Course Brochure

GLOBAL INITIATIVE OF ACADEMIC NETWORKS

सत्यमेव जयते
Ministry of Human Resource Development

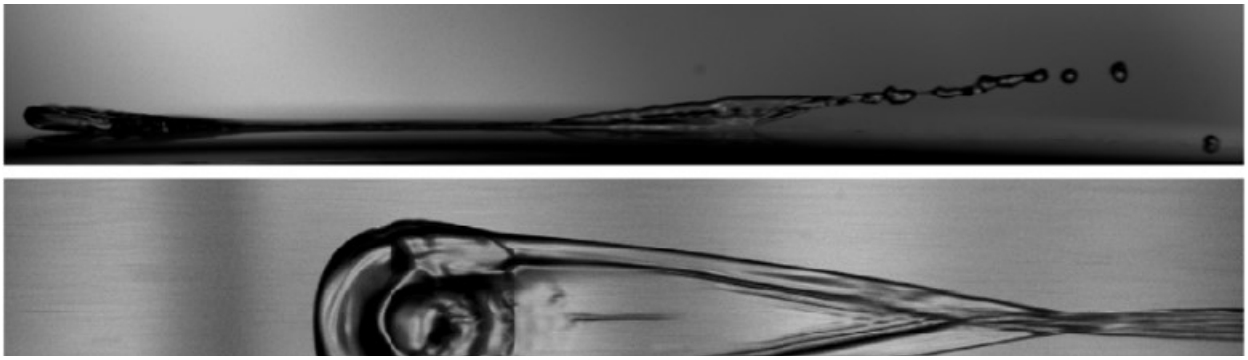
GLOBAL INITIATIVE OF ACADEMIC NETWORKS

International Programme – 2019

On

"Digital Microfluidics: Design & Applications"

(December – 2nd to 6th, 2019)



Droplet Impact on a Moving Solid Surface

Organized by

Department of Chemical Engineering

&

Department of Mechanical Engineering

Malaviya National Institute of Technology Jaipur

Jaipur – 302017 (Rajasthan), India

Digital Microfluidics: Design & Applications

About GIAN (An Initiative of Government of India)

Govt. of India approved a new program titled Global Initiative of Academic Networks (GIAN) in Higher Education aimed at tapping the talent pool of scientists and entrepreneurs, internationally to encourage their engagement with the institutes of Higher Education in India so as to augment the country's existing academic resources, accelerate the pace of quality reform, and elevate India's scientific and technological capacity to global excellence. GIAN is envisaged to catalyse higher Education Institutions in the country that will initially include all IITs, IIMs, Central Universities, IISc Bangalore, IISERs, NITs and IIITs, also subsequently cover good State Universities where the spinoff is vast. GIAN is an evolving scheme which will initially include participation of foreign faculty in Institutes as Distinguished / Adjunct / Visiting faculty / Professors of Practice. They will be delivering their expertise in Short or Semester-long Courses. In addition to Short/Long Term Courses other activities will also be included in due course of time.

GIAN is envisaged to achieve the following objectives:-

a) To increase the footfalls of reputed international faculty in the Indian academic institutes.
b) Provide opportunity to our faculty and students to learn and share knowledge and teaching skills in cutting edge areas.
c) To create avenue for possible collaborative research.
d) To increase participation and presence of international students in the academic Institutes.
e) Opportunity for the students of different Institutes/Universities to interact and learn subjects in niche areas through collaborative learning process.
f) Motivate the best international experts in the world to work on problems related to India.

About The Course

The recent trend for miniaturization of a verity of functions from chemical and biological assays, water and air quality sensors, drug discovery, and production of functional materials, has been led by various microfluidic systems and designs. Digital microfluidics (DMF) is a droplet-based microfluidic system with a planar geometry. The fluid manipulation in DMF is based on actuation of discrete droplets; as such, DMF rarely needs complicated geometries such as mechanical mixers, pumps or valves. The actuation can be based on electro-wetting principle, surface energy gradient, optical or thermal actuation, or a combination of these techniques. The droplet-based characteristics of DMF allows for parallel processing, so it can be scaled easily. The fabrication techniques for DMF can be sophisticated photolithography methods, or simple frugal methods such as ordinary paper based systems.

This course allows the students with different backgrounds ranging from biology, chemistry, to mechanical, and electrical engineering to learn the fundamental of DMF. The course will have two components: (1) lectures, and (2) experiential learning (hands-on training). The lectures will cover three topics: (i) fundamentals of drop manipulation, (ii) Design of DMF systems, and (iii) applications. The experiential learning component is composed of two types of activities: (i) peer learning about DMF, and (ii) hands-on fabrication of frugal DMF systems.

