

ANNOUNCEMENTS

THREE CONTINUING EDUCATION COURSES IN AMSTERDAM IN 1988

Particle–fluid separation and testing of dry powders are the subjects of three post-experience courses to be held in *Amsterdam* in the spring of 1988. The courses are sponsored by the Institution of Chemical Engineers.

A 4-day course on *Solid–Liquid Separation* is to be held 5–8 April, a 2-day course on *Bulk Powder Testing* on 11–12 April and a 3-day course on *Two-phase Separation with Cyclones* on 13–15 April.

All three courses are aimed at practicing engineers or scientists, are pragmatically orientated and use computer-assisted teaching methods. A leaflet with details and an application form may be obtained from the Course Director:

Dr L. Svarovsky
Deputy Chairman
Postgraduate School of Studies in Powder Technology
University of Bradford
Bradford, W. Yorks. BD7 1DP
England
Tel.: (0274) 733466, ext. 378 or 380
Telex: 51309 UNIBFD G

TWO-PHASE FLOW WORKSHOP: MODELLING OF MULTIPHASE SYSTEMS FOR INDUSTRIAL APPLICATIONS

A 5-DAY WORKSHOP
Santa Barbara, California
25–29 April 1988

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 1½-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. Hetsroni*. Nature of multiphase flow systems. Alternative strategies for modelling. Empirical modelling, multifluid modelling, phenomenological modelling. Flow regimes, regimes of heat transfer. Basic variables.
2. **Basic Equations:** *G. Yadigaroglu*. Routes to working equations, averaging control volume. Multifluid models and closure relationships. Jump conditions. Simplified equations. Empirical correlations. Limitations of modelling.
3. **Phase Equilibrium and Phase Change:** *T. G. Theofanous*. Phase equilibrium in single and multiple component systems. Nucleation, heterogeneous and homogeneous. Bubble growth and collapse. Non-equilibrium.
4. **Heat Transfer with Phase Change:** *G. Hetsroni*. Boiling heat transfer, nucleate boiling, forced convection, pre-dryout heat transfer. Multicomponent systems.
5. **Numerical Methods:** *S. Banerjee*. Initial and boundary conditions. Method of characteristics. Finite difference methods. Stability. Explicit and implicit methods. Methods used in computer codes.

Phenomenological modelling

6. **Dispersed Flow Systems:** *G. Hetsroni*. Behavior of single spherical phase element. Stokes flow, internal circulations. Non-spherical particles. Particle-wall interaction. Behavior of single droplets. Particle-turbulence interactions. Modelling of turbulent systems.
7. **Adiabatic Annular Flow:** *G. F. Hewitt*. Annular flow phenomena and modelling. Pressure drop and interfacial friction. Entrainment and deposition. Applications.
8. **Diabatic Annular Flows:** *G. F. Hewitt*. Annular flow heat transfer; onset and suppression of nucleation; convective heat transfer. Critical heat flux predictions. Multicomponent evaporators and condensers.
9. **Stratified Flow:** *S. Banerjee*. Modelling equations; Kelvin-Helmholz instability. Wave behavior. Turbulence in stratified systems; turbulent burst, effects of interface. Interfacial friction. Pipeline applications.
10. **Bubble, Slug and Plug Flow:** *G. F. Hewitt*. Bubble flow, bubble rise velocity, one-dimensional and drift-flux model of bubble flow, void distribution and turbulence. Plug flow, bubble rise velocity, wake effects, bubble entrainment. Slug flow; models for propagation and formation, fluid behavior in slugs, slug coalescence. Severe slugging in pipelines; slug catchers.
11. **Flooding and Down Flow:** *G. F. Hewitt*. Flooding phenomena in two-phase flows. Wave formation and growth. Alternatives in interpretation. Churn flow and churn annular flow.
12. **Post-dryout Heat Transfer and Rewetting:** *G. Yadigaroglu*. Post-dryout, non-equilibrium heat transfer regimes: transition boiling, inverted-annular and dispersed-flow film boiling. Rewetting of a hot wall.

Applications

13. **Nuclear Industry Applications I:** *G. Yadigaroglu*. Operational considerations. Loss-of-coolant accidents, small break, large break; emergency core cooling phenomena and their understanding. Reflooding and rewetting of the core.
14. **Nuclear Industry Applications II:** *T. G. Theofanous*. Severe accident scenarios and phenomena. Three Mile Island. Chernobyl. Vapor explosions. Debris-bed cooling.
15. **Steam Generators:** *G. Hetsroni*. Conventional and nuclear systems. Design problems. Operational problems; corrosion, vibration.
16. **Process and Petroleum Design Applications:** *G. F. Hewitt*. Process boilers; waste heat recovery, reboilers. Condensation and condensers; single component and multicomponent condensation, forms of condenser, condenser design methods. Pipelines.
17. **Space (Microgravity) Applications:** *T. G. Theofanous*. Two-phase phenomena in microgravity environment; heat transfer and flow regimes. Space boiling and condensation systems.
18. **Applications in Chemical Plant Safety Assessment:** *S. Banerjee*. Release mechanisms and blowdown. Level swell phenomena. Environmental release.

