-0)
Dimensions: English
Trend to SI: No
Orientation: Fluid Flow
CHE Lab: 1 course, 13-15 experiments

UNIVERSITY OF MISSISSIPPI

TX: Welty, Wicks & Wilson (Jr/S1/3-0 7 weeks)
Dimensions: English
Trend to SI: Yes
Orientation: Transport
CHE Lab: 1 course, 6 experiments
Difficult Topics: Radiation

UNIVERSITY OF MISSOURI-COLUMBIA

TX: Bennett & Myers (Jr/S2/3-0)
Dimensions: Both
Trend to SI: Yes
Orientation: Transport
CHE Lab: None

UNIVERSITY OF MISSOURI-ROLLA

TX: Bennett & Myers (Jr/S1/3-0)
Dimensions: English
Trend to SI: No
Orientation: Unit Op.
CHE Lab: 1 course, 7 experiments
Difficult Topics: Differential balances

MONTANA STATE UNIVERSITY

TX: McCabe & Smith (Jr/Q2/4-0)
Dimensions: Both
Trend to SI: Yes
Orientation: Unit Op.
CHE Lab: 3 courses, 12 experiments
Difficult Topics: Radiation

UNIVERSITY OF NEBRASKA

TX: McCabe & Smith (Jr/S2/3-0)
Dimensions: Both
Trend to SI: Yes
Orientation: Unit Op.
CHE Lab: 1 course, 4 experiments
Difficult Topics: Learning reasonable values of U's; making trial and error calculations.

UNIVERSITY OF NEW HAMPSHIRE

TX: McCabe & Smith (Jr/S1/3-2)
Dimensions: Both
Trend to SI: Yes
Orientation: Unit Op.
CHE Lab: None
Difficult Topics: Parts of radiation.

UNIVERSITY OF NORTH DAKOTA

TX: Bird, Stewart, Lightfoot; McCabe & Smith (Jr/S1,S2/4-0,3-0) (Parts of two courses)
Dimensions: Both
Trend to SI: Yes
Orientation: Both
CHE Lab: 1 course, 12 experiments
Text Comments: An updated Bird, Stewart & Lightfoot would be helpful.

NORTHWESTERN UNIVERSITY

TX: Holman (Sr/Q2/4-0)
Dimensions: Both
Trend to SI: Yes
Orientation: Unit Op.
CHE Lab: 1 course, 6 experiments

UNIVERSITY OF NOTRE DAME

TX: Welty, Wicks & Wilson (Jr/S1/3-0)
Dimensions: Both
Trend to SI: Yes
Orientation: Transport
CHE Lab: 1 course
Difficult Topics: Differential balances
Text Comments: There should be a text that combines unit operations with transport phenomena at the undergraduate level.

OHIO UNIVERSITY

TX: McCabe & Smith (Jr/Q2/5-0)
Dimensions: Both
Trend to SI: Yes
Orientation: Unit Op.
CHE Lab: 2 courses, 20 experiments

OREGON STATE UNIVERSITY

TX: Welty, Wicks & Wilson (Jr/Q3/4-0)
Dimensions: Both
Trend to SI: Yes
Orientation: T.P.
CHE Lab: 2 courses, 10-15 experiments
Difficult Topics: Radiation concepts, particularly gas radiation.

UNIVERSITY OF PITTSBURGH

TX: McCabe & Smith (Jr/S1/3-1)
Dimensions: Both
Trend to SI: Yes
Orientation: Unit Op.
CHE Lab: 2 courses, 12 experiments
Difficult Topics: Radiation; heat; momentum analogies.

PURDUE UNIVERSITY

TX: Greenkorn & Kessler (Jr/Q1,Q2,Q3/ 3 wks @ 5hr/wk)
Dimensions: Both
Trend to SI: No
Orientation: Both
CHE Lab: 1 course, 12 experiments

UNIVERSITY OF ROCHESTER

TX: Bennett & Myers (Jr/S1/3-0)
Dimensions: Both
Trend to SI: Yes
Orientation: Transport
CHE Lab: 5 courses, 25 experiments
Difficult Topics: Macroscopic balances.

ROSE-HULMAN INSTITUTE OF TECHNOLOGY

TX: Holman (Jr/Q1/4-0
Dimensions: SI
Trend to SI: Yes
Orientation: Unit Op.
CHE Lab: 1 course, 4 experiments
Text Comments: More equipment applications, like Kern.

SOUTH DAKOTA SCHOOL OF MINES AND TECH.

TX: Bennett & Myers (Jr/S1/3-0)
Dimensions: English
Trend to SI: Yes
Orientation: Transport
CHE Lab: 2 courses, 10-12 experiments
Difficult Topics: Design equations for convective, boiling and condensing heat transfer are confusing because the subjects are presented too superficially.
Text Comments: Instead of trying to incorporate all of unit operations into a single text, sequential texts (same nomenclature and terminology) might be advisable.

STANFORD UNIVERSITY

TX: Sissom & Pitts: "Elements of Transport Phenomena" (Sr/Q2/3-2)
Dimensions: Both
Trend to SI: Yes
Orientation: Transport
CHE Lab: 2 courses, 10 experiments
Difficult Topics: Boundary layer; vector analysis.

UNIVERSITY OF SYRACUSE

TX: Bennett & Myers (Jr/S1/3-0)
Dimensions: English
Trend to SI: No
Orientation: Transport
CHE Lab: 2 courses, 12 experiments
Difficult Topics: Derivation of Reynolds' Analogy and Prandtl-Taylor analysis.

UNIVERSITY OF TENNESSEE

TX: McCabe & Smith (Jr/Q1/3-2)
Dimensions: Both
Trend to SI: Yes
Orientation: Unit Op.
CHE Lab: No
Difficult Topics: Natural convection.
Text Comments: Combine transport phenomena and unit op. texts.

UNIVERSITY OF TEXAS-AUSTIN

TX: McCabe & Smith; Bird, Stewart & Lightfoot (Jr/S1/3-1)
Dimensions: English
Trend to SI: No
Orientation: Both
CHE Lab: 2 courses, 16 experiments
Difficult Topics: Radiation; open ended problems.

TEXAS TECH UNIVERSITY

TX: Foust (So/S2/3-0)
Dimensions: Both
Trend to SI: Yes
Orientation: Unit Op.
CHE Lab: 2 courses, 8-10 experiments
Difficult Topics: Transport coefficients
Text Comments: Foust needs to be updated. There is a real need for a course which blends the concepts of transport phenomena with classical unit operations coverage.

