



**CENTRE FOR NANO SCIENCE AND ENGINEERING**  
**Indian Institute of Science, Bangalore - 560 012**

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Ref.: CeNSE/ITEC-1/2024-2025

**Introductory Training Course in Nanofabrication Technologies**

**Venue:** Centre for Nano Science and Engineering, Indian Institute of Science, Bengaluru-12

**Last Date for submission of Application:** as per ITEC division

**Course Content (Technical)**

This course has two parts:

**1. Lecture on various aspects of nanoscience and technology followed by poster session on one of the first two days:**

A series of lectures on “Thin film technology”, “Lithography techniques”, “Photovoltaics”, “CMOS integration”, “Photonics”, “Laser technology”, “III-nitrides: materials and devices”, “Microelectromechanical (MEMS) sensors”, “Technology of MEMS devices”, “Application of MEMS devices”, “Microfluidics for biological applications”, and “Nanopropellers for medicine”.

**2. Practical training on processes used in fabrication of electronics devices: Synthesis/fabrication of nanomaterials/devices and their characterization**

**2a. Preparation and Characterisation of Nanostructured ZnO:**

ZnO is a large-band-gap semiconductor, which is also a piezoelectric. As such ZnO has been studied a variety of applications. This module is designed to provide participants with first-hand experience in the preparation of nanostructured ZnO through microwave irradiation of a solution of a suitable zinc compound. The method is suitable not only for the preparation of nanocrystalline (powder) ZnO, but also ZnO coatings on substrates such as silicon. Both the powder material and the coating so prepared will be characterized by XRD, SEM, FTIR, and Raman analysis.

**2b. Fabrication of a silicon solar cell**

The module is designed to expose the participants to various aspects of solar cell fabrication and characterisation. More specifically, the participants would perform the following fabrication steps: Selection of silicon wafer, RCA cleaning, pyrogenic/wet oxidation, photolithography (dehydration, photoresist coating, aligning and UV exposing, developing), oxide etching using reactive ion etching, deposition and diffusion, contact lithography, front metallisation (sputtering or electron beam evaporation), lift-off, lithography (front side pattern protection), oxide etching on the back side, backside metallization (sputtering or electron beam evaporation), forming gas annealing.

The solar cell devices are then characterised to evaluate their efficiency using an electrical probe station and a solar simulator.

## **2c. Fabrication of a MEMS cantilever**

The module is designed to train the participants in fabricating and characterising a MEMS cantilever for various applications. More specifically, the participants would perform the following fabrication steps: selection of silicon wafer, RCA cleaning, pyrogenic/wet oxidation, photolithography (dehydration, photoresist coating, aligning and UV exposing, developing), oxide etching – wet etching, and cantilever device release using reactive ion etching.

Once the device is fabricated, the participants would be trained in the characterisation of the cantilever devices using scanning electron microscopy and laser Doppler vibrometry.

### **Eligibility Criteria:**

1. The participant must belong to one of the following ITEC countries.
2. Participants should have at least a graduate's degree (from a recognized University) in any branch of Engineering and or Master Degree in Science/Technology.
3. Participants should be member of faculty who is teaching courses/involved in research related to Physics, Chemistry, Materials, Electronics and Communications, Electrical Engineering, and Nanotechnology, or must be a student registered for the PhD degree in Science and Engineering in an accredited academic institution/university in one of the ITEC countries.
4. Recent graduates/Fresher's may join this introductory course. Normal waiver of ITEC norms may be given to applicants.
5. A Statement of Purpose (One page write-up about research interests and/or research work carried out) must be provided.

### **General Requirements:**

Each participant will prepare a poster (42x48 inch) on his research area/work and submit to undersigned through email before the deadline.

Since the competition is very high, participants must submit the original research with detailed technical information in poster which will help in shortlisting for the participation.

### **Contact us:**

#### **Program Co-ordinator:**

Dr. Savitha P

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## **Detailed Technical Programme of the Introductory Training Course in Nanofabrication Technologies**

Briefly, the programme has two parts: (a) lectures during the first two days on various aspects of nanoscience and technology given by members of CeNSE Faculty (b) Hands-on Training in three modules that provide involving the synthesis/fabrication of nanomaterials/devices and their characterization. (c) Poster Sessions in which the Participants present their work/research interest. The details are given below.

The lectures to be delivered during the first two days begin with an introduction to nanomaterials and structures, designed to provide an appreciation of some of the aspects that make such materials and structures unique, interesting, and useful.

This will be followed by a lecture that describe the state-of-the-art facilities established at the National Nanofabrication Centre (NNfC), which enables the fabrication of nanoscale structures and devices in one of the largest clean rooms anywhere in an academic setting anywhere. A subsequent lecture describes the Micro Nano Characterisation Facility (MNCF), which is a unique laboratory in which the electrical, mechanical, optical, and material characteristics of a nanomaterial/structure can be studied in detail using sophisticated tools.

A series of lectures on "Thin film technology", "Lithography techniques", "Photovoltaics", "CMOS integration", "Photonics", "Laser technology", "III-nitrides: materials and devices", "Microelectromechanical (MEMS) sensors", "Technology of MEMS devices", "Application of MEMS devices", "Microfluidics for biological applications", and "Nanopropellers for medicine". The lectures are designed not only to be tutorial but also to provide the context for why nanoscience and technology have been the focus of effort today worldwide.

To ensure that the participants will gain understanding of the material presented, the lecturers ensure that questions are welcome and that a discussion during the lectures is a very important part of the Course.

To ensure that the participants take the lectures seriously and are focused on the lectures, a Quiz will be conducted at the end of the third lecture to evaluate the effectiveness of the lectures in creating an understanding and conveying the excitement of the "nanoworld".

The lectures will be interspersed with Poster Sessions, in which Participants are encouraged to present either the research work they have completed or are carrying out, or their research interests, especially in the "nano domain". This will give them an opportunity to interact with members of CeNSE faculty and technical staff, which is expected to add to the learning experience of the Course. The Poster Sessions will also give participants a break from the class room and the lectures, so that they interact informally with one another and with the CeNSE family.

After two days of lectures, the participants will take part in the "practicals" or laboratory training and experience. Prior to entering the labs, they will all be introduced to safety practices to be followed during the hours they spend in the laboratory.

Following this, they will receive instructions on the three "modules" of the hands-on training they will go through: (a) Synthesis of ZnO nanostructures and their characterization (b) Fabrication of a MEMS cantilever and its characterization (c) Fabrication of a Silicon solar cell and its characterization.

The participants will be divided into batches so that each one will have a turn at the three modules, thus gaining first-hand, introductory experience in nanoscience and technology. A brief description of the modules is given below:

### **Preparation and Characterisation of Nanostructured ZnO:**

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such as silicon. Both the powder material and the coating so prepared will be characterized by XRD, SEM, FTIR, and Raman analysis.

#### **Fabrication of a silicon solar cell**

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#### **Fabrication of a MEMS cantilever:**

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Once the device is fabricated, the participants would be trained in the characterisation of the cantilever devices using scanning electron microscopy and laser Doppler vibrometry.

At the end of the Course, a feedback session will be held so that participants can share their experience in the Course and provide candid and valuable feedback to CeNSE faculty and staff.



**(Dr. Savitha P)**

**CeNSE, IISc Bangalore**

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