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ANNOUNCEMENT

TWO PHASE SHORT COURSE 1980

Stanford University
Department of Chemical Engineering

4–8 August 1980

EXPERIMENTAL METHODS IN TWO-PHASE FLOW

Two-phase flow and heat transfer continue to focus the attention of researchers, and to frustrate and thwart the engineer, in the nuclear, chemical and other industries. New data and information, ideas and hypothesis, 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.
- Highlight of salient points.
- Experimental philosophy and methods.
- 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 Stanford Campus.

Lecturers

S. Banerjee, Professor of Engineering Physics, McMaster University, Canada.
R. B. Duffey, Program Manager, Electric Power Research Institute, Palo Alto, Calif.
P. Griffith, Professor of Mechanical Engineering, M.I.T., Cambridge, Mass.
G. Hetsroni, Professor of Mechanical Engineering, Technion, Haifa, Israel.
G. F. Hewitt, Manager, HTFS, AERE Harwell, England.
R. T. Lahey, Chairman, Department of Nuclear Engineering, Rensselaer Polytechnic Inst., Troy, New York.
V. Schrock, Professor of Nuclear Engineering, University of California at Berkeley, Calif.

MONDAY, 4 AUGUST: BASICS

(1) **Introduction—G. F. Hewitt**
General philosophy of experimental work. Importance of right question. Classification of quantities and methods.

(2) **The nature of two phase flow—S. Banerjee**
Flow pattern-characterization—basic quantities and analytical treatments.

(3) **Averaging—S. Banerjee**
Differences in types of average of time varying quantities. Averaging methods. Mathematical bases.

(4) Statistics of measurement—G. Hetsroni
Precision vs accuracy. General statistical bases, etc.

TUESDAY, 5 AUGUST: MEASUREMENT OF PHASE CONTENT

(5) Review of available methods—V. Schrock
Listing and discussion of alternatives (radiation, impedance, NMR, quick-closing valves, etc.). Discussion of relative merits.

(6) Radiation method—V. Schrock
Bases of radiative methods, gamma, X-ray, neutron, and discussion of relative merits of methods.

(7) Detailed system design for gamma systems—R. T. Lahey
Calculation of required source size, shielding, etc. for gamma absorption system. Detailed design with example. Ditto for gamma scattering.

(8) Local void probes—R. T. Lahey
Conductance probes, optical probes, signal processing.

WEDNESDAY, 6 AUGUST: MEASUREMENT OF FLOW

(9) Review of methods for flow measurement—R. B. Duffy
Listing and appraisal. Velocity and mass flow measurement. Advantages and disadvantages of various methods.

(10) Force and torque methods—R. T. Lahey
Turbine meter, drag disk, true mass flow meter (Coriolis and turbine).

(11) Differential pressure-related methods—R. B. Duffey
Orifices, Venturies, Pitot probes, isokinetic probes, etc.

(12) Transit time techniques—R. T. Lahey
Trace measurements, cross correlation of signals from two instruments.

THURSDAY, 7 AUGUST: HEAT AND TRANSFER EXPERIMENTATION

(13) Introduction to temperature measurement—P. Griffith
Sensors, accuracy, problems of temperature measurement in non-equilibrum fluids, etc.

(14) Heat transfer experimentation—P. Griffith
Heater design, indirect/direct heating. Transient response. Fluid heated or cooled system.

(15) Mass transfer experimentation—P. Griffith
Electrochemical methods, gas absorption, interfacial area measurement.

(16) Mechanistic studies of CHF and heat transfer in annular flow—G. F. Hewitt
Film flow, heat transfer coefficient; visualization. Onset and suppression of nucleation.

FRIDAY, 8 AUGUST: MEASUREMENT OF FLOW STRUCTURE

(17) Photographic methods—G. F. Hewitt
High speed photography, holography, X-ray photography, etc.

(18) Local velocity measurement—G. Hetsroni

Laser Doppler anemometry, optical probes, stereo-photography, etc.

(19) Particle size measurement—G. Hetsroni

Photographic methods, scattering methods, laser methods, etc.

RESERVATIONS

The course fee including room and board is $800 per registrant. Accomodations will be made on campus at one of Stanford's newest and most comfortable student residences (w/o private baths). Three meals per day will be provided. The course fee EXCLUSIVE of room and board is $600. Course fee includes printed lectures.

Please make checks payable to Stanford University and mail to:

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

Reservations to be made by 10 June 1980.