Miranda House
University of Delhi

Organizes

TWO WEEKS HANDS-ON TRAINING WORKSHOP ON SEMICONDUCTOR DEVICES FABRICATION

in association with

CENTER FOR INNOVATION IN INFECTIOUS DISEASE RESEARCH, EDUCATION AND TRAINING

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DELHI SCHOOL OF SKILL ENHANCEMENT & ENTREPRENEURSHIP DEVELOPMENT

20 March - 03 April 2023

Smart Materials and Devices Laboratory,
Multidisciplinary Research Center,
Miranda House, University of Delhi

9:00 am to 4:00 pm (Daily)

https://www.mirandahouse.ac.in/

Technical Program

Two week hands-on training course on Semiconducting Device Fabrication

20 March to 3 April 2023

Time	Activity		
Day 1 (Monday, 20th March 2023)			
10:00 AM - 01:00 AM	Inauguration Ceremony		
01:00 PM - 02:00 PM	*Lunch Break*		
02:00 PM - 05:00 PM	Introduction of students along with Lab visit and familiarization with the facilities		
Day 2 (Tuesday, 21st March 2023)			
09:00 AM - 11:00 AM	Lecture on "Basics of Semiconductor"		
11:00 AM - 01:00 PM	Hands-on training on "Types of substrates and their cleaning process"		
01:00 PM - 2:00 PM	*Lunch Beak*		
02:00 PM - 04:00 PM	Lecture on " Device Fabrication Techniques"		
Day 3 (Wednesday, 22nd March 2023)			
09:00 AM - 11:00 AM	Lecture on "Vacuum Pumps"		
11:00 AM - 01:00 PM	Hands-on training on "Vacuum Systems handling and operations"		
01:00 PM - 2:00 PM	*Lunch Beak*		
02:00 PM - 04:00 PM	Lecture on "Film Deposition Techniques"		
Day 4 (Thursday, 23rd March 2023)			
	Level 1 Batch-I	**Level 1 Batch-II**	**Level 1 Batch-III**
09:00 AM - 01:00 PM	Hands-on training on "Thermal Evaporation Technique" *To be contd.*	Hands-on training on "RF Sputtering Technique" *To be contd.*	Hands-on training on "Sol-gel Technique" *To be contd.*
01:00 PM - 2:00 PM	*Lunch Beak*		
02:00 PM - 04:00 PM	Hands-on training on "Thermal Evaporation Technique"	Hands-on training on "RF Sputtering Technique"	Hands-on training on "Sol-gel Technique"
Day 5 (Friday, 24th March 2023)			
	Level 1 Batch-I	**Level 1 Batch-II**	**Level 1 Batch-III**
09:00 AM - 01:00 PM	Hands-on training on "Sol-gel Technique" *To be contd.*	Hands-on training on "Thermal Evaporation Technique" *To be contd.*	Hands-on training on "RF Sputtering Technique" *To be contd.*
01:00 PM - 2:00 PM	*Lunch Beak*		

02:00 PM - 04:00 PM	Hands-on training on “Sol-gel Technique”	Hands-on training on “Thermal Evaporation Technique”	Hands-on training on “RF Sputtering Technique”
Day 6 (Monday, 27th March 2023)			
	Level 1 Batch-I	**Level 1 Batch-II**	**Level 1 Batch-III**
09:00 AM - 01:00 PM	Hands-on training on “RF Sputtering Technique” *To be contd.*	Hands-on training on “Sol-gel Technique” *To be contd.*	Hands-on training on “Thermal Evaporation Technique” *To be contd.*
01:00 PM - 2:00 PM	*Lunch Beak*		
02:00 PM - 04:00 PM	Hands-on training on “RF Sputtering Technique”	Hands-on training on “Sol-gel Technique”	Hands-on training on “Thermal Evaporation Technique”
Day 7 (Tuesday, 28th March 2023)			
	Level 2 Batch-I	**Level 2 Batch-II**	
09:00 AM - 01:00 PM	Hands-on training on “Deposition of ZnO/NiO thin films on ITO substrates for pn junction formation using RF Sputtering Technique” *To be contd.*	Hands-on training on “Deposition of thin film of Aluminum on glass substrate using Thermal Evaporation Technique” *To be contd.*	
01:00 PM - 2:00 PM	*Lunch Beak*		
02:00 PM - 04:00 PM	Hands-on training on “Deposition of ZnO/NiO thin films on ITO substrates for pn junction formation using RF Sputtering Technique”	Hands-on training on “Deposition of thin film of Aluminum on glass substrate using Thermal Evaporation Technique”	
Day 8 (Wednesday, 29th March 2023)			
	Level 2 Batch-I	**Level 2 Batch-II**	
09:00 AM - 01:00 PM	Hands-on training on “Deposition of thin film of Aluminum on pn junction of ZnO/NiO using Thermal evaporation Technique”	Hands-on training on “Patterning of Aluminum coated substrate using Photolithography Technique” *To be contd.*	
01:00 PM - 2:00 PM	*Lunch Beak*		
02:00 PM - 04:00 PM	Hands-on training on “Measurement and study of IV characteristics of fabricated pn junction”	Hands-on training on “Patterning of Aluminum coated substrate using Photolithography Technique”	
Day 9 (Thursday, 30th March 2023)			