TUFTS UNIVERSITY

TX: McCabe & Smith (Jr/S1/3-0)
Dimensions: Both
Trend to SI: Yes
Orientation: Unit Op.
CHE Lab: 1 course, 6 ex[illegible]ents

TULANE UNIVERSITY

TX: Bennett & Myers (Jr/S1/4-0)

Dimensions: English
Trend to SI: Yes
Orientation: Transport
CHE Lab: 1 course, 8 experiments

UNIVERSITY OF TULSA

TX: Kreith (Jr/S1,S2/3-0)

Dimensions: Mostly English
Trend to SI: Yes
Orientation: Unit Op.
CHE Lab: 2 courses, 16-20 experiments

UNIVERSITY OF UTAH

TX: Kreith (Jr/Q2/4-0)

Dimensions: SI
Trend to SI: Yes
Orientation: Both
CHE Lab: 3 courses, 10 projects

Difficult Topics: Radiation, dimensional analysis, analogies, unsteady state.
Text Comments: Problems and examples should correspond better with reality or industrial practice.

VILLANOVA UNIVERSITY

TX: McCabe & Smith (Jr/S1/4-0)

Dimensions: English
Trend to SI: Yes
Orientation: Units Op.
CHE Lab: 3 courses, 24 experiments

Difficult Topics: Heat transfer analogies; condensation and boiling heat transfer coefficients.

VIRGINIA POLYTECHNIC INSTITUTE AND STATE UNIVERSITY

TX: Welty, Wicks & Wilson (Jr/Q2/5-0)

Dimensions: Both
Trend to SI: Yes
Orientation: Transport
CHE Lab: 1 course, 7 experiments

Difficult Topics: Highly mathematical topics, such as boundary conditions for partial differential equations.

WIDENER COLLEGE

TX: Welty, Wicks & Wilson (Sr/S1/3-2)

Dimensions: Both
Trend to SI: Yes
Orientation: T.P.
CHE Lab: None

Difficult Topics: Mathematics.

UNIVERSITY OF WASHINGTON (SEATTLE)

TX: Kreith (Jr/Q3/3-0)

Dimensions: Both
Trend to SI: Yes
Orientation: Unit Op.
CHE Lab: 2 courses, 6 experiments

UNIVERSITY OF WISCONSIN-MADISON

TX: McCabe & Smith; Bird, Stewart & Lightfoot (Jr/S1/3-2)
(2 courses) (Jr/S1/3-0)

Dimensions: Both
Trend to SI: Yes
Orientation: Both
CHE Lab: 2 courses, 17 experiments

WORCESTER POLYTECHNIC INSTITUTE

TX: Holman (Jr/Q1/7-0)

Dimensions: SI
Trend to SI: Yes
Orientation: Transport
CHE Lab: 1 course

Difficult Topics: Radiation
Text Comments: Could use more material on fundamentals of heat transfer.

RENSSELAER POLYTECHNIC INSTITUTE

TX: Holman (Jr/S2/3-0)

Dimensions: Both
Trend to SI: Yes
Orientation: T.P.
CHE Lab: 1 course, 6 experiments

Difficult Topics: Multi-dimensional conduction; convection in cross-flow; setting up boundary conditions.
Text Comments: Basically well written, but convective part definitely needs improvement.

BUCKNELL UNIVERSITY

TX: McCabe & Smith; (Jr/S1/3-3)
Welty, Wicks & Wilson

Dimensions: English
Trend to SI: Yes
Orientation: Both
CHE Lab: No

Difficult Topics: Shell balances; radiation.

ECOLE POLYTECHNIQUE DE MONTREAL

TX: Kreith (Jr/S2/4-1)

Dimensions: SI
Trend to SI: Yes
Orientation: Transport
CHE Lab: 3 courses, 15 experiments

Difficult Topics: Heat transfer with change in phase (evaporators).

[illegible]EAD UNIVERSITY

TX: McCabe & Smith (Jr/S2/2-3)

Dimensions: Both
Trend to SI: Yes
Orientation: Unit Op.
CHE Lab: None

Text Comments: It seems that in our rush toward computer applications, mathematical modeling and the use of higher math, we are losing sight of the practical knowledge that is needed to give students confidence in their area of expertise.

NOVA SCOTIA TECHNICAL COLLEGE

TX: McCabe & Smith (Jr/S2/3-0)

Dimensions: Both
Trend to SI: Yes
Orientation: Unit Op.
CHE Lab: 1 course, 4-5 experiments

Difficult Topics: Convective heat transfer coefficients, geometrical factors in radiation, conduction with heat sources.

QUEENS UNIVERSITY

TX: Welty, Wicks & Wilson (Jr/S1/3-2)
McCabe & Smith (Jr/S2/3-2)

Dimensions: Both
Trend to SI: Yes
Orientation: Both
CHE Lab: 2 courses, 10 experiments

ROYAL MILITARY COLLEGE

TX: McCabe & Smith; (Jr/S2/3-0)
Welty, Wicks & Wilson (5 weeks)

Dimensions: Both
Trend to SI: Yes
Orientation: Both
CHE Lab: 2 courses, 14 experiments

UNIVERSITY OF WESTERN ONTARIO

TX: Personal Notes (Jr/S2/3-1)

Dimensions: Both
Trend to SI: Yes
Orientation: Transport
CHE Lab: None

UNIVERSITY OF WINDSOR

TX: Greenkorn & Kessler (Jr/S2/3-3)

Dimensions: Both
Trend to SI: Yes
Orientation: Transport
CHE Lab: No

Fluid Flow

UNIVERSITY OF AKRON

TX: McCabe & Smith (Jr/S1/2-3)

Dimensions: Both
Trend to SI: Yes
Orientation: Unit Op.
CHE Lab: None

UNIVERSITY OF ARIZONA

TX: McCabe & Smith; (So/S2/3-0)
Bird, Stewart, (Jr/S2/3-0)
Lightfoot (2 courses)

Dimensions: Both
Trend to SI: Yes
Orientation: Unit Op.
CHE Lab: 2 courses, 13 experiments

Difficult Topics: Practical topics, such as pump sizing, heat exchangers, etc.

Text: Foust, 2nd ed., is eagerly awaited.

UNIVERSITY OF ARKANSAS

TX: McCabe & Smith (Jr/S1/3-0)

Dimensions: English (75%); SI (25%)
Trend to SI: Gradual
Orientation: Unit Op.
CHE Lab: 2 courses, 12 experiments

Text: Lacks section on pump characteristic curves.

BRIGHAM YOUNG UNIVERSITY

TX: DeNevers (Jr/S1/3-0)

Dimensions: Both
Trend to SI: Yes
Orientation: Unit Op.
CHE Lab: 2 courses, 10 experiments

Difficult Topics: Application of differential transport equations to real problems.

BUCKNELL UNIVERSITY

TX: McCabe & Smith (So/S2/3-0)

Dimensions: English
Trend to SI: Yes
Orientation: Unit Op.
CHE Lab: No

Difficult Topics: Shell balances; control volume.

UNIVERSITY OF CALIFORNIA, BERKELEY

TX: McCabe & Smith (Jr/Q1/3-1)

Dimensions: Both
Trend to SI: No
Orientation: Unit Op.
CHE Lab: 2 courses, 6 experiments

Difficult Ar... Mathematical skills, cle... ntation of written rep...

