

7. **Two-phase Flow in Horizontal and Inclined Pipes:** *G. F. Hewitt*. Stratified flow; simple and more advanced models, turbulence. Slug flow; flow behaviour in slugs, slug frequency and velocity.
8. **Closure Relationships:** *G. Yadigaroglu*. Interfacial area. Wall and interface friction. Relationships between void fraction and interfacial friction. Interfacial heat transfer. Empirical closure laws.
9. **Two-phase Heat Transfer:** *G. Hetsroni*. Regimes of heat transfer. Boiling heat transfer; nucleate boiling, forced convection. Correlation and models. Critical heat flux: mechanisms and correlations.
10. **Dryout and Post-dryout:** *G. Yadigaroglu*. Post-dryout heat transfer; non-equilibrium heat transfer regimes, transition boiling, inverted annular and dispersed flow film boiling.
11. **Multidimensional Modelling:** *S. Banerjee*. Basic multidimensional equations. Direct simulation. Large eddy simulation. Turbulence modelling; three-dimensional.
12. **Instabilities in Two-phase Flow:** *G. Yadigaroglu*. Modes of instability, fundamentals, mechanisms. The Ledinegg instability, flow distribution instabilities, density wave oscillations etc. Analytical tools, stability maps, BWR stability.

#### *Applications*

13. **LOCA Phenomena:** *G. Yadigaroglu*. Loss-of-coolant accidents, small-break, large-break; emergency core cooling phenomena and their understanding. Reflooding and rewetting of the core.
14. **Steam Generators:** *G. Hetsroni*. Nuclear steam generators. Design considerations. Operational problems; corrosion, vibration etc. Extension of lifetime.
15. **Process Boilers and Condensers:** *G. F. Hewitt*. Process boilers, waste heat recovery, reboilers, operational problems. Process condensers; selection of pipe venting, multicomponent systems.
16. **Computer Codes:** *G. F. Hewitt*. Generic approach in computer codes for nuclear reactor transient analysis. Specific codes (RELAP, TRAC etc). Achievements and limitations of codes. Future development and applications in nuclear and non-nuclear systems.
17. **Severe Accidents:** *G. Yadigaroglu*. Severe accident scenario and phenomena. Vapour explosions. Debris-bed cooling etc.
18. **Space and Microgravity Applications:** *S. Banerjee*. Two-phase phenomena in a microgravity environment heat transfer and flow regimes. Space boiling and condensation systems.

#### HOTEL INFORMATION

Participants may stay at the Sheraton Santa Barbara at a special room rate of \$89/night. Please contact the hotel directly [*Tel:* (805) 963-0744 or *Fax:* (805) 962-0985] and mention the workshop.

#### REGISTRATION INFORMATION

Registration is requested by **20 January 1991**. To request space after this date call (805) 893-4993 or 893-3456. No refunds will be granted after this date unless the workshop is cancelled. To secure registration, send registration form plus payment prior to **20 January**.

#### WORKSHOP FEES

Registration fees are \$1100(U.S.) and include lectures notes, copies of all slide notes, reception and workshop banquet. 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 S. BANERJEE  
*Tel.* (805) 893-4993 *Fax:* (805) 893-3456**

#### SHORT COURSES

on

### MULTIPHASE FLOW AND HEAT TRANSFER: BASES, MODELLING AND APPLICATIONS IN (A) THE NUCLEAR POWER INDUSTRY AND (B) THE PROCESS INDUSTRIES

*Hosted by*

Swiss Federal Institute of Technology (ETH), Zurich, Switzerland

*18–22 March 1991*

The modular courses feature coordinated, comprehensive series of lectures by experts and are of interest to practising engineers and to researchers who wish to obtain a condensed and critical view of present basic

knowledge (Part I) or information on the state of the art regarding applications in specialized industries (Parts IIA and IIB).

The courses aim at an interdisciplinary transfer of knowledge. Emphasis this year is on: numerical methods and codes; nuclear and non-nuclear severe accident phenomena; and oil-gas transport.

*The lecturers*

**Sanjoy Banerjee**, Professor at the Department of Chemical and Nuclear Engineering, University of California, Santa Barbara, U.S.A.

**Michael L. Corradini**, Professor of Nuclear Engineering and Engineering Physics at the University of Wisconsin, Madison, U.S.A.

**Gad Hetsroni**, Danciger Professor of Engineering at Technion—Israel Institute of Technology, Haifa, Israel.

**Geoffrey F. Hewitt**, Professor of Chemical Engineering at Imperial College of Science, Technology and Medicine, London, England.

**Rene V. A. Oliemans**, Head of the Fluid Flow Section at the Koninklijke/Shell Laboratorium in Amsterdam (KSLA) and Visiting Professor of Multiphase Flow at the Technical University of Delft, The Netherlands.

**George Yadigaroglu**, Professor of Nuclear Engineering at the Swiss Federal Institute of Technology in Zurich (ETHZ) and Head of the Thermal-Hydraulics Laboratory at the Paul-Scherrer Institute, Switzerland.

*Contents of lectures*

**Part I. Bases**

1. Introduction and basics
2. Basic equations
3. Flow regimes, pressure drop and void fraction
4. Two-phase flow in vertical pipes
5. Two-phase flow in horizontal and inclined pipes
6. Closure relationships
7. Two-phase heat transfer
8. Post-dryout heat transfer
9. Numerical methods
10. Multidimensional modelling
11. Computer codes
12. Instabilities in two-phase flow

**Part IIA. Water Reactor Applications**

- 13A. LOCA phenomena
- 14A. Severe accidents
- 15A. Codes for transient and accident analysis
- 16A. Severe accident codes
- 17A. Steam generators
- 18A. Vapor explosions

**Part IIB. Process and Petroleum Industry Applications**

- 13B. Multicomponent heat and mass transfer
- 14B. Emergency relief system vent sizing
- 15B. Two-phase flow in the petrochemical industry
- 16B. Dense gas and mist dispersions
- 17B. Oil/water/gas flows: characteristics and measurement
- 18B. Vapor-cloud explosions

For further information contact:

Professor G. Yadigaroglu  
ETH-Zentrum  
CH-8092 Zurich, Switzerland  
Tel. (41-1) 256.4615

---

*Call for Papers*

**9th CONFERENCE ON HEAT TRANSFER ORGANIZED BY UIT  
WITH THE COOPERATION OF THE UNIVERSITY OF PISA**

The 9th Conference on Heat Transfer of the Italian Union of Thermofluidynamics will be held in the second week of June 1991 in Pisa, Italy. The exact location and date of the conference will be fixed shortly and communicated in a second announcement.