	Level 2 Batch-I	Level 2 Batch-II
09:00 AM - 01:00 PM	Hands-on training on "Deposition of thin film of Aluminum on glass substrate using Thermal Evaporation Technique" *To be contd.*	Hands-on training on "Deposition of ZnO/NiO thin films on ITO substrates for pn junction formation using RF Sputtering Technique" *To be contd.*
01:00 PM - 2:00 PM	*Lunch Beak*	
02:00 PM - 04:00 PM	Hands-on training on "Deposition of thin film of Aluminum on glass substrate using Thermal Evaporation Technique"	Hands-on training on "Deposition of ZnO/NiO thin films on ITO substrates for pn junction formation using RF Sputtering Technique"
Day 10 (Friday, 31st March 2023)		
	Level 2 Batch-I	**Level 2 Batch-II**
09:00 AM - 01:00 PM	Hands-on training on "Patterning of Aluminum coated substrate using Photolithography Technique" *To be contd.*	Hands-on training on "Deposition of thin film of Aluminum on pn junction of ZnO/NiO using Thermal evaporation Technique"
01:00 PM - 2:00 PM	*Lunch Beak*	
02:00 PM - 04:00 PM	Hands-on training on "Patterning of Aluminum coated substrate using Photolithography Technique"	Hands-on training on "Measurement and study of IV characteristics of fabricated pn junction"
Day 11 (Monday, 3rd April 2023)		
09:00 AM - 10:00 AM	MCQs based Test and Feedback session	
10:00 AM - 11:00 AM	*Beak*	
11:00 AM - 12:00 PM	**Valedictory Function**	

Syllabus

Basics of Semiconducting materials: Semiconductors, insulators and conductors. Properties of semiconductor. Brief description of simple p-n junction diode, fabrication and characterization. Application of p-n junction diodes.

(2 Hours)

Semiconducting device fabrication techniques: different steps involved in fabrication of a semiconducting device including: Film Deposition, Thermal Oxidation, Doping, Lithography, Dicing, testing and packaging.

(2 hours)

Thin Film Deposition Techniques using Physical and Chemical Deposition Techniques: Brief description about the thin film deposition techniques. Their advantages and disadvantages.

(4 hours)

Hands on Experience

Deposition Techniques: (i) Thermal Evaporation (ii) RF Sputtering and (iii) Chemical Solution Deposition techniques.

(16 hours)

Fabrication of a contacts using thermal evaporation technique

(12 hours)

Fabrication of oxide thin films using sputtering techniques

(20 hours)

Fabrication of a simple p-n junction diode and study of its I-V characteristics

(4 hours).

Course Learning Outcomes

Students/ participants will be able to:

- **Understand basic principle of semiconductor chip fabrication technology qualitatively, types of instruments required, procedures followed, characteristics of devices and their applications.**
- **Gain concepts of thin films.**
- **Gain the knowledge of photolithography**
- **Understand basic principle and theory of vacuum systems and various methods of thin film deposition.**
- **Grasp the deep knowledge of applications of chip fabrication technology and their uses in day-today life and in engineering and industry.**

What are Semiconductors?

Semiconductors are materials whose conductivities lie between those of conductors and insulators. Pure elements or compounds such as gallium, arsenide, or cadmium selenide may be used.

What are Integrated Circuits (ICs)?