UNIVERSITY OF CALIFORNIA (SANTA BARBARA)

TX: Bennett & Myers (Jr/Q1/4-0)

Dimensions: Both
Trend to SI: Yes
Orientation: Both
CHE Lab: 2 courses, 8 experiments

Difficult Topics: Differential momentum balance and boundary layers.

CATHOLIC UNIVERSITY

TX: Bennett & Myers (Jr/S2/3-0)

Dimensions: Both
Trend to SI: Yes
Orientation: Transport
CHE Lab: 2 courses, 21 experiments

Difficult Topics: Drag and turbulence; Similarity; Analogies

Text: Would like a text half-way between transport and unit operation orientation. Theory is good to have, but also are the more practical aspects.

UNIVERSITY OF CINCINNATI

TX: Bennett & Myers (Jr/S1/4-0)

Dimensions: English
Trend to SI: Yes
Orientation: T.P.
CHE Lab: 2 courses, 10 experiments

Text Comments: More examples and more detail in math development.

CLEMSON UNIVERSITY

TX: McCabe & Smith (Jr/S1/3-0)

Dimensions: English
Trend to SI: Yes
Orientation: Unit Op.
CHE Lab: 2 courses, 10 experiments

Text: Older edition of text is better than newest edition.

CLEVELAND STATE UNIVERSITY

TX: Roberson & Crowe (Jr/Q1, Q2/4-0)

Dimensions: Both
Trend to SI: No
Orientation: Transport
CHE Lab: 3 courses, 15 experiments

Difficult Topics: Velocity profiles in turbulent flow; Conservation of momentum.

COLORADO SCHOOL OF MINES

TX: Bird, Stewart, & Lightfoot; McCabe & Smith (Jr/S1,S2/3-0)

Dimensions: Both
Orientation: Both
CHE Lab: 1 course, 9 experiments

UNIVERSITY OF COLORADO

TX: Bennett & Myers (Jr/S1/4-0)

Dimensions: English
Trend to SI: Yes
Orientation: T.P.
CHE Lab: 4 courses, 13 experiments

Difficult Topics: Turbulence.

CORNELL UNIVERSITY

TX: McCabe & Smith (Jr/S1/3-3)

Dimensions: Both
Trend to SI: Yes
Orientation: Unit Op.
CHE Lab: 1 course, 6 experiments

UNIVERSITY OF DELAWARE

TX: Denn: "Process Fluid Mechanics" (in press) (Jr/S1/3-0)

Dimensions: Both
Trend to SI: No
Orientation: Both
CHE Lab: 2 courses

UNIVERSITY OF DETROIT

TX: Olson (Jr/S2/3-1/2)

Dimensions: Both
Trend to SI: Yes
Orientation: None
CHE Lab: 1 course, 20 experiments

Difficult Topics: Potential flow; Boundary layer separation.

GROVE CITY COLLEGE

TX: Sissom & Pitts

Dimensions: Both
Trend to SI: Yes
Orientation: Transport
CHE Lab: None

Difficult Topics: Boundary layer theory

HOWARD UNIVERSITY

TX: McCabe & Smith (Jr/S1/4-0)

Dimensions: Both
Trend to SI: Yes
Orientation: Unit Op.
CHE Lab: 2 courses

Difficult Topics: Flow of Compressible Fluids.

Text Comments: More example problems needed. Better mixture of Unit Operations and Transport Phenomena.

IOWA STATE UNIVERSITY

TX: McCabe & Smith; Bennett & Myers (Jr/Q1/4-0)

Dimensions: Both
Trend to SI: No
CHE Lab: 2 courses, 8 experiments

UNIVERSITY OF KENTUCKY

TX: Streeter (Jr/S1/3-0)

Dimensions: SI
Trend to SI: No
Orientation: Fluid Mechanics
CHE Lab: 2 courses, 8 experiments

Difficult Topics: Conservation of Energy and Momentum.

LAFAYETTE COLLEGE

TX: McCabe & Smith (Jr/S1/3-3)

Dimensions: English
Trend to SI: Yes
Orientation: Unit Op.
CHE Lab: No

LAMAR UNIVERSITY

TX: Fox & McDonald (Jr/S1, S2/3-0)

Dimensions: English
Orientation: Neither
CHE Lab: 1 course, 8 experiments

Difficult Topics: Derivations starting with differential momentum balance to get laminar or turbulent flow equations.

UNIVERSITY OF LOWELL

TX: McCabe & Smith (So/S1/2-3)

Dimensions: Both
Trend to SI: No
Orientation: Unit Op.

Difficult Topics: Compressible flow.

LOUISIANA STATE UNIVERSITY

TX: Bird, Stewart, Lightfoot (Jr/S1/3-0)

Dimensions: English
Trend to SI: Yes
Orientation: Transport
CHE Lab: 3 courses, 12 experiments

Difficult Topics: Tensor analysis; partial differential equations.

Fluid Flow

UNIVERSITY OF MAINE

TX: McCabe & Smith (Jr/S1/3-0)

Dimensions: English (75%); SI (25%)
Trend to SI: Yes
Orientation: Unit Op.
CHE Lab: 2 courses, 8 experiments

Difficult Topics: Mass transfer mechanisms

Text: Improved treatment of transport phenomena preceding unit operations.

UNIVERSITY OF MARYLAND

TX: Bennett & Myers (Jr/S1/4-0)

Dimensions: English
Trend to SI: Yes, Gradual
Orientation: T.P.
CHE Lab: None

MASSACHUSETTS INSTITUTE OF TECHNOLOGY

TX: BSL (So, Jr/S2/4-0)

Dimensions: Both
Trend to SI: Yes
Orientation: Transport
CHE Lab: 3 courses, 80 contact hrs

Difficult Topics: Understanding the physics of a problem and translating that into a mathematical problem statment.

Text: More problems, particularly some which students can visualize; Order-of-magnitude problems; More readable mass transfer section.

UNIVERSITY OF MICHIGAN

TX: Tek & Wilkes, "Fluid Flow & Heat Transfer" (So,Jr/S1/3-0)

Dimensions: English
Trend to SI: No
Orientation: Both
CHE Lab: 1 course, 13-15 experiments

MICHIGAN STATE UNIVERSITY

TX: 1. Bennett & Myers; (Jr/Q1/5-0)
2. BSL (Sr/Q2/3-0)

Dimensions: English & SI
Trend to SI: Some
Orientation: Unit Op./Transport
CHE Lab: 2 courses, 25 experiments

Text: (B&M) Not good as a beginning text in fluid flow and momentum transfer.

MICHIGAN TECH UNIVERSITY

TX: McCabe & Smith; Bird, Stewart, Lightfoot (Jr/Q1,Q2,Q3 3-0,3-0,6-0) (3 courses)

Dimensions: Both
Trend to SI: Yes
Orientation: Both
CHE Lab: 3 courses, 12-14 experiments

Difficult Topics: Transport Phenomena.
Text: Need an undergraduate text which incorporates both transport phenomena and unit op.

