

# FUNDAMENTALS OF MULTISCALE HEAT TRANSFER

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## Overview

Scientific advances in nanotechnology and nanoscience have grown leaps and bounds over the last two decades, and with that questions have emerged about suitably employing the knowledge gained from these investigations at the atomistic scale to the utilization of humankind. While the subject is multidisciplinary, mechanical engineering forms a significant part of research and development in nanoscale thermal sciences. For example, with the increasing number of transistors being squeezed into the microprocessor chip to enhance computer performance, novel thermal management strategies need to be designed for efficient energy removal from such small-scale devices and prevent formation of hot spots. Here, the length scales of the systems considered are comparable to those of energy (lattice vibrations known as phonons) and charge carriers (electrons), which make continuum theories insufficient to understand the molecular scale transport. Thus, for awareness of such contemporary scientific and technological challenges and to provide next generation of researchers with tools to address these problems, exposure to nanoscale heat transfer is important. A holistic representation of thermal transport problems varying across scales of length and time, require integrated discussions of continuum and molecular heat transfer topics.

This course will provide researchers across various scientific disciplines engaged with multiscale thermal management problems a broad exposure to analytical, numerical and experimental techniques that cohesively describe heat transfer processes across nano-to-macro length scales. A “bottom-up” strategy will be adopted and the uniqueness of this course offering lies on its cross-disciplinary character by bridging the boundaries of engineering and pure sciences.

<b>Modules</b>	<b>A: Nano/microscale heat transfer : March 12 - March 14</b> <b>B: Micro/continuum heat transfer : March 15 – March 16</b> <b>Number of participants for the course will be limited to thirty.</b>
<b>You Should Attend If...</b>	<ul style="list-style-type: none"><li>▪ you are an electronics or mechanical or materials engineer or researcher interested in designing novel thermal management solutions for packaging and nanomaterial applications.</li><li>▪ you are scientist interested in understanding fundamental energy transport processes in metals, semiconductors and dielectrics</li><li>▪ you are a student or faculty from academic institution interested in learning about how the nanoscale atomic features contribute to macroscopic thermal properties</li></ul>
<b>Fees</b>	The participation fees (excluding GST of 18%) for taking the course is as follows: <b>Participants from abroad: US \$500</b> <b>Industry/ Research Organizations: Rs 25,000/-</b> <b>Academic Institutions: Rs 10,000/-</b> <b>Students &amp; Research Scholars: INR: 3,000/-</b> The above fees include all instructional materials, computer use for tutorials and assignments, laboratory usage charges, free internet facility. The participants will be provided with accommodation on payment basis. (for details of fee payment – please see page 3)

## The Faculty



**Dr. Ganesh Balasubramanian** is an Assistant Professor of Mechanical Engineering at Iowa State University. His research and teaching interests are in computational materials engineering, nanoscale thermal and fluid transport, structural and mechanical properties of multi-component systems, developing novel curriculum for teaching emerging technologies.



**Dr. Sandip Kumar Saha** is an Assistant Professor of Mechanical Engineering at Indian Institute of Technology Bombay. His research interests include thermal management of electronics, thermal storage system for solar thermal applications, green buildings, heat transfer and computational fluid dynamics.

### For Registration

**First register at GIAN site:** <http://www.gian.iitkgp.ac.in/GREGN>

**Then sent Application with Fees to Course coordinators:**

**Prof. Sandip Kumar Saha,**  
Course Coordinators,  
Department of Mechanical Engineering,  
Indian Institute of Technology Bombay,  
Powai, Mumbai – 400 076  
Phone: +91 22 25767392  
Fax: +91 22 2572 6875  
Email: [sandip.saha@iitb.ac.in](mailto:sandip.saha@iitb.ac.in)

**Deadline for submitting application: 26 February, 2018**

**Notification of acceptance: 28 February, 2018**

- Incomplete application forms will not be entertained.
- For additional copies of the registration form, please photocopy or type in the format given. For further details: <http://www.iitb.ac.in/~cep/>

### **Boarding & Lodging**

Limited accommodation is available in the Institute Guest house/ Hostels for a very limited number of participants on payment as per actual and with advance request.



## Course Coordinator

**Prof. Sandip Kumar Saha**  
Phone: 022 2576 7392  
E-mail: [sandip.saha@iitb.ac.in](mailto:sandip.saha@iitb.ac.in)

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

**GIAN Short Term Course on**  
**FUNDAMENTALS OF MULTISCALE HEAT TRANSFER**

**12 – 16 March 2018**

**Registration Form**

Name (in block letters): \_\_\_\_\_  
\_\_\_\_\_

Qualification: \_\_\_\_\_

Designation: \_\_\_\_\_

Organization: \_\_\_\_\_

Mailing Address: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Mobile: \_\_\_\_\_

Fax: \_\_\_\_\_

Email: \_\_\_\_\_

Payment: Rs: \_\_\_\_\_

DD No.: \_\_\_\_\_ Dt: \_\_\_\_\_

(DD in favour of "Registrar, IIT Bombay – CEP a/c")

**Or NEFT/ RTGS**

(Please furnish the foll. details if NEFT/RTGS)

Name of A/c Holder:

UTR NO./Transaction ID:

Name of Bank & Branch:

Date of Payment:

Amount:

IIT Guest House/ Hostel accommodation required:

YES / NO

Signature of Applicant: \_\_\_\_\_

Date:

**Venue for Classes**

Classes will be held in Seminar Hall of Van Vihar Guest House, IIT Bombay.

**Lecture Notes**

To fully realize the objectives of the course, the lecture notes will be made available at the time of registration at IIT Bombay.

**Date & Time of Registration:**

12<sup>th</sup> March 2018, 9.00 AM at Van Vihar Guest House, IIT Bombay.

**COURSE FEE (Excluding GST of 18%)**

**Participants from abroad: US \$500/-**

**Industry/ Research Organizations: INR: 25,000/-**

**Academic Institutions/ Faculty/ NGO: INR: 10,000/-**

**Students & Research Scholars: INR: 3,000/-**

The above fees include all instructional materials, computer use for tutorials and assignments, laboratory usage charges, free internet facility.

The participants will be provided with accommodation on payment basis.

The fees may be paid by demand draft drawn in favour of "**The Registrar, IIT Bombay - CEP Account**".

**Or through NEFT/RTGS:**

Name of beneficiary: Registrar, IIT Bombay

Account name: IIT Main Account

Name of Bank: State Bank of India, IIT Powai

Beneficiary A/C No: 00000010725729128

Bank MICR Code: 400002034

IFSC Code: SBIN0001109

SWIFT Code: SBININBB519