Microfabrication Techniques and Device Integration: Principles, Processes, and Applications

Overview

Microfabrication is a foundational technology driving innovations across electronics, biomedical devices, sensors, and more. It enables the miniaturization and integration of complex functions, leading to the development of smaller, faster, and more efficient devices. Central to producing integrated circuits and semiconductors, microfabrication supports everything from smartphones to industrial automation. Advances have allowed the scaling of transistors to nanometer levels and the creation of low-power and energy-harvesting devices. The field also propels research in emerging materials like graphene, fostering next-generation electronics and flexible technologies. Microfabrication is vital to environmental monitoring through micro-sensors and significantly contributes to the global economy, especially in the semiconductor sector. It creates job opportunities in research, development, and manufacturing, while also driving technological progress in healthcare, energy, and communication. By continuously pushing the boundaries of miniaturization and performance, microfabrication remains a key enabler of innovation and a transformative force in shaping modern life.Microfabrication is driving the next wave of technological progress, from smart devices and healthcare to advanced computing and environmental sustainability.

Course Objectives

The course on the area Microfabrication and Devices is designed to provide participants with a deep understanding of the principles, techniques, and applications of microfabrication in device engineering. The key objectives of the course are:

- Understand fundamental microfabrication techniques
- Explore material properties and their impact on device performance
- Learn device integration and packaging techniques
- Gain practical knowledge of microdevice fabrication
- Characterize and test microfabricated devices
- Explore applications across various industries
- Identify emerging trends and future directions
- Develop problem-solving and critical thinking skills
- Bridge the gap between academia and industry
- Encourage collaborative learning and innovation

The outcome of this course is as follows.

By the end of this course, participants will have a solid understanding of microfabrication processes, be able to characterize and test microdevices, and appreciate the wide range of applications and future trends in the field. This will empower them to apply their knowledge in both academic research and industrial applications, driving innovation in the microfabrication landscape.

Teaching Faculty with allotment of Lectures and Tutorials

- Prof. Mohd Faizul Bin Mohd Sabri (MFS): 12 hrs lectures
- Prof. Rabibrata Mukherjee (RM): 3 hrs lectures
- Dr. Sunilkumar D (SKD): 3 hrs tutorials
- Mr. Sujit Kumar Pattanayak (SKP): 3 hrs tutorials

Modules and schedules	**A:Day 1: 07-09-2025** Inauguration Lecture 1 (1h): Introduction to modelling and simulation software for MEMS (MFS) Lecture 2 (1h): Scaling Laws and Miniaturization (MFS) Tutorial 1 (2 hrs): Detailed discussion on machines and micro fabrications in machining laboratory (SKD) **B: Day 2: 08-09-2025** Lecture 3 (1h): Properties of Materials for MEMS (MFS) Lecture 4 (1h): Design considerations of Microdevices/ Microsystems (MFS) Lecture 5 (1h): Microfabrication: Photolithography (MFS) Tutorial 2 (1h): Detailed discussion on materials characterization in Materials laboratory (SKD) **C: Day 3: 09-09-2025** Lecture 6 (1h): Microfabrication: materials deposition (MFS) Lecture 7 (1h): Microfabrication: Etching and materials removal (MFS) Tutorial 3 (2 hrs): Application of Operations Research in manufacturing industry (SKP) **D: Day 4: 10-09-2025** Lecture 8 (1h): Microfabrication: Integration and Assembly (MFS) Lecture 9 (2 hrs): Sensors and Actuators: Electrostatic, Thermal, Piezoelectric & Magnetic (MFS) Lecture 10 (2 hrs): "Soft Lithographic Pattern Fabrication" on soft surfaces (RM) **E: Day 5: 11-09-2025** Lecture 11 (1h): Active learning for materials screening and optimization

	(MFS) Lecture 12 (1h): MEMS devices case studies (MFS) Lecture 13 (1h): Atomic Force Microscope (RM) Tutorial 4 (1h): Open Discussions on challenges in Microfabrication & Devices (SKP) **Evaluation of Learning Outcomes (Examination/Test, Feedback) & Certificate distribution.** **Number of participants for the course will be limited to fifty.**
Who can attend …	This course is designed for a broad audience of students, researchers, and professionals who are interested in gaining a deep understanding of microfabrication techniques and their applications in device engineering. Below are the primary groups who will benefit from attending. The prerequisite for this course are as follows: Basic Knowledge: Participants are expected to have a fundamental understanding of physics, chemistry, and engineering principles. Technical Background: A background in materials science, electronics, or mechanical systems will be beneficial.
Fees	The participation fees for taking the course is as follows: • Participants from abroad: $ 250 • Industry/Research Organizations: ₹ 5000/- • Academic Institutions Faculty: ₹ 2000/- • External Students: ₹ 500/- • Internal PG & PhD Students: ₹ 500/- • Internal UG Students: Nil The above fee include all instructional materials, computer use for tutorials and assignments, laboratory equipment usage charges, 24 hr free internet facility. The participants may be provided with accommodation on payment basis.

