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ANNOUNCEMENT

BASES OF TWO-PHASE FLOW

Two-Phase Short Course, Stanford University, Department of Chemical Engineering, 9–13 August 1982

Two-phase flow and heat transfer continue to provide a focus for the attention of researchers, and to frustrate and thwart the engineer, in the nuclear, chemical, and other industries. New data and information, ideas and hypotheses, facts and erroneous theories, continue to be produced.

The purpose of this course is to provide the practicing engineer with:

- An up-to-date condensed and critical view of the state of knowledge
- Highlights of salient points
- Sources of data and correlations
- Design philosophy and methods
- An outline of the outstanding areas of uncertainties

The course will consist of:

- A series of coordinated lectures by well known experts
- Lecture notes to be distributed prior to the course discussions
- Selected movies and slides to illustrate physical phenomena
- Excellent and convenient accommodations on the Stanford Campus
- Limited attendance

LECTURERS

S. Banerjee Professor of Chemical and Nuclear Engineering, University of California, Santa Barbara, California, U.S.A.

A. E. Dukler Dean of Engineering, University of Houston, Houston, Texas, U.S.A.

G. Hetsroni Professor of Mechanical Engineering, Technion, Haifa, Israel

G. F. Hewitt Head, Engineering Sciences Division, AERE, Harwell, England

R. T. Lahey Jr. Chairman, Department of Nuclear Engineering, RPI, Troy, New York, U.S.A.

J. H. Stuhmiller Jaycor, Del Mar, California, U.S.A.

G. B. Wallis Professor of Engineering, Dartmouth College, Hanover, New Hampshire, U.S.A.

COURSE DIRECTOR

G. Hetsroni Visiting Scholar, Department of Chemical Engineering, Stanford University, Stanford, CA 94305, U.S.A.

Monday, 9 August 1982

INTRODUCTION—G. F. HEWITT

Explanation of philosophy of the course, introduction to two-phase flow, description of techniques. Sets scene for the rest of the material in the course.

BASIC QUANTITIES I—G. HETSRONI

Definitions of quality, void fraction, relative velocity, fluxes, averaged properties, jump conditions.

BASIC QUANTITIES II—G. HETSRONI

Local instantaneous equations, instantaneous space-averaged equations, local time-averaged equations, composite averaged equations, flow modeling.

FLOW REGIMES—A. E. DUKLER

Importance of flow regimes, general description, classification, flow pattern maps, prediction of transitions.

Tuesday, 10 August 1982

BASIC EQUATIONS—S. BANERJEE
Modeling methods and their application in various flow regimes, drift flux model, two fluid model, regime related model.

HORIZONTAL STRATIFIED AND SLUG FLOW—A. E. DUKLER
Force balance, stratification, surface waves and instabilities; periodic flows, slugging; vertical and horizontal slug flows; effects of inertia, gravity, viscosity and surface tension.

DROP-GAS INTERACTION—G. HETSRONI
The basic equations for a drop (or bubble) in another fluid; boundary conditions; simple solution for spherical drop; deviation from sphericity, more complex solutions.

ONE DIMENSIONAL FLOW MODELS—G. B. WALLIS
Methods of analysis, simple analytical models and solutions, differential vs integral analysis; flow of suspensions bubbly flow and drop flow.

Wednesday, 11 August 1982

COUNTERCURRENT FLOW AND FLOODING PHENOMENA—G. B. WALLIS
Falling film flow; wave growth phenomena; onset on flooding under various geometrical conditions; effect of entrance conditions; analytical expressions for the onset of flooding; empirical correlations for flooding.

CRITICAL-CHOKING FLOW—G. B. WALLIS
Shock phenomena in bubbly and other two phase flows; attenuation, value and analysis of potential surge; propatation velocities; experimental results and analytical solution; calculation techniques.

INSTABILITIES I—R. T. LAHEY
Classification of instabilities; fundamental static instabilities; relaxation instability (simple and compound), dynamic instabilities (fundamental and compound).

INSTABILITIES II—R. T. LAHEY
Analysis of static and dynamic instabilities such as acoustic instability, density wave instability, pressure drop instability, etc.

Thursday, 12 August 1982

MOMENTUM INTERACTION BETWEEN FLUIDS—R. T. LAHEY
Basic equations; significance of virtual mass effects; relationships for phasic interactions; practical applications.

COMPUTATIONAL METHODS—J. H. STUHMILLER
Numerical methods in two phase flow; limitations of numerical techniques; evaluation of the relative performance of various numerical schemes; future developments in numerical modelling and associated computational methods.

MODELING OF BUBBLY-PLUG FLOW—J. H. STUHMILLER
Motion of individual bubbles in a fluid; two phase plug flow, velocity of plug flow bubbles, effect of physical properties, etc; computer simulation of bubbly/plug flows and calculation of bubble growth rate by coalescence, etc.

WAVE PHENOMENA—S. BANERJEE
Types of interfacial waves; Kelvin-Helmholtz and other instability mechanisms; continuity waves; soliton waves; other two phase wave phenomena.

ANNULAR FLOW—G. F. HEWITT
Measurement of annular flow parameters (film thickness, pressure drop, etc.); analytical methods; the triangular relationship, the interfacial roughness relationship, correlations for deposition rate.

NON-EQUILIBRIUM FLOWS—S. BANERJEE
Types of departure from thermodynamic equilibrium in two phase systems; interfacial mass and heat transfer; prediction of nonequilibrium flows; applications in reactor safety analysis, chemical plant analysis, etc.

EMPIRICAL CORRELATIONS—G. F. HEWITT
The nature and limitations of empirical correlations in two phase flows; statement and description of correlations for pressure drop in straight circular channels; correlations for pressure changes at singularities (changes of cross section, orifices, bends, T's, etc.); correlations for void fraction; the future evolution of empirical correlations in two phase flow.

Reservations

Please return by 2 July 1982

The course fee, including room and board, is $900 per registrant. Accommodations will be made on campus at one of Stanford's student residences (w/o private baths). Three meals per day will be provided. ☐

The course fee EXCLUSIVE of room and board is $700. I will be planning my own accommodations. ☐

Course Fee Includes Printed Lectures

Please make checks payable to Stanford University. Detach and mail to:

Department of Chemical Engineering
Stanford University
Stanford, CA 94305, U.S.A.

Name ______________________

Affiliation ______________________

Address ______________________

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Phone ______________________