UNIVERSITY OF MINNESOTA

TX: Streeter (Jr/Q2/5-0)

Dimensions: SI
Trend to SI: Complete
Orientation: Fluid Mechanics
CHE Lab: 3 courses, 14 experiments

Difficult Topics: Basic concepts of mechanics and mechanical energy.

UNIVERSITY OF MISSOURI-COLUMBIA

TX: Bennett & Myers (2 courses) (Jr/S1/3-0) (Jr/S2/3-0)

Dimensions: Mostly English
Trend to SI: Yes
Orientation: Transport
CHE Lab: 2 courses, 12 experiments

Text Comments: Many good texts available.

UNIVERSITY OF MISSOURI-ROLLA

TX: Bennett & Myers (Jr/S1, S2/3-0)

Dimensions: English
Trend to SI: No
Orientation: Unit Op. and Transport
CHE Lab: 1 course, 6 experiments

Difficult Topics: Differential approach
Text: More practical emphasis.

UNIVERSITY OF MISSISSIPPI

TX: Greenkorn & Kessler (Jr/S1/3-0)

Dimensions: Both
Trend to SI: Yes
Orientation: Transport
CHE Lab: 2 courses, 12 experiments

Text Comments: Textbooks should be written from students' point of view, should not attempt to cover all possible topics and should cover each major topic in more detail.

MISSISSIPPI STATE UNIVERSITY

TX: McCabe & Smith (Jr/S1/3-0)

Dimensions: Both
Trend to SI: Yes
Orientation: Unit Op.
CHE Lab: 1 course, 15-20 experiments

Difficult Topics: Momentum transport
Text: Could be condensed to present concepts more clearly.

MONTANA STATE UNIVERSITY

TX: McCabe & Smith (Jr/Q1/4-0)

Dimensions: Both
Trend to SI: Yes
Orientation: Transport
CHE Lab: 3 courses, 12 experiments

UNIVERSITY OF NEBRASKA

TX: DeNevers (Jr/S1/3-0)

Dimensions: Both
Trend to SI: No
Orientation: Unit Op.
CHE Lab: 1 course, 4 experiments

Difficult Topics: Momentum transport and momentum balances.

UNIVERSITY OF NEW HAMPSHIRE

TX: McCabe & Smith (Jr/S1/3-2)

Dimensions: Both
Trend to SI: SI
Orientation: Unit Op.
CHE Lab: No

NEW JERSEY INSTITUTE OF TECHNOLOGY

TX: Foust (Jr/S1/3-0)

Dimensions: Both
Trend to SI: Yes
Orientation: Both
CHE Lab: 1 course, 7-8 experiments

Text Comments: More and better illustrative problems.

UNIVERSITY OF NEW MEXICO

TX: Bennett & Myers (So/S1/3-0)

Dimensions: Both
Trend to SI: Yes
Orientation: Transport
CHE Lab: 2 courses, 15 experiments

Difficult Topics: Inability to formulate problems based on the available information

Text Comments: Good to teach from but of little value as a reference book. McCabe & Smith is exactly the opposite. An updated version of Foust would be ideal.

UNIVERSITY OF NORTH DAKOTA

TX: Bird, Stewart & Lightfoot; McCabe & Smith, 2 courses (Jr/S1/4-0) (Jr/S2/3-0)

Dimensions: Both
Trend to SI: Yes
Orientation: Unit Op. and Transport
CHE Lab: 1 course, 12 experiments

Text: An updated BSL would be helpful.

NORTHWESTERN UNIVERSITY

TX: Sabersky, Acosta and Hauptmann (Jr/Q1/4-1)

Dimensions: English
Trend to SI: Yes
Orientation: Fluid Mechanics
CHE Lab: 1 course, 4-6 experiments

Difficult Topics: Mass transfer in a continuous contacting apparatus.

Text: Text should have notation and orientation consistent with subsequent heat and mass transfer courses.

OHIO STATE UNIVERSITY

TX: Bennett & Myers; Personal Notes (So/Q3/3-2)

Dimensions: Both
Trend to SI: Yes
Orientation: Transport
CHE Lab: 1 course, 6 experiments

Difficult Topics: Transport theory.

OREGON STATE UNIVERSITY

TX: Welty, Wicks, Wilson (Jr/Q1/5-0)

Dimensions: Both
Trend to SI: Yes
Orientation: T.P.
CHE Lab: 2 courses, 10-15 experiments

Difficult Topics: Turbulence

PURDUE UNIVERSITY

TX: Greenkorn & Kessler, "Transfer Operations" (Jr/Q1,Q2, Q3/1-0)* *5 hr/wk for 3 weeks

Dimensions: Both
Trend to SI: No
Orientation: Transport
CHE Lab: 1 course, 12 experiments

RENSSELAER POLYTECHNIC INSTITUTE

TX: Olson, R., "Essentials of Engineering Fluid Mechanics", 3rd edition (Jr/S1/3-0)

Dimensions: Both
Trend to SI: Yes
Orientation: Unit Op.
CHE Lab: 1 course, 6 experiments

Difficult Topics: Boundary layer theory; potential flow; vorticity; rotational and irrotational flow.

UNIVERSITY OF RHODE ISLAND

TX: Bennett & Myers (Jr/S1/3-0)

Dimensions: Both
Trend to SI: Yes
Orientation: Transport Phenomena
CHE Lab: 2 courses

Difficult Topics: Compressible flow.

RICE UNIVERSITY

TX: Bird, Stewart, Lightfoot (Sr/S1/3-0)
Fox & McDonald (Sr/S1/3-3)

Dimensions: Both
Trend to SI: Yes
Orientation: One course each, Unit Op. and Transport
CHE Lab: 2 courses, 10 experiments

UNIVERSITY OF ROCHESTER

TX: Bennett & Myers (So/S2/3-0)

Dimensions: Both
Trend to SI: Yes, slowly
Orientation: Both
CHE Lab: 5 courses, 25 experiments

Difficult Topics: Macroscopic balances; tensors

Text: More rigorous material, more careful derivations for the sharper student.

ROSE-HULMAN INSTITUTE OF TECHNOLOGY

TX: McCabe & Smith (So/Q3/4-0)

Dimensions: English
Trend to SI: Yes
Orientation: Unit Op.
CHE Lab: 1 course, 4 experiments

UNIVERSITY OF SOUTHERN CALIFORNIA

TX: McCabe & Smith (Jr/S1/4-0)

Dimensions: Both
Trend to SI: Yes
Orientation: Unit Op.
CHE Lab: 1 course, 7-8 experiments

Difficult Topics: Compressible Flow.
Text Comments: Too many errors; spotty coverage of many topics.

