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ANNOUNCEMENTS

TWO-PHASE FLOW WORKSHOP

MULTIPHASE FLOW AND HEAT TRANSFER: BASES AND APPLICATIONS

A 5-DAY-WORKSHOP

Hosted by
Department of Chemical and Nuclear Engineering and University Extension,
The University of California, Santa Barbara, U.S.A.

9–13 January 1989

THE PROGRAM

Two-phase flow and boiling heat transfer continue to focus the attention of researchers and to frustrate and challenge the engineer in the chemical, nuclear, oil-and-gas, cryogenic and other industries. New data and information, ideas and hypotheses, and facts and erroneous theories continue to be produced.

The short course described here is patterned after similar courses offered for a number of years at Stanford University and more recently at the University of California—Santa Barbara and at ETH—Zurich. Its intent is to provide:

- A condensed and critical view of present knowledge including areas of uncertainty
- Transfer of knowledge from one area of application to another
- Sources of data and correlations
- System analysis and design philosophy and methods

The course features:

- A program of coordinated lectures by experts in the field (18 $1\frac{1}{2}$-hour lectures)
- A complete set of lecture notes and copies of slides
- Movies to illustrate physical phenomena
- Limited enrollment.

CONTENTS OF LECTURES

Bases

1. **Introduction:** *G. F. Hewitt.* Nature of multiphase flows. Manifestation in industrial application. Design needs for steady-state and transient operation.
2. **Flow Regimes:** *G. Hetsroni.* Description of flow regimes. Flow regime maps. Analytical bases for the flow regime transitions.
3. **Basic Equations I:** *G. Yadigaroglu.* Control volumes. Steady-state momentum, energy and continuity equations. One-dimensional models, drift flux models.
4. **Measurement and Correlation of Void Fractions:** *G. Yadigaroglu.* Selection of technique. Radiation techniques, impedance methods, other methods. Correlation of void fractions; correlations in terms of slip ratio, drift flux correlations etc.
5. **Measurement and Correlation of Pressure Gradient:** *G. Hetsroni.* Pressure and pressure drop measurements; techniques and problems. Data trends. Bases of correlations and comparison with data. Correlations for straight pipes and singularities.
6. **Two-phase Flow in Vertical Pipes:** *G. F. Hewitt.* Bubble flow; drift flux correlations, void profile, turbulence. Plug flow; bubble rise velocity, mechanisms, stability. Annular flow; basic theory, entrainment and deposition, modelling, applications.
7. **Two-phase Flow in Horizontal and Inclined Pipes:** *G. F. Hewitt.* Stratified flow; simple and more advanced models, turbulence. Slug flow; fluid behaviour in slugs, slug frequency and velocity.
8. **Two-phase Heat Transfer I:** *G. Hetsroni.* Boiling heat transfer nucleate boiling, forced convection. Correlations and models.
9. **Two-phase Heat Transfer II:** *G. Yadigaroglu.* Critical heat flux (dryout); mechanisms, correlations, prediction. Post-dryout heat transfer; non-equilibrium heat transfer reigmes, transition boiling, inverted-annular and dispersed flow film boiling.

10. **Basic Equations II:** *S. Banerjee.* Averaging. Time and space dependent effects. Virtual mass. Multifield models. Requirements for closure relationships.
11. **Closure Relationships:** *S. Banerjee.* Interfacial area. Wall and interface friction. Interfacial heat transfer. Empirical closure laws.
12. **Numerical Methods:** *S. Banerjee.* Initial and boundary conditions method of characteristic. Finite difference methods. Stability. Explicit and implicit methods. Methods used in computer codes.

Applications

13. **Process and Petroleum Industry Applications:** *G. F. Hewitt.* Process boilers and condensers. Pipelines. Separators.
14. **Nuclear Applications I: Operational and Design Base Transients:** *G. Yadigaroglu.* Operational transients with and without scram. Large break LOCAs (loss of cooling accidents) and ECCS (emergency core cooling systems). Small break LOCAs.
15. **Nuclear Applications II: Severe Accidents:** *G. Yadigaroglu.* General introduction. Contributing phenomena; core/concrete interaction, dryout in porous media, steam explosions. Examples; Three Mile Island, Chernobyl.
16. **Space (Microgravity) Applications:** *S. Banerjee.* Two-phase phenomena in microgravity environment. Heat transfer and flow regimes. Space boiling and condensation systems.
17. **Steam Generators:** *G. Hetsroni.* Conventional and nuclear systems. Design problems. Operational problems: corrosion vibration.
18. **Applications in Chemical Plant Safety Assessment:** *S. Banerjee.* Release mechanisms and blowdown. Level swell phenomena. Environmental release.

REGISTRATION INFORMATION

Registration is requested by **20 December 1988**. To request space after this date call (805) 961-4993 or 961-3456. No refunds will be granted after this date unless the workshop is cancelled. To secure registration, send registration form plus payment prior to **20 December**.

WORKSHOP FEES

Registration fees are $1000 (U.S.) and include lectures notes, copies of all slide notes, reception and workshop banquet. Because of space limitations, participants are urged to register well before the deadline.

FOR FURTHER INFORMATION CALL
PROFESSOR G. HETSRONI
on (805) 961-4993 or 961-3412

ENROLLMENT APPLICATION

DO NOT WRITE IN THIS BOX

Mail to: University of California Extension
Santa Barbara, CA 93106
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TWO-PHASE FLOW FUNDAMENTALS X461 EDP 71053 FEE: $1000 (U.S.)

Please Check:

☐ Payment enclosed.

☐ Purchase order or official letter enclosed.

☐ Reservation tentative pending authorization. **Registration Deadline: 20 December 1988**