An integrated circuit (IC), sometimes referred to as a chip, microchip, or microelectronic circuit, is a semiconductor wafer used to manufacture microscopic resistors, capacitors, diodes, and transistors. Integrated circuits include amplifiers, oscillators, timers, counters, logic gates, computer memory, microcontrollers, and microprocessors. A circuit integrated is the central component of all modern electrical devices. As the name suggests, it is an integrated system comprising several microscopic and interconnected components implanted on a thin semiconductor material substrate (usually silicon crystal).

Semiconductor Chip Significance: Semiconductors are utilised in virtually every industry, including aerospace, transportation, communications, renewable energy, information technology, and medical equipment. They are the mind and soul of all contemporary electronic, information, and communication technology goods. These chips are increasingly prevalent in contemporary automobiles, home appliances, and essential medical equipment like as ECG machines.

Recent Demand Growth: The Covid-19 pandemic-driven push to bring substantial chunks of daily economic and crucial activity online, or at least digitally empower them, has underlined the significance of chip-powered computers and mobile devices in people's daily lives. The demand for these essential components has exceeded the supply, resulting in a global chip shortage, diminished economic growth, and lost jobs.

In December 2021, the Central Government approved 76,000 crore under the Production-Linked Incentive (PLI) plan to promote the growth of various semiconductor products in India. Semiconductors and displays are at the core of modern electronics, driving the next phase of Industry 4.0's digital revolution.

Why is semiconductor industry necessary?

Semiconductor chips are the lifeblood of the present information age. They enable electronic devices to compute and control tasks that simplify our lives.

These semiconductor chips are the driving force behind the development of ICT (Information and Communication Technologies) and one of the leading contributors to the current global economy. They are employed in national

security-implications-bearing infrastructures such as communication, energy transmission, etc. The expansion of the semiconductor and display ecosystem will have a multiplier effect on other economic sectors as a result of its increased integration into the global value chain.

These chips are produced in only a few countries worldwide. The industry is led by the United States, Taiwan, South Korea, Japan, and the Netherlands. Germany is a rising ICT producer as well.

India and semiconductor market

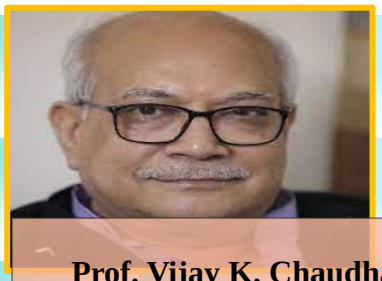
India imports all chips at present, and the market is projected to increase from $24 billion to $100 billion by 2025. However, India has recently taken a number of efforts to stimulate domestic semiconductor chip production: The Union Cabinet has allocated 76 billion to support the creation of a "semiconductor and display manufacturing ecosystem." As a result, design firms would receive substantial incentives to create chips.

India has also introduced the Scheme for Promoting Manufacturing of Electronic Components and Semiconductors (SPECS) to promote the manufacturing of electronic components and semiconductors. In addition, the MeitY has launched the Design Linked Incentive (DLI) Scheme in 2021, which will assist at least 20 domestic semiconductor design companies in achieving a turnover of more than Rs. 1,500 crore over the next five years. It is anticipated that India's semiconductor consumption will exceed USD 80 billion by 2026 and USD 110 billion by 2030.

Given India's considerable ability and experience, it may be preferable, at least for the time being, for the new mission there would be a need to concentrate on other areas of the chip-making chain, such as design centres, testing facilities, packaging, etc.

There is a need for Semiconductors, as well as a global demand, which India can supply; nevertheless, it would require growing current capabilities and developing ecosystems. Government and industry collaboration is therefore vital.

Chief Patron



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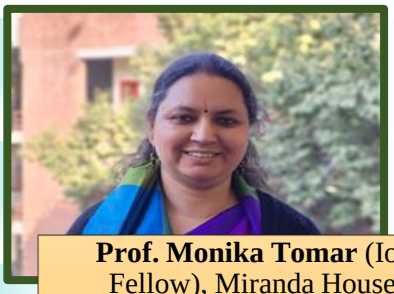

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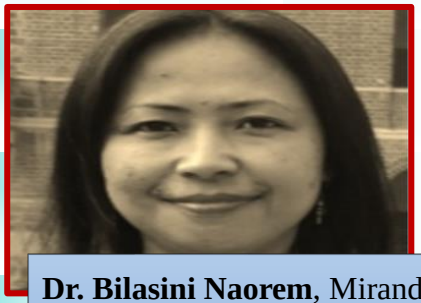

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Volunteers

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