UNIVERSITY OF SOUTHWESTERN LOUISIANA

TX: Bennett & Myers (Jr/S1/3-0)

Dimensions: English
Trend to SI: Perhaps
Orientation: Neither
CHE Lab: 3 courses, experiments vary

Difficult Topics: Filtration

SYRACUSE UNIVERSITY

TX: Bennett & Myers (Jr/S1/3-0)

Dimensions: English
Trend to SI: Yes
Orientation: Transport
CHE Lab: 2 courses, 12 experiments

Difficult Topics: Learning to set up mathematical equations to describ some physical phenomena.

TEXAS TECH UNIVERSITY

TX: Foust (So/S2/3-0)

Dimensions: Both
Trend to SI: Yes
Orientation: Unit Op.
CHE Lab: 2 courses, 8-10 experiments

Difficult Topics: Transport Coefficients.

UNIVERSITY OF TENNESSEE-KNOXVILLE

TX: McCabe & Smith (2 courses) (So/Q3/3-2) (Jr/Q1/3-2)

Dimensions: Both
Trend to SI: Yes
Orientation: Unit Op.
CHE Lab: None

Difficult Topics: Flow equations, conservation of momentum.

TENNESSEE TECHNOLOGICAL UNIVERSITY

TX: McCabe & Smith (Jr/Q2/3-0)

Dimensions: Both
Trend to SI: Yes
Orientation: Unit Op.
CHE Lab: 1 course, 6 experiments

Difficult Topics: Compressible Flow
Text: More and better problems; Modernize correlations and math presentations; Improve examples of process applications.

TUFTS UNIVERSITY

TX: McCabe & Smith; Bird, Stewart, & Lightfoot (2 courses) (Jr/S1/3-0) (Sr/S1/3-0)

Dimensions: Both
Trend to SI: Yes
Orientation: Unit Op.
CHE Lab: 1 course, 6 experiments

TULANE UNIVERSITY

TX: DeNevers (So/S2/2-0)

Dimensions: English
Trend to SI: Yes
Orientation: Fluid Mechanics
CHE Lab: 1 course, 8 experiments

UNIVERSITY OF TULSA

TX: Streeter, 6th ed. (Jr/S1,S2/3-0)

Dimensions: Both
Trend to SI: Not unless adopted by industry.
Orientation: Unit Op.
CHE Lab: 2 courses, 16-20 experiments

Difficult Topics: Use g_c; conversion of units; trial and error problems.

UNIVERSITY OF UTAH

TX: deNevers, "Fluid Mechanics" (Jr/Q1/4-0)

Dimensions: Both
Trend to SI: Yes
Orientation: Fluid Mechanics
CHE Lab: 1 course

VILLANOVA UNIVERSITY

TX: McCabe & Smith (Jr/S1/4-0)

Dimensions: Both
Trend to SI: Both will be used.
Orientation: Unit Op.
CHE Lab: 3 courses, 25 experiments

Difficult Topics: NPSH; Flow in looped lines.
Text Comments: McCabe & Smith is too shallow in theory; Bennett & Myers is impractical. Brown gave a good treatment of both practical and theoretical aspects. Undergraduate needs both in a reasonable balance.

UNIVERSITY OF WASHINGTON

TX: Bird, Stewart & Lightfoot (Jr/Q1/4-0)

Dimensions: Both
Trend to SI: No
Orientation: Transport
CHE Lab: 2 courses, 6 experiments

Text: A scaled-down version of BSL with a better treatment of the subject of chapters 6 & 7; i.e. a more practical approach, would be welcome.

WIDENER COLLEGE

TX: Streeter (Sr/S2/3-2)

Dimensions: Both
Trend to SI: Yes
Orientation: Fluid Mechanics
CHE Lab: None

Difficult Topics: Mathematics

UNIVERSITY OF WISCONSIN-MADISON

TX: McCabe & Smith; Bird, Stewart & Lightfoot (Jr/S1/3-2) (Jr/S1/3-0)

Dimensions: Both
Trend to SI: Yes
Orientation: Both
CHE Lab: 2 courses, 17 experiments

WORCESTER POLYTECHNIC INSTITUTE

TX: Streeter 6th ed. (Jr/Q1/7-0)

Dimensions: Both
Trend to SI: Yes
Orientation: None
CHE Lab: 1 course, 5 experiments

Difficult Topics: Forces and moments; Angular and linear momentum
Text: Eliminate "slugs". Handle gas laws better; Introduce more problems with a chemical engineering flavor.

UNIVERSITY OF [redacted]

TX: McCabe & Smith (Jr/S1/3-0)

Dimensions: English (75%); SI (25%)
Trend to SI: Yes
Orientation: Unit Op.
CHE Lab: 2 courses, 8 experiments

Difficult Topics: Mass transfer mechanisms

Text: Improved treatment of transport phenomena preceding unit operations.

UNIVERSITY OF MARYLAND

TX: Bennett & Myers (Jr/S1/4-0)

Dimensions: English
Trend to SI: Yes, Gradual
Orientation: T.P.
CHE Lab: None

MASSACHUSETTS INSTITUTE OF TECHNOLOGY

TX: BSL (So, Jr/S2/4-0)

Dimensions: Both
Trend to SI: Yes
Orientation: Transport
CHE Lab: 3 courses, 80 contact hrs

Difficult Topics: Understanding the physics of a problem and translating that into a mathematical problem statment.

Text: More problems, particularly some which students can visualize; Order-of-magnitude problems; More readable mass transfer section.

UNIVERSITY OF MICHIGAN

TX: Tek & Wilkes, "Fluid Flow & Heat Transfer" (So,Jr/S1/3-0)

Dimensions: English
Trend to SI: No
Orientation: Both
CHE Lab: 1 course, 13-15 experiments

MICHIGAN STATE UNIVERSITY

TX: 1. Bennett & Myers: (Jr/Q1/5-0)
2. BSL (Sr/Q2/3-0)

Dimensions: English & SI
Trend to SI: Some
Orientation: Unit Op./Transport
CHE Lab: 2 courses, 25 experiments

Text: (8&%) Not good as a beginning text in fluid flow and momentum transfer.

MICHIGAN TECH UNIVERSITY

TX: McCabe & Smith; Bird, Stewart, Lightfoot (Jr/Q1,Q2,Q3 3-0,3-0,6-0) (3 courses)

Dimensions: Both
Trend to SI: Yes
Orientation: Both
CHE Lab: 3 courses, 12-14 experiments

Difficult Topics: Transport Phenomena.
Text: Need an undergraduate text which incorporates both transport phenomena and unit op.

UNIVERSITY OF MINNESOTA

TX: Streeter (Jr/Q2/5-0)

Dimensions: SI
Trend to SI: Complete
Orientation: Fluid Mechanics
CHE Lab: 3 courses, 14 experiments

Difficult Topics: Basic concepts of mechanics and mechanical energy.

