

REGISTRATION FORM

Name _____

Designation _____

Highest Degree _____

Department _____

Institute/Org. _____

Full Address _____

Fax: _____ Phone: _____

E-mail: _____

Research Interests:

**Recommendation of Head of
Institute/Organization with seal**

COURSE DURATION: Jan 03 – 08, 2011

Probable Speakers for the Course:

J. Akhtar (CEERI Pilani)
D. Kunzru (IITK/Chemical Engg.)
V.K. Jain (IITK/ Mechanical Engg.)
M.K. Das (IITK/Mechanical Engg.)
K. Kar (IITK/Material Sc and Mech. Engg.)
A.K. Saha (IITK/Mechanical Engg.)
A. Ghatak (IITK/Chemical Engg.)
S. Khandekar (IITK/Mechanical Engg.)
S. Panda (IITK/Chemical Engg.)
S. Bhattacharya (IITK/Mechanical Engg.)
B. Bhattacharya (IITK/Design and Mech. Engg.)
K. Muralidhar (IITK/Mechanical Engg.)
U. Das (IITK/Electrical Engg.)
P.K. Panigrahi (IITK/Mechanical Engg.)

ACCOMMODATION:

Accommodation for the duration of the course will be arranged in the Visitors Hostel of the Institute.

HOW TO APPLY:

The course is limited to 30 QIP participants and 15 sponsored by the Industry.

Faculty of Engineering Colleges:

Those interested in attaching the course are requested to complete the enclosed registration form in all respects. A **Draft** of **Rs. 200/-** payable to **COORDINATOR, CONTINUING EDUCATION PROGRAM, IIT KANPUR** should accompany the completed form. This amount is a caution deposit and will be refunded to participants on completion of the course. TA will be paid to teachers as per QIP norms and will be limited to sleeper class train travel. DA will be paid as per rules.

Professional Engineers:

Course Fee Rs. 6000/-

The **Draft** for the **course fee** should be made payable to **COORDINATOR, MICRO SCALE ENGINEERING**. The participants would have to bear their own travel and stay expenses.

Last Date of Submission: Nov. 1st, 2010

Dr. P.K. Panigrahi

Professor,

Department of Mechanical Engineering
Indian Institute of Technology Kanpur

Kanpur – 208016 Uttar Pradesh

Phone: (O) 0512-2597686 (R) 0512-2598307

Fax: 0512-2597408 E-mail: panig@iitk.ac.in

Announcement

A short Term Course

On

Micro Scale Engineering

January 03 – 08, 2011

Sponsored under the

Quality Improvement Program

Ministry of Human Resources Development

Government of India



Department of Mechanical Engineering

Indian Institute of Technology, Kanpur

Coordinator

Prof. P.K. Panigrahi

Course Content
A short Term Course (under QIP)
January 03 – 08, 2011
Title: **Micro Scale Engineering**

12. Measurement techniques: Velocity, Temperature and concentration measurements, LIF, PIV, LCT, IRT

In recent years, many prototype devices of Micro-Electro-Mechanical-Systems i.e. micro sensors, micro actuators, micro mixers, micro pumps, micro valves etc. have been developed. The optimization in performance of these devices requires understanding of fundamental concepts i.e. breakdown of constitutive laws and new flow regimes etc. Many fundamental issues that are not observed in macro flows are prominent in micro scale fluid dynamics. The Reynolds number is much less than unity due to small transverse length scales. However, the velocity gradient is quite high leading to high viscous forces. Thus, the hydrodynamic pressure drops in a single fluidic network is quite high and the design of micro pump is no more trivial. Therefore, electrokinetic and surface tension forces are used as alternatives to move the bulk fluid. The high viscous damping affects the probability of hydrodynamic instabilities, essential for effective mixing. Thus, concept at chaotic mixing as an alternative strategy in an active field of research. In biological applications, molecular structural changes electrical charges, and polar structures are frequently encountered leading to different mechanics in micro scale. Overall, there are fundamental difference in micro flows from macro flows in the following areas:

- Surface dominated effects
- Low Reynolds number effects
- Non-continuum effects
- Multi scale effects

This course is directed to the researchers in multi disciplinary areas i.e. Civil Engg. Chemical Engg. Biotechnology, Aerospace Engg and Mechanical Engg. Fabrication of micro devices, associated theoretical concepts and characterization tools will be discussed.

Course Content:

1. Micro fabrication: Photo lithography, Etching, Laser based micro machining, Bonding techniques.
2. Micro channel flow: Hydraulic Resistance, series & parallel network.
3. Micro scale Transport phenomena: Slip effect, Liquid slip mechanism, Physical parameters, Thermal creep, Diffusion equation, Reacting flat plate, Reverse osmosis.
4. Charged species flow: Electro-hydrodynamic transport, Ionic mobility, Electrokinetic phenomena, Electric double layer, Electrophoresis, Electroosmosis, Electroosmotic pump.
5. Surface tension: Contact angle, Young-Laplace equation, Coating flows, Capillary motion, Diffuse capillary flow.
6. Micro scale conduction: Energy carries, Time and length scales, Hyperbolic heat conduction equation, Boltzmann transport theory, Thin Film conduction, Laser heating.
7. Micro scale convection: Temperature jump, Brinkmann number, Viscous heating.
8. Micro heat pipe: Capillary pressure, Liquid pressure drop, Vapor pressure drop, Capillary limit, Viscous limit, Sonic limit, Entrainment limit, Boiling limit.
9. Flow control: Actuator requirement, Sensor requirement, Micro synthetic jet, Micro flap, Micro ballon, Shear stress sensor, Oil-film interferometry, Liquid crystal sensors, Bio sensors.
10. Two phase flows: Two phase poiseuille flow, Gas bubbles in micro channel, Plug motion in capillary, Micro drops, Marangoni convection in drops, Electro wetting, DNA Arrays.
11. Magnetophoresis: Magnetic beads, Bio separation, Magnetic particle motion