Parts of this 20 lecture series is adapted from core topics of an international course (i.e. the International Advanced Course on the Interface, Drops and Liquid Sprays Physics, LIDESP) which is held every year in different locations around the world (e.g. Germany, UK, and Taiwan), given by Prof. Amirfazli. Other tailor made lectures are based on expertise of Prof. Amirfazli in the field of droplets, and a graduate level course at the York University, consultation with colleagues such as Dr. E. Ghafarzadeh at the Department of Electrical and Computer Engineering, York University, and knowledge of available resources at the MNIT Jaipur to deliver a successful course.

Course Objectives

The course objective is to provide the participants with today's detailed knowledge on the physics of drops in the context of digital microfluidics, the most updated methods for fabrication and design of digital microfluidics devices and overview of application areas as it relates to mechanical, chemical and biological systems for advanced technological and industrial areas. Specific attention will be paid to the applications in life science, such as microdroplet management. Frugal fabrication methods will not only be presented to the participants, but also participants will be coached to make their own digital microfluidics system during the hands-on component of this course.

drop management in microscale, including micro structured surfaces will be treated in detail.

Course Content

Introduction to the course and its goal; various types of microfluidic systems and their applications, a discussion of the state of digital microfluidics in today's research and technology landscape.
The theory of capillarity (Laplace equation), and wetting (Young equation). Physics of micro-drops and their behavior in microsystems with hydrophobic, hydrophilic for smooth, textured and patterned surfaces.
A discussion of energy minimization that governs the shape of a static interface. A discussion of examples relevant to DMF, e.g. coalescence or splitting of drops.

Introduction to simulation tools such as Surface Evolver.
In this 1st experiential learning component of the course participants will try the Surface Evolver for simulating basic examples of energy minimization relevant to DMF.

Droplet adhesion force; contact angle hysteresis and pinning of droplets. A discussion of examples relevant to DMF, e.g. pinning of a droplet for dosing, or growing single crystals in a DMF system.

Hands-on design of frugal DMF based on paper (circuit design for intake, delivery, mixing and delivery to the analysis point). Fabrication methods for creating patterned surfaces and surface with energy gradient for digital drop manipulation. Special emphasis will be put on micro-contact printing methods and diffusion based patterning techniques.

Fabrication and design methods for electrowetting on dielectric (EWOD) based systems in digital microfluidics systems. Examples of various fabrication methods based on glass, silicon, and PCB substrates will be provided. Also, material choices will be

discussed.

Fabrication lab. Working in groups and under guidance of the instructor the participants in this experiential learning component of the course participants will try to fabricate PDMS based stamps to create patterned surfaces to make their own patterned surfaces to be used for the DMF practice design (L3).
Frugal digital microfluidics systems based on ordinary paper. Design and fabrication methods for paper based DMF will be presented.

Applications
Biomedical applications of digital microfluidics systems. This is by far the most advanced area for application of DMF systems.
Low cost graphite electrode design and fabrication experiential learning. In this session and the L6, participants will fabricate their own DMF system based on frugal DMF techniques.
Industrial application of digital microfluidics systems; examples from oil industry.
Environmental monitoring applications of digital microfluidics systems.
Closing thoughts on the future of DMF: opportunities and challenges.

Who Can Attend

- Faculty members from reputed academic institutions.
- Research scholars and postgraduate students from reputed academic institutions.
- Industry experts

The course is addressed to scientists, professionals, company engineers, R&D managers and graduate students in the fields of Engineering, Chemistry, Biology, Medicine, Applied and Fundamental Sciences. **This course is especially of interest to those dealing with phenomena involving drops and sprays, in order to get acquainted with the traditional background and the most recent developments of this discipline**.

Course Registration Process

Step 1: One Time Registration

Registration for GIAN courses is not free because of constraint in the maximum number of participants allowed to register for a course. In order to register for any course under GIAN, candidate will have to get registered one time first to GIAN Portal of IIT Kharagpur using the following steps: 1. Create login and password at http://www.gian.iitkgp.ac.in/GREGN/index 2. Login and complete the Registration Form. 3. Select Courses 4. Confirm your application and payment information. 5. Pay Rs. 500/- (non-refundable) through online payment gateway. 6.

Download and print "pdf file" of your enrolment application form for your personal records and copy of the same to be sent to the Course Coordinator.

Step 2: Institute Registration

1. Institute registration process is an offline process. Interested candidates are requested to download the Registration Form (docx/pdf).

2. Course Fee (Non-refundable):

The participation fee to attend the short course shall be:

Participants from Abroad -	US $ 100.0
Professionals from Industry/Research Organisations –	Rs. 5000.0
Faculty from Academic Institutions -	Rs. 3000.0
Research Scholars/Students -	Rs. 1000.0

The above fee includes the instructional materials, internet facility and snacks between the sessions. The accommodation will be provided on payment basis subject to availability on request otherwise participants will have to make their own stay arrangement.