UNIVERSITY OF MISSOURI-COLUMBIA

TX: Bennett & Myers (2 courses) (Jr/S1/3-0) (Jr/S2/3-0)

Dimensions: Mostly English
Trend to SI: Yes
Orientation: Transport
CHE Lab: 2 courses, 12 experiments

Text Comments: Many good texts available.

UNIVERSITY OF MISSOURI-ROLLA

TX: Bennett & Myers (Jr/S1, S2/3-0)

Dimensions: English
Trend to SI: No
Orientation: Unit Op. and Transport
CHE Lab: 1 course, 6 experiments

Difficult Topics: Differential approach
Text: More practical emphasis.

UNIVERSITY OF MISSISSIPPI

TX: Greenkorn & Kessler (Jr/S1/3-0)

Dimensions: Both
Trend to SI: Yes
Orientation: Transport
CHE Lab: 2 courses, 12 experiments

Text Comments: Textbooks should be written from students' point of view, should not attempt to cover all possible topics and should cover each major topic in more detail.

M[redacted]IPPI STATE UNIVERSITY

TX: McCabe & Smith (Jr/S1/3-0)

Dimensions: Both
Trend to SI: Yes
Orientation: Unit Op.
CHE Lab: 1 course, 15-20 experiments

Difficult Topics: Momentum transport
Text: Could be condensed to present concepts more clearly.

MONTANA STATE UNIVERSITY

TX: McCabe & Smith (Jr/Q1/4-0)

Dimensions: Both
Trend to SI: Yes
Orientation: Transport
CHE Lab: 3 courses, 12 experiments

UNIVERSITY OF NEBRASKA

TX: DeNevers (Jr/S1/3-0)

Dimensions: Both
Trend to SI: No
Orientation: Unit Op.
CHE Lab: 1 course, 4 experiments

Difficult Topics: Momentum transport and momentum balances.

UNIVERSITY OF NEW HAMPSHIRE

TX: McCabe & Smith (Jr/S1/3-2)

Dimensions: Both
Trend to SI: SI
Orientation: Unit Op.
CHE Lab: No

NEW JERSEY INSTITUTE OF TECHNOLOGY

TX: Foust (Jr/S1/3-0)

Dimensions: Both
Trend to SI: Yes
Orientation: Both
CHE Lab: 1 course, 7-8 experiments

Text Comments: More and better illustrative problems.

UNIVERSITY OF NEW MEXICO

TX: Bennett & Myers (So/S1/3-0)

Dimensions: Both
Trend to SI: Yes
Orientation: Transport
CHE Lab: 2 courses, 15 experiments

Difficult Topics: Inability to formulate problems based on the available information

Text Comments: Good to teach from but of little value as a reference book. McCabe & Smith is exactly the opposite. An updated version of Foust would be ideal.

UNIVERSITY OF NORTH DAKOTA

TX: Bird, Stewart & Lightfoot; McCabe & Smith, 2 courses (Jr/S1/4-0) (Jr/S2/3-0)

Dimensions: Both
Trend to SI: Yes
Orientation: Unit Op. and Transport
CHE Lab: 1 course, 12 experiments

Text: An updated BSL would be helpful.

NORTHWESTERN UNIVERSITY

TX: Sabersky, Acosta and Hauptmann (Jr/Q1/4-1)

Dimensions: English
Trend to SI: Yes
Orientation: Fluid Mechanics
CHE Lab: 1 course, 4-6 experiments

Difficult Topics: Mass transfer in a continuous contacting apparatus.
Text: Text should have notation and orientation consistent with subsequent heat and mass transfer courses.

OHIO STATE UNIVERSITY

TX: Bennett & Myers; Personal Notes (So/Q3/3-2)

Dimensions: Both
Trend to SI: Yes
Orientation: Transport
ChE Lab: 1 course, 6 experiments

Difficult Topics: Transport theory.

OREGON STATE UNIVERSITY

TX: Welty, Wicks, Wilson (Jr/Q1/5-0)

Dimensions: Both
Trend to SI: Yes
Orientation: T.P.
ChE Lab: 2 courses, 10-15 experiments

Difficult Topics: Turbulence

PURDUE UNIVERSITY

TX: Greenkorn & Kessler, "Transfer Operations" (Jr/Q1,Q2, Q3/1-0)* *5 hr/wk for 3 weeks

Dimensions: Both
Trend to SI: No
Orientation: Transport
ChE Lab: 1 course, 12 experiments

RENSSELAER POLYTECHNIC INSTITUTE

TX: Olson, R., "Essentials of Engineering Fluid Mechanics", 3rd edition (Jr/S1/3-0)

Dimensions: Both
Trend to SI: Yes
Orientation: Unit Op.
ChE Lab: 1 course, 6 experiments

Difficult Topics: Boundary layer theory; potential flow; vorticity; rotational and irrotational flow.

UNIVERSITY OF RHODE ISLAND

TX: Bennett & Myers (Jr/S1/3-0)

Dimensions: Both
Trend to SI: Yes
Orientation: Transport Phenomena
ChE Lab: 2 courses

Difficult Topics: Compressible flow.

RICE UNIVERSITY

TX: Bird, Stewart, Lightfoot (Sr/S1/3-0)
Fox & McDonald (Sr/S1/3-3)

Dimensions: Both
Trend to SI: Yes
Orientation: One course each, Unit Op. and Transport
ChE Lab: [illegible] courses, 10 experiments

UNIVERSITY OF ROCHESTER

TX: Bennett & Myers (So/S2/3-0)

Dimensions: Both
Trend to SI: Yes, slowly
Orientation: Both
ChE Lab: 5 courses, 25 experiments

Difficult Topics: Macroscopic balances; tensors
Text: More rigorous material, more careful derivations for the sharper student.

ROSE-HULMAN INSTITUTE OF TECHNOLOGY

TX: McCabe & Smith (So/Q3/4-0)

Dimensions: English
Trend to SI: Yes
Orientation: Unit Op.
ChE Lab: 1 course, 4 experiments

UNIVERSITY OF SOUTHERN CALIFORNIA

TX: McCabe & Smith (Jr/S1/4-0)

Dimensions: Both
Trend to SI: Yes
Orientation: Unit Op.
ChE Lab: 1 course, 7-8 experiments

Difficult Topics: Compressible Flow.
Text Comments: Too many errors; spotty coverage of many topics.

UNIVERSITY OF SOUTHWESTERN LOUISIANA

TX: Bennett & Myers (Jr/S1/3-0)

Dimensions: English
Trend to SI: Perhaps
Orientation: Neither
ChE Lab: 3 courses, experiments vary

Difficult Topics: Filtration

SYRACUSE UNIVERSITY

TX: Bennett & Myers (Jr/S1/3-0)

Dimensions: English
Trend to SI: Yes
Orientation: Transport
ChE Lab: 2 courses, 12 experiments

Difficult Topics: Learning to set up mathematical equations to describ some physical phenomena.

