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Fabrication Techniques for MEMs-based sensors : clinical perspective

By Prof. Hardik Jeetendra Pandya | IISc Bangalore

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Intro - Fabrication Techniques for MEMs-based sensors clinical perspective

This course is designed with an aim of educating students in the area of microtechnology and its use to fabricate sensors and systems. The students will have an exposure to sensors and its importance in the real world. The students will also able to understand how to fabricate some of those sensors. Several examples of engineering devices used in clinical research will be also covered. Class 10000 non-conventional clean room and some equipment within it will also be shown. Below are some of the course outcomes. Ability to understand microfabrication process Understand sensors used in electronics and biomedical areas Understand Clean Room (Class 1 to Class 10000) Understand Microengineering Technology Design the process flow for fabricating microheater required in gas sensors. Design the process flow for fabricating forces sensors for biomedical application. Design microheater for gas sensors as per specifications. Design force sensors as per specifications. Understand fabrication of microfluidic platforms, micro-cantilevers, flexible force sensors, inter-digitated electrodes, polymer-glass bonding etc. for clinical research

INTENDED AUDIENCE : Engineering Students, Faculty from Engineering Colleges

PREREQUISITES : Bas (https://swayam.gov.in/) (https://swayam.gov.in/nc_details/NPTEL)

INDUSTRY SUPPORT : Companies working in semiconductors and integrated circuits: Intel, AMD, Samsung, Texas Instruments, Analog Devices etc

Summary

Course Status :	Completed
Course Type :	Elective
Duration :	12 weeks
Category :	∘ Electrical, Electronics and Communications Engineering
Credit Points :	3
Level :	Undergraduate
Start Date :	14 Sep 2020
End Date :	04 Dec 2020
Enrollment Ends :	25 Sep 2020
Exam Date :	20 Dec 2020 IST

Note: This exam date is subjected to change based on seat availability. You can check final exam date on your hall ticket.

This is an AICTE approved FDP course

Course layout

Week 1 : Introduction to microengineering devices and its applications
Week 2 : Clean room, contaminants, wafer cleaning processes (DI water, RCA, metallic impurities, etc.).
Week 3 : Introduction to the microheater, force sensors, microfluidic devices, its specifications, and applications.
Week 4 : Masks: Types of masks, Types of Photoresists, Spin Coaters Lithography process: optical lithography, x-ray, and e-beam lithography, lift-off techniques, soft lithography, Use of resists (spin coating, positive and negative photoresists), photoresist pre-baking, exposure, and development.
Week 5 : Etching: Isotropic/anisotropic, selectivity, wet and plasma assisted etching.
Week 6 : Types of wafers and orientations. Techniques of metallization: PVD [(Sputtering – DC, RF, and Magnetron), thermal evaporation, e-beam evaporation].

Week 7 : Chemical Va electric films (Plasma Enhance Chemical Vapor Deposition (PECVD)), Atomic Layer Deposition
Week 8 : Understar g the process flow for fabricating microheating microheating devices. Process flow for microheater, force sensors, and microfluidic devices.
Week 9 : Wafer dicing and bonding techniques, Microfluidic Chips
Week 10 : Process Flow for Fabricating Flexible Force Sensors and Force Sensors on Silicon, Process Flow for Fabricating VOC sensors, Biochips
Week 11 : Clinical Research: Problems and Solutions using Microengineering Device
Week 12 : Visit to non-conventional Class 10000 Clean Room and discussing few equipment within

Books and references

1. J.D. Plummer, M.D. Deal, P.G. Griffin, Silicon VLSI Technology, Pearson Education, 2001. S.A. Campbell,
2.The Science and Engineering of Microelectronic Fabrication, Oxford University Press, 2001. S.M. Sze (Ed), VLSI Technology, 2nd Edition, McGraw Hill, 1988 Senturia
3. S. D., Microsystem Design, Kluwer Academic Publisher, 2001 Madou, M Fundamentals of Microfabrication, CRC Press, 1997. Gad-el-Hak, M., Ed.;
4. The MEMS Handbook; CRC Press: New York, NY, 2002.

