ELECTROKINETICS IN POROUS MEDIA

Overview

Electrokinetic phenomena are a generic term applied to effects associated with the movement of ionic solutions near charged interfaces. It involves the relative displacement of solid or fluid drops in a fluid medium or two immiscible fluids with a charged interface. The transport of charged fluids, colloids or liquid/ gas bubbles of sizes on the scale of a micro/nano meter in a liquid medium is often a concern in microfluidic devices. When a solid surface is brought in contact with an electrolyte a charge density appears at the solid-fluid interface due to the dissociation/ association reactions of charge groups. The charge on the surface is then balanced by counter charges of the electrolyte to form a electric double layer, which consists of an inner compact layer where ions are strongly adhere to the surface (the Stern layer) and a outer diffuse layer develops in which the ions are distributed according to the Coulombic interactions and thermal agitation. In the diffuse layer, the ions are loosely connected and can diffuse by an external mechanism such as electric field. The electrokinetic transport has been proposed as the most convenient means to transport bio-fluids through micro- and nanochannels, analyzing DNA sequencing, protein analysis, drug delivery, geotechnical engineering, sound design and micro electromechanical systems (MEMS). Due to its universality in applications, a thorough understanding of electrokinetic phenomena is of utmost important. The present course will focus on modeling and numerical solutions of electrically driven flow in micro- and nano-scale, cross-coupling flows in partially saturated porous media based on electrokinetic couplings including the effects of ion filtration. The second part of this course will cover topics such as, electrophoresis, transport of biomolecules, steady/unsteady flow in porous media, and applications in MEMS. The numerical algorithms based on the finite volume methods to solve the governing mathematical models will be described.

Internationally acclaimed academic researcher and practitioner with proven knowledge, experience, and demonstrable ability in teaching, consultancy, research, and training in the field of electrokinetics in porous media will deliver lectures and discuss cases in the course. The course will be planned and offered as per the norms set by IIT Roorkee.

Objectives

The primary objectives of the course are as follows:

i) Demonstration of a thorough analytical understanding of electro kinetics phenomena,
ii) Introduction to mathematical model and CFD based simulation of electrokinetics,
iii) Presentation of a condensed, critical and updated view of basic knowledge and future developments, in relation to systems and phenomena encountered in industrial and biological applications,
iv) Electrokinetic coupling effects associated with the flow of the pore water in porous media under steady state and transient operating conditions,
v) Interdisciplinary transfer of knowledge from one area of applications to another related to electrokinetic flow,
vi) Understanding the utility of electrokinetics and its application,
vii) Electro-osmotic and electrophoretic transport phenomena in porous domain.

Experts in the field of electrokinetics on porous media will conduct the course, which will be planned and offered as per the norms set by the GIAN programme. Course participants will be provided exposure to all the related topics through lectures and hands-on exercises. Case studies and group assignments will also be shared to stimulate research motivation of participants.

Modules	**A: Duration : November 27 – December 08, 2017 (12 days)** **B: Venue : Department of Mathematics** **Indian Institute of Technology Roorkee** Number of participants for the course module will be limited.
You Should Attend If…	Participants from Industry, Research, Government and Non- Government Organizations, Faculty and Students from Institutions all over the world who are interested in the course are welcome to register.
Fees	The participation fees for attending the course are as follows: **Participants from abroad:** US $ 500 **Industry:** Rs. 15,000/- **Officers of Govt. Organisations/NGOs:** Rs. 10000 **Faculty or Scientists of Research / Academic Institutions:** Rs. 10000 **Students of Academic Institutions-:** Rs. 3000 The above participation fee includes soft copy of all instructional materials, laboratory and computer use for tutorials and internet facility. The participants will be provided with single/double occupancy accommodation on **payment basis** at the IITR/NIH guest house. Hotel accommodation may also be arranged on **payment basis** at nearby places, if requested. For more details please visit ***www.iitr.ac.in***

The Faculty

Prof. **André Revil** is Directeur de Recherche at UMR ISTERRE (CNRS), Université de Savoie Mont-Blanc. He studied for his doctorate at the Ecole de Physique du Globe de Strasbourg. He held an associate professor position at the Colorado school of Mines and a chargé de recherche position at CNRS. He investigates various numerical methods for the simulation of electrokinetic flow with applications for hydro geo physics and porous media flow. He has published more than 234 research papers in reputed international journals. He received the Fellowship for outstanding young scientists (ACI-Jeune Chercheur) and the Bronze Medal of CNRS; he is a Fellow of the American Geophysical Union. He published two books in the field of electrical properties of porous media.
Webpage: http://www.andre-revil.com
Contact email id: andre.revil@univ-smb.fr

Prof**. Somnath Bhattacharyya** is a Professor at the Department of Mathematics, IIT Kharagpur, West Bengal, India. He has received his Ph.D. degree from IISC, Bangalore India. His research interest involve Computational Fluid Dynamics and Microfluidics Modelling. He has received several awards and fellowships for research collaboration in USA, UK and Germany, which includes the BOYSCAST, DST fellowship, EPSRC, UK fellowship, Max-Planck fellowship etc. He has published more than ninety research papers in reputed international journals of high impact factor like Journal of Fluid Mechanics, Physics of Fluids, Physical Review E, Soft Matter (RCS), International Journal of Heat and Mass Transfer, Chemical Engineering Science etc.
web page: http://facweb.iitkgp.ernet.in/~somnath

Dr. **Ameeya Kumar Nayak** is a Associate Professor of Department of Mathematics at the IIT Roorkee, Uttarakhand, India. He has received his Ph.D. degree from Department of Mathematics, IIT Kharagpur, India. He has received several fellowships for research collaboration in Norway, USA and Germany. His research contributions are in the electrokinetics and mass transfer in micro and nano domains. He has published more than 30 research papers in reputed international journals. He is proactive in industrial research and book writing in the area of electrokinetics and reactor modeling.

Contact email id: nayakfma@iitr.ac.in

Course Co-ordinator

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REGISTRATION AND ACCOMODATION REQUEST FORM
(To reach electronically by 30th October, 2017)

ELECTROKINETICS IN POROUS MEDIA
November 27-December 08, 2017
Department of Mathematics
Indian Institute of Technology Roorkee
Roorkee, Uttarakhand

After Completion, please mail to: **Dr. Ameeya Kumar Nayak** **Department of Mathematics** **Indian Institute of Technology Roorkee** **Uttarakhand-247667, India** Phone: +91-1332284777 (O) +91-1332286777 (R), +91-9634972590 E-mail: nayakfma@iitr.ac.in Alternate mail id: ameeyakumar@gmail.com	**Affix passport size photograph**

1. Name of applicant (in block letters): Ms./Mr. /Dr. ……..

2. Status (Mark anyone): Student….., Not a student……..

(a) If a Student:
Academic program under which registered currently……
Date since when registered…….
Name of Academic/ Research Institution……

(b) If not a Student
Nature of employment (Teaching, Research, Govt. service, NGO, Industry)……..
Organization where employed……
Employed since…….
Designation……
Academic qualifications……

3. Full Postal Address for Communication:

4. E-mail id:

5. Phone numbers: Mobile……., Landline……..

Date: **Signature of applicant**

Note:

(i) Application should reach Mathematics Department Office at the above address latest by 30th October, 2017. Scanned copy may be sent by e-mail.
(ii) The seats are limited and will be filled generally on the first come first serve basis. Decision of the course coordinator will be final in this regard.
(iii) Please start your travel to Roorkee to attend the course only if you have received a formal confirmation.