



# Introductory Training Course on Nanofabrication Technologies

4<sup>th</sup> Feb – 24<sup>th</sup> Feb 2020

(Supported by ITEC, MEA, GoI)



## Program Schedule

Date/Day	Time	Event	Speakers	Topic
4 <sup>th</sup> Feb 2020, Tuesday	10:00 - 10:30	Overview of CeNSE academic and Research activities- Prof Navakanta Bhat		
	10:30-10:40	<b>Special Talk</b>	<b>Ms. Amita Sneh</b>	Office of International Relation
	10:40 –11:00			Introduction by the Participants
	11:00 –11:30	<b>Tea Break</b>		
	11:30 – 1:00	Introduction by Participants		
	1:00 – 2:30	<b>Lunch Break</b>		
	2:30 –3:30	<b>Lecture 1</b>	<b>Prof. S A Shivashankar</b>	Nanomaterials
	3:00 – 4:00	<b>Tea Break</b>		
	04:00 –05:00	<b>Special Talk</b>	<b>Dr. Sanjeev Kumar Shrivastava</b>	Overview-About Linking Researchers and Resources through the National Portal “I-STEM”
5 <sup>th</sup> Feb 2020, Wednesday	9:00 – 10:30	<b>Lecture 2</b>	<b>Dr. Vijayaraghavan Madakasira</b>	Introduction on Nano Fabrication and Case Study
	10:30 –11:30	<b>Lecture 3</b>	<b>Prof. Sushoban Avasthi</b>	Low-cost Heterojunction Solar Cells
	11:30 –12:00	<b>Tea Break</b>		
	12:00 – 1:00	<b>Lecture 4</b>	<b>Prof Manoj Varma</b>	Biosensors
	1:00 – 2:00	<b>Lunch Break</b>		
	2:00 – 3:30	<b>Lecture 5</b>	<b>Prof Rudra Pratap</b>	Piezoelectric Sensors
	3:30 – 4:00	<b>Tea Break</b>		
4:00 – 5:00	<b>Lecture 6</b>	<b>Prof Praveen Ramamurthy</b>	Organic Electronics	
6 <sup>th</sup> Feb 2020, Thursday	9.00-10.00	<b>Special Talk</b>	<b>Dr. R N Narahari</b>	IPR
	10:00 –11:30	<b>Lecture 7</b>	<b>Prof Navakanta Bhat</b>	CMOS Devices and Integration
	11:30 –12:00	<b>Tea Break</b>		
	12:00 –01:00	<b>Lecture 8</b>	<b>Prof Prosenjit Sen</b>	3D Integration
	1:00 – 2:30	<b>Lunch Break</b>		
	02:30 –03:30	<b>Special Talks</b>	<b>Dr. Suresha. S.J</b>	Electron Microscopy
	3.30-4.00		<b>Mr. Prakash/ Mr. Varadu P</b>	Maintenance of Facilities
	4:00 pm	<b>Tea Break</b>		



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**7<sup>th</sup> Feb 2020 Friday**

<b>Time</b>	<b>Event</b>
<b>10:00 – 11:00 AM</b>	<b>NNFC Safety Training</b>
<b>11:00 – 11:30 AM</b>	<b>Introduction to Thin Films</b>
<b>11:30 – 12:00 PM</b>	<b>Introduction to Furnaces and Wet Etch</b>
<b>12:00 – 12:30 PM</b>	<b>Introduction to Dry Etch</b>

**12:30 - : 2:00 : Lunch Break**

<b>Time</b>	<b>Event</b>
<b>2:00 PM - 2:30 PM</b>	<b>Introduction to Lithography</b>
<b>2:30 PM – 3:00 PM</b>	<b>Introduction to Process modules and discussions</b>
<b>3:00 PM - 3:30 PM</b>	<b>PV / Cantilever fabrication video demo</b>



**8<sup>th</sup> Feb – 9<sup>th</sup> Feb 2020 Saturday & Sunday**

**Study tour within Karnataka**



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**4<sup>th</sup> Feb – 24<sup>th</sup> Feb 2020**  
 (Supported by ITEC, MEA, GoI)



**10<sup>th</sup> Feb 2020 Monday**

Batch -1 PV 1 9:30 AM – 1:00 PM	Batch -2 Cantilever - 1 9:30 AM – 1:00 PM	Batch - 3 PV - 1 9:30 AM – 1:00 PM	Batch - 4 Cantilever 1 9:30 AM – 1:00 PM	Batch - 5 PV – 1 9:30 AM – 1:00 PM	Batch - 6 Cantilever 1 9:30 AM – 1:00 PM
NNFC: 1 : Starting substrate - one um oxide wafer 2: Ellipsometer - Introduction and measurement 3: Lithography for diffusion window	NNFC: 1 : Wafer cleaning ( RCA ) 2: LPCVD ( SiN deposition)	MNCF : Probe station 2 /FIB	MNCF: XRD/Raman	Thin Films lab	NNFC annex lab -1