Instructor bio

Prof. Hardik Jeetendra Pandya

IISc Bangalore

Biodata (Self Introduction): Dr. Hardik J. Pandya is an assistant professor in the Department of Electronic Systems Engineering, Division of Electrical Sciences, IISc Bangalore where he is developing Advanced Microsystems and Biomedical Devices Facility for Clinical Research and Biomedical and Electronic (10-6-10-9) Engineering Systems Laboratory to carry out cutting-edge research on novel devices to solve unmet problems in biology and medicine. He is recipient of prestigious Early Career Research Award from Science and Engineering Research Board, Government of India as well as a start-up grant of 228 Lacs from IISc. He has taught Design for Analog Circuits, Analog Integrated Circuits, VLSI technology, and Semiconductor Devices to undergraduate and graduate students from Electronic Engineering, Instrumentation Engineering, and Applied Physics. He seek to understand and exploit novel ways of fabricating microengineering devices using glass, silicon, polymers and integrate with unusual classes of micro/nanomaterials. His research interests include integrating biology/medicine with micro- and nanotechnology to develop innovative tools to solve unmet clinical problems. His current research focuses on flexible sensors for smart catheters, microsensors, microfluidic devices, and microelectromechanical systems, all lately with an emphasis on cancer diagnosis, therapeutics, e-nose, and biomedical device technologies. Before joining IISc, he worked as a postdoctoral scientist in the Department of Mechanical Engineering, Maryland Robotics Center, University of Maryland, College Park and in the Department of Medicine, Brigham and Women's Hospital–Harvard Medical School affiliated with Harvard-MIT Health Science and Technology. His work has resulted in several patents and publications. His work has been highlighted as "Breaking Research News" by The Physicians Committee for Responsible Medicine and has been featured on IEEE Transactions on Biomedical Engineering July 2016 issue cover image as well as IEEE TBME July 2016 feature article for the website and monthly highlights. The work on portable cancer diagnosis tool was also featured on Science Translational Medicine as an Editorial Choice, Breast Cancer Diagnosis, March 2016 and has been highlighted on CapeRay blog as "Biochips and Diagnostic tools" in April 2016. His work has been published in high-quality journals including Lab on a Chip, IEEE Transactions on Biomedical Engineering, IEEE Journal of Microelectromechanical Systems, Sensors and Actuators B,

Biosensors and Bioel ence and Nanotechnology Letters, Sensors and Transducers, and Journal of Micromechanics and Micromachining. (https://swayam.gov.in/) (https://swayam.gov.in/nc_details/NPTEL)

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Course certificate

The course is free to enroll and learn from. But if you want a certificate, you have to register and write the proctored exam conducted by us in person at any of the designated exam centres.

The exam is optional for a fee of Rs 1000/- (Rupees one thousand only).

Date and Time of Exams: 20 December 2020, Morning session 9am to 12 noon; Afternoon Session 2pm to 5pm.

Registration url: Announcements will be made when the registration form is open for registrations.

The online registration form has to be filled and the certification exam fee needs to be paid. More details will be made available when the exam registration form is published. If there are any changes, it will be mentioned then.

Please check the form for more details on the cities where the exams will be held, the conditions you agree to when you fill the form etc.

CRITERIA TO GET A CERTIFICATE:

Average assignment score = 25% of average of best 8 assignments out of the total 12 assignments given in the course.

Exam score = 75% of the proctored certification exam score out of 100

Final score = Average assignment score + Exam score

YOU WILL BE ELIGIBLE FOR A CERTIFICATE ONLY IF AVERAGE ASSIGNMENT SCORE >=10/25 AND EXAM SCORE >= 30/75.

If one of the 2 criteria is not met, you will not get the certificate even if the Final score >= 40/100.

Certificate will have your name, photograph and the score in the final exam with the breakup.It will have the logos of NPTEL and IISc Bangalore. It will be e-verifiable at nptel.ac.in/noc (http://nptel.ac.in/noc)

Only the e-certificate will be made available. Hard copies will not be dispatched.

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Score	Type of Certificate
>=90	Elite+Gold
75-89	Elite+Silver
>=60	Elite
40-59	Successfully Completed
<40	No Certificate

No. of credits recommended by NPTEL:3
An additional 1 credit may be awarded if the University deems it fit, based on the actual student effort involved.

Elite

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Fabrication Techniques for MEMs-Based Sensors: Clinical Perspective

with a consolidated score of **60** %

Online Assignments	22.34/25	Proctored Exam	37.5/75

Total number of candidates certified in this course: **152**

Prof. G. L. Sivakumar Babu
Chairman, Centre for Continuing Education
IISc Bangalore

Sep-Dec 2020
(12 week course)

Prof. L. Umanand
NPTEL Coordinator
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Department: Electronics and Communication Engineering

2020-2021

REPORT

FDP[NPTL Course] on "Fabrication techniques for MEMs based sensors: clinical perspective "

I am V.Radha Krishna ,working as Asst.Prof, in department of ECE.I attended NPTEL course [FDP] on "Fabrication techniques for MEMs based sensors : clinical perspective" conducted by IISC Bangalore form 14-09-2020 to 04-12-2020.Resource person for FDP is " Prof Hardik J Pandya" from IISc Bangalore. This NPTEL Course is organized for 12 weeks. Topics covered in this FDP are Micro engineering Devices & Applications, Sensor fabrication Rooms , Masks, Photoresist, Etching, Wafers, Vapor depositions, Process flow for fabricating Micro Electronic Sensors etc. This FDP is useful for Teaching subjects like VLSI Design, MEMS, Micro Electronics .

Radha Krishna 9/12/20

V.Radha Krishna

Asst.Prof,

ECE

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