Role of Fluid Flow and Mass Transport in Porous Media for Design of Chemical Reactors for Groundwater Remediation

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Overview

Gorundwater water flow and mass transport constitutes one of the most important components of the natural hydro-environmental systems. The vulnerability of groundwater to various pollutants urge for the development of appropriate remediation techniques of polluted ground water. The proposed course is based on the reasoning that designing a program for remediating environmental pollutants in the groundwater requires a thorough knowledge of fluid flow and mass transport processes in the subsurface as well as the issues relating to the design and optimization of chemical reactors.

Permeable reactive barrier (PRB), which is a low-cost technology to clean or remediate the contaminated groundwater, has gained significant acceptance worldwide, although its use/application in the Indian conditions have not been explored to a large extent. Dissemination of knowledge on topics involving PRB in the Indian context, is therefore, an ideal step in mitigating and remediating various groundwater aquifers of the country. The overarching objective of this course is to develop an understanding of the design of chemical reactor for treatment of environmental pollutants in the subsurface (saturated and unsaturated regions) and their dependence on the fluid flow and mass transport in these domains. Modeling is an essential tool in understanding and designing the bio-physico-chemico processes involved in contaminant transport processes. It is necessary for a reliable/realistic model to answer several relevant questions, such as, what is the purpose of the predictive calculations, what level of precision is expected, what are the advantages and disadvantages of the developed approach, etc. For this reason, the application of model in designing PRBs is emphasized in this course.

On completion of this course, the participants should be able to develop an understanding of the general theories of flow and mass transport in porous media, reactor design and optimization, parameter estimation using appropriate experimental techniques, and determine the relationships between the parameters and, coupled processes that govern contaminant transport and remediation. The participants should also be able to appreciate how to integrate theory and practice to analyse specific contamination problems and develop concepts for the remediation of the environmental pollutants. This course is organized for one week involving 15 hours of lectures, 5 hours of tutorials and 4 hours of laboratory demonstration. The lecture notes, case studies, and assignments will be shared to stimulate research motivation of participants.

Modules	Single Module of one week from **20th August-2018** to **24th August 2018** **(Number of participants for the course will be limited to fifty.)**
You Should Attend If…	▪ You are an environmental engineer / subsurface hydrologist / chemical engineer / interested in designing and implementing Permeable Reactive Barriers for groundwater remediation. ▪ You are scientists from governmental or private R&D Laboratories and Industries (Oil, Chemicals, etc.) associated with environmental projects and interested to learn on remediation techniques. ▪ You are a student or faculty from academic institution interested in learning principles and how to do research on PRBs for remediation.
Fees	The participation fees for taking the course is as follows: **Participants from abroad : US $500** **Industry/ Research Organizations: INR 15000** **Academic Institutions (Faculty): INR 5000** **Academic Institutions (Students): INR 1000** The above fee include all instructional materials, computer use for tutorials and assignments, laboratory equipment usage charges, 24 hr free internet facility. The participants will be provided with accommodation on payment basis.

The Faculty

Dr. Diganta B. Das is an Associate Professor/Senior Lecturer of Chemical Engineering, and the Theme Leader of the Process Engineering Research Group in the School of Automotive, Aeronautical, Chemical and Materials Engineering at Loughborough University (LU), Leicestershire, UK. Dr. Das is also the Deputy Academic Lead of the University Global Research Challenge on Changing Environment and Infrastructure. He also helps co-ordinate the water engineering related research activities within the recently formed Midlands Innovation Partnership (MIP) of 8 Midlands Based Universities in the UK. His broad research interests are – multiphase flow in porous media; dynamic capillary effects; groundwater contaminant and solute transport; and solid waste management, etc.

Dr. Suresh A. Kartha is an Associate Professor in the Department of Civil Engineering at Indian Institute of Technology, Guwahati. He has done his PhD in the area of flow and transport in porous media from IIT Kanpur and thereafter joined IIT Guwahati as a faculty. His broad research interests are – flow and transport through porous media; landfill leaching; heap leaching of metals; groundwater flow and contaminant transport; hydrology; and numerical modeling; etc.

Course Co-ordinator

Dr. Suresh A. Kartha
Phone: 0361 2582422
E-mail: kartha@iitg.ac.in

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http://www.gian.iitkgp.ac.in/GREGN

How to enroll and register for the course

Please follow the following steps for registration:

- Go to GIAN website http://www.gian.iitkgp.ac.in/GREGN (First time users need to register and pay a one - time fee of INR 500/-)
- Select course: "ROLE OF FLUID FLOW AND MASS TRANSPORT IN POROUS MEDIA FOR DESIGN OF CHEMICAL REACTORS FOR GROUNDWATER REMEDIATION".
- Once you enroll for the course, an Enrolment/Application number will be generated, and the course coordinators will be notified.
- The course coordinators will shortlist the candidates out of the applicants and the shortlisted candidates will be notified by email.