THE LECTURERS

Sanjoy Banerjee is Professor and Chairman of the Department of Chemical and Nuclear Engineering, University of California—Santa Barbara. He also serves the University as Co-Director of the Center for Risk Studies and Safety. Previously in Canada, he occupied the positions of Westinghouse Professor of Engineering Physics at McMaster University and of Acting Director of Applied Science in the Whiteshell Nuclear Research Establishment. He was a founding member of the Canadian Advisory Committee on Nuclear Safety and serves as a consultant to governmental and industrial organizations in several countries. He is a member of several Editorial Boards and has served as Chair of the American Nuclear Society Thermal Hydraulics Division.

Gad Hetsroni is Danciger Professor of Engineering at Technion—Israel Institute of Technology. Presently he is Visiting Professor, University of California—Santa Barbara. He has occupied positions at Westinghouse, EPRI and Stanford University in the U.S.A. He has also served as Director of the National Council for Research and Development in Israel and as Dean of the Faculty of Mechanical Engineering at Technion. He has worked on many different aspects of two-phase flow and is the founder and Editor of the *Int. J. Multiphase Flow* and Editor of the *Handbook of Multiphase Systems*.

Geoffrey F. Hewitt is Head of the Thermal Hydraulics Division at the Harwell Laboratory and Professor of Chemical Engineering at the Imperial College of Science and Technology in England. His Division at Harwell is the center for the Heat Transfer and Fluid Flow Service (HTFS). Dr Hewitt has published widely in two-phase flow and heat transfer, including books on annular two-phase flow and measurement methods. He is Editor and Editorial Board Member for a number of international journals and a member of the Editorial Board of the *Heat Exchanger Design Handbook*.

Theofanis G. Theofanous is Professor of Chemical and Nuclear Engineering and Director of the Center for Risk Studies and Safety at the University of California—Santa Barbara. He has consulted extensively on the subjects of two-phase flow, heat transfer and safety with various offices of the U.S. Nuclear Regulatory Commission and in particular with the Advisory Committee on Reactor Safeguards, an association that continues after 15 years. He is an Editor of *Nuclear Engineering and Design* and remains active in the Thermal Hydraulics Division of the American Nuclear Society.

George Yadigaroglu is Professor of Nuclear Engineering and Director of the Nuclear Engineering Laboratory at the Swiss Federal Institute of Technology in Zurich (ETHZ). He was previously Professor of Nuclear Engineering at the University of California—Berkeley and from 1979 until 1982 he served as Head of the Nuclear Regulatory Service of the Greek Atomic Energy Commission. He has done research and has actively consulted for various organizations and national laboratories on a range of two-phase flow and heat transfer topics. He is a member of the Editorial Board of *Experimental Heat Transfer* and an Associate Editor of the *Int. J. Multiphase Flow*.

COURSE DIRECTORS

S. Banerjee and G. Hetsroni

REGISTRATION INFORMATION

Registration is requested by 1 April 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 1 April.

ENROLLMENT APPLICATION				DO NOT WRITE IN THIS BOX	
Mail to: University of California Extension Santa Barbara, CA 93106 Phone: (805) 961-4143					
Make all checks payable to: THE REGENTS OF THE UNIVERSITY OF CALIFORNIA					
SOCIAL SECURITY NO.	COMPANY/AGENCY	TITLE	DEGREE		
FIRST NAME AND MIDDLE INITIAL			LAST NAME		
ADDRESS					
CITY	STATE	ZIP CODE	DAYTIME PHONE	TELEX	
TWO-PHASE FLOW FUNDAMENTALS		X461	EDP 71053	FEE: \$1000 (U.S.)	
Please Check:		I wish to stay at the Sheraton Santa Barbara at the specially reserved room rate of \$75/night <input type="checkbox"/>			
<input type="checkbox"/>	Payment enclosed.				
<input type="checkbox"/>	Purchase order or official letter enclosed.		Amount enclosed to cover room at Sheraton Santa Barbara _____		
<input type="checkbox"/>	Reservation tentative pending authorization.		Registration Deadline: 1st April 1988		

WORKSHOP FEES

Registration fees are \$1000 (U.S.) and include lecture notes, copies of all slide notes, reception and workshop banquet. Participants may stay at the Sheraton Santa Barbara at the special room rate that has been reserved for the workshop of \$75/night. The lectures will be conducted at the Sheraton. Because of space limitations, participants are urged to register well before the deadline.

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

*The University of Tulsa's Division of Continuing Engineering Education
 Presents the Following 1988 U.S. & International Production Schools to the
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 Tulsa, OK 74104
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