The Faculty (Experts)

Prof. Mohd Faizul Bin Mohd Sabri is a Professor at Universiti Malaya specializing in Microelectromechanical Systems (MEMS), thermoelectrics, and lead-free solder alloys. After obtaining his PhD in MEMS from Tohoku University, Japan, in 2009, he established the NanoMicro Engineering Laboratory at UM to advance research in nano and micro engineering. His work, supported by UM, MOHE, industry, and international collaborators, focuses on electronic packaging, waste heat recovery, and thermoelectric simulations. He has published over 200 papers, filed several patents, and supervised 32 postgraduate students. He also holds visiting and adjunct positions abroad and currently serves as President of the Malaysian Thermoelectric Society.

Prof. Rabibrata Mukherjee is a Professor in the Department of Chemical Engineering at IIT Kharagpur, having joined in 2009 after 12 years as a Scientist at CGCRI, Kolkata. He holds a PhD from IIT Kanpur (2007), where he received the Shah Schulman Best PhD Thesis Award. His research focuses on thin polymer film instability, soft lithography, polymer blends, nanofluidics, and organic solar cells. He has published 34 journal papers, co-authored 5 book chapters, and holds 4 Indian patents. A recipient of the CSIR Young Scientist Award (2007) and MRSI Medal (2014), he also received IIT Kharagpur's best teaching feedback in 2015.

Course Co-ordinators

1. Mr. Sujit Kumar Pattanayak, Assistant Professor, Dept. of Mechanical Engineering, National Institute of Technology Silchar, Assam 788010, India. Email: sujupat@mech.nits.ac.in, Contact Numbers: +91-9101070609, 9435172451
2. Dr. Sunilkumar D, Assistant Professor, Dept. of Mechanical Engineering, National Institute of Technology Silchar, Assam 788010, India. Email: sunilkumar@mech.nits.ac.in, Contact Number: +91-8012828125

About Silchar

Silchar is the second largest town in the state of Assam. It was the kingdom of the Kachchari kings from 1755 to 1830. It was annexed to the British East India Company in 1833. The city has now attained a cosmopolitan status with inhabitants from all over India although Bengali speaking people constitute the majority. It is an educational and business hub in North East India next to Guwahati. Aesthetically the campus is very beautiful with greeneries and wet lands. During the month of July-September the weather in Silchar is quite humid. During this period, the average high is 35°C and the average low is 25°C.

How to reach NIT Silchar

The city is well connected by Road, Train and Air. There are direct flights from Kolkata and Guwahati and trains from New Delhi, Kolkata, Guwahati, and Agartala. Daily bus services are available from Agartala, Guwahati, Aizawl, and Imphal. The Institute is located around 35 kms from the Silchar airport, 10 kms from the Silchar railway station, 14 kms from ISBT Silchar, and 8 kms from the heart of the Silchar town. Prepaid taxi and auto services are available from Silchar.

Registration Guidelines (Step-by-Step):

1. Courses Registration for GIAN course may be done by paying the requisite fees as below through SBI collect.

   Pay the requisite course fee online through the SBI Collect Portal at https://www.onlinesbi.sbi/sbicollect/ Following the path Educational institute > NIT Silchar > ONLINE FEE COLLECTION ACCOUNT NIT SILCHAR>GIAN COURSE NIT SILCHAR_2700200_Sujit Kumar Pattanayak.

2. Fill out the Registration form given below, sign it. Send the scan copy of the filled in form with scanned copy of course fee transaction slip obtained by SBI collect to the course coordinator e-mail address (**sujupat@mech.nits.ac.in or sunilkumar@mech.nits.ac.in**). This is for the Course Coordinator's record. Now, await the Course Coordinator's confirmation.

GIAN: Global Initiative of Academic Network

NAME OF THE COURSE: Microfabrication Techniques and Device Integration: Principles, Processes, and Applications

(Course ID: 2700200)

Duration: 7-11 September, 2025

Department of Mechanical Engineering,

National Institute of Technology Silchar, Assam, India

REGISTRATION FORM

GIAN Portal Application Number:

Full Name: Category (Industry/Academic/Student):

Organization:

Address:

Email Id:

Mobile Number:

Highest Academic qualification:

SBI Collect payment details:

Transaction Id/Ref No	Date	Amount

Accommodation Required: Yes/No (please tick in the applicable field)

Date:

Place:

Signature of Applicant