Shortlisted applicants must pay the applicable fees using either by:

- Demand Draft (DD) drawn in favour of "Registrar, INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI", payable at IIT Guwahati. Please write your Name and Enrolment / Application number at the back of the DD, and post/courier it, to reach by 5th August 2018.

or

- Online Transfer of Money in the following account

Account Holder:	Registrar IIT Guwahati
Name of Bank:	State Bank of India, IIT Guwahati, Guwahati-781039
Account Number:	10196461054
IFSC Code:	SBIN0014262
SWIFT Code:	SBININBB159
MICR Code:	781002053

Shortlisted candidates need to fill the course registration form attached with this brochure and send it to the course coordinator along with DD or Online Payment Proof. Email the course registration form to the Course coordinator.

Indian students are advised to submit Demand Draft, which will be returned back on attending the full course.

Fees:

Student: INR 1000/- (Refundable)
Participants from abroad: US $500/-
Industry/Research Organizations: INR 15000/-
Academic Institutions (Faculty): INR 5000/-

REGISTRATION FORM

GIAN Course on

ROLE OF FLUID FLOW AND MASS TRANSPORT IN POROUS MEDIA FOR DESIGN OF CHEMICAL REACTORS FOR GROUNDWATER REMEDIATION

Name: _____

Designation: _____

Organization: _____

Address: _____

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_____

E-Mail: _____

Phone:_____

Mobile: _____

Fax:_____

Fees Payable to "Registrar IIT Guwahati"

Transaction No. or DD No._____

Dated: _____

Bank Name: _____

Rs. _____

Signature of Applicant

Detail Schedule and Content of Lectures (Tentative)

Day 1

Lecture 1: 2 hrs: (DBD)

Location of groundwater in reference to aquifer layers, vulnerability of groundwater to contamination, generic theories of fluid flow, mass transport and reactions in porous media involving single and multiple fluids phases; scales of observations; concept of representative elementary volume; methods of estimating significant parameters that govern these processes.

Lecture 2: 1 hr: (SAK)

Causes of groundwater contamination

– anthropogenic causes like leaching from waste dump landfills; leaking of oils from underground tanks; acid mine drainage; mine wastes; sewer pipe leakage; septic tank leakage; pesticide leaching due to fertilizer applications in farming; etc.

- natural causes like geochemical leaching of metals and other chemical species due to percolation of soil moisture through sedimentary rocks; salt water intrusion; etc.

Tutorial 1: 2 hrs: (DBD)

Hands on experience on theoretical calculation of important parameters; problem solving; assignment of group course work which involve preparing a status report based on literature review

Day 2

Lecture 3: 2 hrs: (DBD)

Surface and subsurface interactions for fluid flow and solute transport; coupled processes across free (e.g., underground lakes and large fissures) and porous domains underground; current approaches for modelling free and porous flow domains; boundary and interfacial conditions; experimental determination of significant parameters

Lecture 4: 1 hr: (SAK)

Mathematical formulations of finite-difference modeling of groundwater flow and solute transport

Tutorial 2: 2 hrs: (DBD)

Demonstration of modelling software; problem solving on lectured topics

Day 3

Lecture 5: 3 hrs: (DBD)

Design and optimization of in-situ chemical reactor (namely, plug flow reactor) for remediation of subsurface contaminants, e.g., permeable reactive barrier; important materials of construction; physico-chemical processes; design of laboratory experiments for PRB; modelling fluid flow in the reactor; practical issues related to implementation of chemical reactor; coupling reactors with other processes. e.g., biological and electro-kinetic processes

Lab Demo-1: 2 hrs: (SAK)

Flow of liquids in cylindrical columns filled with landfill refuse soil; Measurement of moisture content variations using Decagon moisture content sensors and data-loggers

Day 4

Lecture 7: 3 hrs: (DBD)

Bioremediation of aquifer system; modelling biological systems (used in for bioremediation); Monitoring for pollutants in hydro-environmental system - membrane based sensors

Lecture 8: 1 hr: (SAK)

NAPL contaminant transport theories in porous media; Examples of NAPL; Application of multi-phase transport for NAPL contamination; how the oil fields in Assam are polluting aquifers with NAPL; remediation strategy; etc.

Lab Demo-2: 2 hrs: (SAK)

Flow of liquids in trapezoidal heap shaped 3-dimensional apparatus filled with landfill refuse soil and normal (uncontaminated) soil; measurement of moisture content variations, soil-moisture potential, and temperature using decagon sensors and data-loggers

Day 5

Lecture 9: 2 hrs: (DBD)

Examples of Successes and Failures of Remediation Techniques; Monitoring for pollutants in hydro-environmental system - geoelectrical techniques / measurements for environmental monitoring

Tutorial 4: 1 hr: (DBD)

Group presentation by all groups on their coursework (assigned on Day 1); feedback to all participants on their performance; general discussions and future directions

Test/Quiz (multiple choice questions): 24 August 2018