3. The Registration fee has to be paid via Demand Draft/NEFT, in favour of ***"Registrar, MNIT Jaipur"*** payable at Jaipur. Payment can also be done through National Electronic Funds Transfer (NEFT) to the account of "Registrar, MNIT Jaipur" (Account No. : 676801700388 ICICI Bank, Branch MNIT Jaipur, IFSC Code: ICIC0006768.

4. Scan copy of the filled in "Registration Form" along with scan copy of "Demand Draft/ Receipt of NEFT" and Application Form generated in Step 1 must be sent via E-mail to the Course Coordinator of the programme ***asingh.mech@mnit.ac.in ; asmnitj@gmail.com ,*** on or before September 27, 2019.

5. Hard copy of the above mentioned documents must reach to the Programme Coordinator of the programme on or before June 30, 2016 by 5 PM. Postal address –

   Dr. Amit Kumar Singh
   Assistant Professor and Coordinator GIAN Course
   Department of Mechanical Engineering
   Malaviya National Institute of Technology Jaipur, J. L. N. Marg, Jaipur – 302017, Rajasthan, India

6. Duly filled registration forms should reach latest by September 27th, 2019.

7. Selection will be made purely on First Come First Serve Basis and Eligibility (Subject to fulfilling of the seats available).

8. Maximum forty (40) participants will be accommodated in the course.

9. The Brochure and the Registration Form may be downloaded from the Institute website www.mnit.ac.in.

Important Information

1. After successful completion of the course, all participants will get participation certificates alongwith grades and credits as per Institute norms.
2. No TA, DA will be provided to the participants.
3. Limited accommodation is available in the Institute campus which will be provided on First Come and First Serve Basis on payment mode.
4. Additional Fees for accommodation (if required):

   Rs 400/day for Students (Excluding Food Charges)* Rs 500/day for Faculty (Guest House-Twin Sharing basis, Excluding Food Charges)

   Food Charges on actual basis

THE FACULTY

Prof. Alidad Amirfazli

Prof. Amirfazli has produced exciting results in wetting behavior of surfaces, drop adhesion and shedding, understanding and application of super-hydrophobic coatings. He has more than 200 scientific contributions, many in prestigious peer reviewed journals. Before joining the York University in 2013 as the founding Chair of the Department of Mechanical Engineering, Alidad Amirfazli held the Canada Research Chair in Surface Engineering at the University of Alberta, Canada where he also served as the Associate Chair for Research (ME) between 2009 - 2012.

In 2014 Amirfazli was inducted into the Royal Society of Canada's College of New Scholars, Artists, and Scientists. He is currently serving as the President of the RSC's College of New Scholars, Artists, and Scientists. He is the Editor for the Advances in Colloid and Interface Science and Editorial board member of other journals. Dr. Amirfazli has been the recipient of the Martha Cook Piper Research prize, Killam Annual Professorship, and Petro-Canada Young Innovator Award.

COURSE COORDINATOR:

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About MNIT Jaipur

The college was established in 1963 with the name as **Malaviya Regional Engineering College, Jaipur** as a joint venture of the Government of India and the Government of Rajasthan, Subsequently; on June 26, 2002 the college has been given the status of National Institute of Technology and on 15 August 2007, Proclaimed Institute of National Importance through Act of Parliament. The Institute is fully funded by Ministry of Human Resource Development (MHRD), Government of India. More than 12,000 students have already been graduated since its establishment.

About Jaipur

Rajasthan's beautiful Pink City Jaipur, was the stronghold of a clan of rulers whose three hill forts and series of palaces in the city are important attractions. Known as the Pink City because of the colour of the stone used exclusively in the walled city, Jaipur's bazaars sell embroidered leather shoes, blue pottery, tie and dye scarves and other exotic wares. Western Rajasthan itself forms a convenient circuit, in the heart of the Thar desert which has shaped its history, lifestyles and architecture.

Tourist Interested Places are:

Jantar Mantar, Amber Fort, Moti Doongari and Lakshmi Narayan Temple, City Palace, Albert Hall (Museum), Hawa Mahal, Jaigarh Fort, Sisodia Rani Garden and many more.....

How Reach MNIT Jaipur

MNIT Jaipur is centrally located in Jaipur City famously known as "Pink City". Jaipur is one of famous tourist destination in India and situated around 250 Km from Delhi. One can reach Jaipur by Air, Train or Bus from different parts of India. Weather is generally pleasant in Jaipur in the Month of July.

The course is being organized by the Department of Mechanical Engineering & Department of Chemical Engineering. We look forward to your participation and support in making this conference a success.

Website:

MNIT Jaipur - www.mnit.ac.in
MHRD GIAN - www.gian.iitkgp.ac.in