TEXAS TECH UNIVERSITY

TX: Foust (So/S2/3-0)

Dimensions: Both
Trend to SI: Yes
Orientation: Unit Op.
ChE Lab: 2 courses, 8-10 experiments

Difficult Topics: Transport Coefficients.

UNIVERSITY OF TENNESSEE-KNOXVILLE

TX: McCabe & Smith (2 courses) (So/Q3/3-2) (Jr/Q1/3-2)

Dimensions: Both
Trend to SI: Yes
Orientation: Unit Op.
ChE Lab: None

Difficult Topics: Flow equations, conservation of momentum.

TENNESSEE TECHNOLOGICAL UNIVERSITY

TX: McCabe & Smith (Jr/Q2/3-0)

Dimensions: Both
Trend to SI: Yes
Orientation: Unit Op.
ChE Lab: 1 course, 6 experiments

Difficult Topics: Compressible Flow
Text: More and better problems; Modernize correlations and math presentations; Improve examples of process applications.

TUFTS UNIVERSITY

TX: McCabe & Smith; Bird, Stewart, & Lightfoot (2 courses) (Jr/S1/3-0) (Sr/S1/3-0)

Dimensions: Both
Trend to SI: Yes
Orientation: Unit Op.
ChE Lab: 1 course, 6 experiments

TULANE UNIVERSITY

TX: DeNevers (So/S2/2-0)

Dimensions: English
Trend to SI: Yes
Orientation: Fluid Mechanics
ChE Lab: 1 course, 8 experiments

UNIVERSITY OF TULSA

TX: Streeter, 6th ed. (Jr/S1,S2/3-0)

Dimensions: Both
Trend to SI: Not unless adopted by industry.
Orientation: Unit Op.
ChE Lab: 2 courses, 16-20 experiments

Difficult Topics: Use g_c; conversion of units; trial and error problems.

UNIVERSITY OF UTAH

TX: deNevers, "Fluid Mechanics" (Jr/Q1/4-0)

Dimensions: Both
Trend to SI: Yes
Orientation: Fluid Mechanics
ChE Lab: 1 course

VILLANOVA UNIVERSITY

TX: McCabe & Smith (Jr/S1/4-0)

Dimensions: Both
Trend to SI: Both will be used.
Orientation: Unit Op.
ChE Lab: 3 courses, 25 experiments

Difficult Topics: NPSH; Flow in looped lines.
Text Comments: McCabe & Smith is too shallow in theory; Bennett & Myers is impractical. Brown gave a good treatment of both practical and theoretical aspects. Undergraduate needs both in a reasonable balance.

UNIVERSITY OF WASHINGTON

TX: Bird, Stewart & Lightfoot (Jr/Q1/4-0)

Dimensions: Both
Trend to SI: No
Orientation: Transport
ChE Lab: 2 courses, 6 experiments

Text: A scaled-down version of BSL with a better treatment of the subject of chapters 6 & 7; i.e. a more practical approach, would be welcome.

WIDENER COLLEGE

TX: Streeter (Sr/S2/3-2)

Dimensions: Both
Trend to SI: Yes
Orientation: Fluid Mechanics
ChE Lab: None

Difficult Topics: Mathematics

UNIVERSITY OF WISCONSIN-MADISON

TX: McCabe & Smith; Bird, Stewart & Lightfoot (Jr/S1/3-2) (Jr/S1/3-0)

Dimensions: Both
Trend to SI: Yes
Orientation: Both
ChE Lab: 2 courses, 17 experiments

WORCESTER POLYTECHNIC INSTITUTE

TX: Streeter 6th ed. (Jr/Q1/7-0)

Dimensions: Both
Trend to SI: Yes
Orientation: None
ChE Lab: 1 course, 5 experiments

Difficult Topics: Forces and moments; Angular and linear momentum
Text: Eliminate "slugs". Handle gas laws better; Introduce more problems with a chemical engineering flavor.

UNIVERSITY OF WYOMING

TX: a. Fox & McDonald (So/S1/3-0)
b. Welty, Wicks & Wilson (Jr/S1/3-0)
c. McCabe & Smith (Jr, Sr/S2/3-2)

Dimensions: Both
Trend to SI: Yes
Orientation: a & b, Transport
c, Unit Op.

Difficult Topics: Boundary layer; Macroscopic momentum balance; Mass Transfer
Text: A transport phenomena text is needed which presents many examples worked out in detail.

UNIVERSITY OF ALBERTA

TX: DeNevers (Jr/S1/3-1)

Dimensions: English
Trend to SI: Yes
Orientation: Both
CHE Lab: 4 courses, 12 experiments

Difficult Topics: Compressible Flow
Text Comments: Need SI version of text.

ECOLE POLYTECHNIQUE

TX: (Personal notes), King (Sr/Q2, Q3, 5-0, 5-3)

Dimensions: English
Trend to SI: Yes
Orientation: Unit Op. and Transport
CHE Lab: 2 ccurses, 16 experiments

Difficult Topics: Compressible Flow; Momentum Transfer.

MC MASTER UNIVERSITY

TX: Allen, T. & Ditsworth, R.L., "Fluid Mechanics" (Jr/S1/3-3)

Dimensions: Both
Trend to SI: Yes
Orientation: Fluid Mechanics
CHE Lab: 1 course, 3 experiments

Difficult Topics: Application of mathematics to solve engineering problems.

UNIVERSITY OF NEW BRUNSWICK

TX: None, Library Resources (So/S1, S2/3-0)

Dimensions: Both
Trend to SI: Yes
Orientation: Unit Op.
CHE Lab: 2 courses, 12-20 experiments

Difficult Topics: Proceeding from a visible, physical situation to a describing equation.

NOVA SCOTIA TECHNICAL COLLEGE

TX: McCabe & Smith (Jr/S1/3-0)

Dimensions: Both
Trend to SI: Yes
Orientation: Unit Op.
CHE Lab: 3 courses, 8-10 experiments

Difficult Topics: Concept of momentum and its balances; fluid flow through packed columns. Fluid and particle motion in centrifugal force field.
Text Comments: Expanded discussion on boundary layer concept; More examples and problems.

UNIVERSITY OF OTTAWA

TX: BSL (Jr/S1, S2/2-0)

Dimensions: Both
Trend to SI: Yes
Orientation: Transport
CHE Lab: 2 courses, 16 experiments

Difficult Topics: Derivation and application of Navier-Stokes Equation.

QUEEN'S UNIVERSITY (Jr/S2/3-2)

TX: Bennett & Myers

Dimensions: Both
Trend to SI: Yes
Orientation: Both
CHE Lab: 2 courses, 10 experiments

ROYAL MILITARY COLLEGE

TX: McCabe & Smith; Welty, Wicks & Wilson (Jr/S1/3-0)

Dimensions: Both
Trend to SI: Yes
Orientation: Both
CHE Lab: 2 courses, 14 experiments

Difficult Topics: Vector & Tensor approaches.

UNIVERSITY OF TORONTO

TX: McCabe & Smith (Jr/S1/2-1)

Dimensions: Both
Trend to SI: Yes
Orientation: Unit Op.
CHE Lab: None

UNIVERSITY OF WESTERN ONTARIO

TX: Notes by Instructor (So/S2/3-1)

Dimensions: Both
Trend to SI: Yes
Orientation: T.P.
CHE Lab: None

UNIVERSITY OF WINDSOR

TX: Streeter (So/S1/2-2)

Dimensions: Both
Trend to SI: Complete by 1979-80
Orientation: Transport
CHE Lab: None

B I B L I O G R A P H Y

Bennett, C. O. and Myers, J. E.: "Momentum, Heat and Mass Transfer," 2nd ed., McGraw-Hill, New York, 1974.

Bird, R. B., Stewart, W. E. and Lightfoot, E. N.: "Transport Phenomena," Wiley, New York, 1960.

DeNevers, N.: "Fluid Mechanics," Addison-Wesley, Reading, Mass., 1972.

Foust, A., et al: "Principles of Unit Operations," Wiley, New York, 1962.

Fox, R. W. and McDonald, A. I.: "Introduction to Fluid Mechanics," Wiley, New York, 1973.

Greenkorn, R. A. and Kessler, D. P.: "Transfer Operations," McGraw-Hill, New York, 1972.

Holman, J. P.: "Heat Transfer," 3rd ed., McGraw-Hill, New York, 1972.

King, C. J.: "Separation Processes," McGraw-Hill, New York, 1971.

Kreith, F.: "Principles of Heat Transfer," 3rd ed., Intext, New York, 1973.

McCabe, W. L. and Smith, J. C.: "Unit Operations in Chemical Engineering," 2nd ed., McGraw-Hill, New York, 1967.

Roberson, J. A. and Crowe, C.: "Engineering Fluid Mechanics," Houghton-Mifflin, New York, 1978.

Sabersky, R. H., et al: "Fluid Flow: First Course in Fluid Mechanics," 2nd ed., Macmillan, New York, 1971.

Sissom, L. and Pitts, D. R.: "Elements of Transport Phenomena," McGraw-Hill, New York, 1972.

Streeter, V. J. and Wylie, B.: "Fluid Mechanics," 6th ed., McGraw-Hill, New York, 1975.

Tek, M. R. and Wilkes, J. O.: "Fluid Flow and Heat Transfer," University of Michigan.

Thomson, W. J. and Scheldorf, J. J.: "The Rates of Transport Processes," University of Idaho.

Welty, J. R., Wicks, C. E. and Wilson, R. E.: "Fundamentals of Momentum, Heat and Mass Transfer," Wiley, New York, 1969.

Instructor _____ University _____

1. Is the English or SI system used in problem assignments?

2. Do you expect a significant shift to the SI system in the next 5 years?

3. Is this text also the principal text for another course? If so, please give title.

4. Would you classify the text as unit operations oriented (eg. McCabe and Smith) or transport phenomena oriented (eg. Bird, Stewart and Lightfoot)?

5. Is the course designed for chemical engineers only, or do other engineering students usually enroll?

6. Does your department offer a chemical engineering laboratory course with credit separate from the Heat Transfer or Fluid Flow lecture courses? If so,

   a) How many courses _____

   b) Contact hours per semester _____

   c) Number of experiments (all areas) _____

7. What topics, if any, seem particularly difficult for the student?

8. Is there a need for a better textbook in this area? How might your present text be improved?

. COURSE IDENTIFICATION

RSE BER	CATALOG NUMBER	TITLE	HRS/WK CLASS	HRS/WK LAB	YEAR	SEM/QTR (Circle)
.	_____	_____	_____	_____	So/Jr/Sr	1 2 3
.	_____	_____	_____	_____	So/Jr/Sr	1 2 3
.	_____	_____	_____	_____	So/Jr/Sr	1 2 3

3. COURSE RESOURCES/CLASS DATA

RSE BER	TEXT (Author, Title, Ed.)	STUDENTS ENROLLED	STUDENTS MAJOR
1.	_____	_____	ChE, ME, ____
2.	_____	_____	ChE, ME, ____
3.	_____	_____	ChE, ME, ____

C. TIME ALLOCATIONS

_____ Weeks per (semester/quarter) (circle 1)

_____ Minutes per class session (based on three sessions/wk)

D. Do you use any demonstrations or films in the classroom? If so, please elaborate.

E. What is the typical student's reaction upon completion of the course?

F. Please attach a course outline.

G. I (do, do not) plan to attend the New York meeting.

Instruc _____ UNIVERSITY _____

Part II - TOPICS IN FLUID FLOW

	COURSE #	SESSIONS
Properties/Definitions		
Viscosity; Mass, Force Units	_____	_____
Fluid Statics		
Manometers	_____	_____
Buoyancy, Flotation	_____	_____
Plane surfaces	_____	_____
Curved surfaces	_____	_____
_____	_____	_____
Flow Equations		
Continuity	_____	_____
Bernoulli	_____	_____
Conservation of Momentum	_____	_____
_____	_____	_____
Incompressible Flow		
Laminor/Turbulent flow	_____	_____
Friction factors	_____	_____
Equivalent Length of fittings	_____	_____
Boundary Layer, Velocity Distribution	_____	_____
Piping Systems	_____	_____

	COURSE #	SESSIONS
Compressible Flow		
Isothermal	_____	_____
Isentropic	_____	_____
Non-isothermal	_____	_____
Sonic velocity	_____	_____
Ideal Fluid Flow	_____	_____
Dimensional Analysis	_____	_____
Non-Newtonian Fluids	_____	_____
Fluid Measurement		
Orifice, Venturi	_____	_____
Pitot tube, others	_____	_____
Fluid Machinery		
Pumps	_____	_____
Turbines	_____	_____
Other Topics		
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____

Instructor _____ UNIVERSITY _____

Part II - TOPICS IN HEAT TRANSFER

	COURSE #	SESSIONS
Dimensional Analysis		
Steady State Conduction in One Dimension		
Plane-systems		
Radial Systems		
Heat Source Systems		
Fins		
Steady State Conduction in Two Dimensions		
Curvilinear Squares		
Relaxation		
_____		
Unsteady State Conduction		
Lumped heat capacity		
Heisler charts		
Schmidt plot		
_____		
Boundary Layer Theory		
Forced Convection Correlations		
Pipes/tubes		
Cylinders/spheres		
Tube banks		
_____		
Natural Convection Correlations		
Flat plates		
Cylinders/spheres		
Combined natural & forced convection		
_____		
Radiation		
Mechanism		
Shape factors		
Gray Bodies		
Gas radiation		
Solar radiation		
Phase Change		
Condensation		
Boiling		
_____		
Heat Exchanges		
Overall coefficient		
Fouling Factors		
Shell side co-efficients		
Pressure drops		
Other Topics		
_____		
_____		