**1:00 PM – 2.00 PM: Lunch Break**

Batch -1 PV 1 2:00 PM – 5:00 PM	Batch -2 Cantilever - 1 2:00 PM – 5:00 PM	Batch - 3 PV - 1 2:00 PM – 5:00 PM	Batch - 4 Cantilever 1 2:00 PM – 5:00 PM	Batch - 5 PV – 1 2:00 PM – 5:00 PM	Batch - 6 Cantilever 1 2:00 PM – 5:00 PM
NNFC: 4 : Wet oxide etching 5: Photo resist strip 6: Dektak measurement	NNFC: 3 : Ellipsometer - Introduction and measurement 4: Lithography (2 samples: 1 – cantilever, 2 – use quarter inch substrate, any mask for metal lift off process demo)	MNCF : AFM /LDV	MNCF: SEM/XPS	NNFC annex lab -1	Thin Films lab



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**11<sup>th</sup> Feb 2020 Tuesday**

<b>Batch -1 PV 1 9:30 AM – 1:00 PM</b>	<b>Batch -2 Cantilever - 1 9:30 AM – 1:00 PM</b>	<b>Batch - 3 PV - 1 9:30 AM – 1:00 PM</b>	<b>Batch - 4 Cantilever 1 9:30 AM – 1:00 PM</b>	<b>Batch - 5 PV – 1 9:30 AM – 1:00 PM</b>	<b>Batch - 6 Cantilever 1 9:30 AM – 1:00 PM</b>
<b>NNFC: 7 : Wafer cleaning RCA - level 2 - level 1 8: Diffusion</b>	<b>NNFC: 5: Dry etching - SiN etch and silicon etch 6: ashing</b>	<b>MNCF : SEM /XPS</b>	<b>MNCF : Probe station 2 /FIB</b>	<b>Packaging Lab</b>	<b>Systems Lab</b>

**1:00 PM – 2.00 PM: Lunch Break**

<b>Batch -1 PV 1 2:00 PM – 5:00 PM</b>	<b>Batch -2 Cantilever - 1 2:00 PM – 5:00 PM</b>	<b>Batch - 3 PV - 1 2:00 PM – 5:00 PM</b>	<b>Batch - 4 Cantilever 1 2:00 PM – 5:00 PM</b>	<b>Batch - 5 PV – 1 2:00 PM – 5:00 PM</b>	<b>Batch - 6 Cantilever 1 2:00 PM – 5:00 PM</b>
<b>NNFC: 9 : PSG etching 10: FPP measurement ( sheet resistance ) 11 : Front metal deposition</b>	<b>NNFC : 7: Metallization for lift off on quarter substrate - Sputter Cr /Au 10/50 nm 8: Wet etch - Lift off process 9: Inspection</b>	<b>MNCF : TEM /Solar Simulator</b>	<b>MNCF: AFM /LDV</b>	<b>Systems Lab</b>	<b>Packaging Lab</b>



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**12<sup>th</sup> Feb 2020 Wednesday**

<b>Batch -1</b> PV 1 9:30 AM – 1:00 PM	<b>Batch -2</b> Cantilever - 1 9:30 AM – 1:00 PM	<b>Batch - 3</b> PV - 1 9:30 AM – 1:00 PM	<b>Batch - 4</b> Cantilever 1 9:30 AM – 1:00 PM	<b>Batch - 5</b> PV – 1 9:30 AM – 1:00 PM	<b>Batch - 6</b> Cantilever 1 9:30 AM – 1:00 PM
<b>NNFC: 12:</b> <b>Lithography (</b> <b>contact pads) 13:</b> <b>Wet Al etching 14 :</b> <b>Spin coating and</b> <b>back oxide etch</b>	<b>MNCF: FTIR</b> <b>/Zeta</b>	<b>MNCF : XRD</b> <b>/Raman</b>	<b>NNFC: 1 : Wafer</b> <b>cleaning ( RCA )</b> <b>2: LPCVD ( SiN</b> <b>deposition)</b>	<b>Gas sensor Lab</b>	<b>Annexe Lab-2 /</b> <b>ZnO synthesis</b>

**1:00 PM – 2.00 PM: Lunch Break**

<b>Batch -1</b> PV 1 2:00 PM – 5:00 PM	<b>Batch -2</b> Cantilever - 1 2:00 PM – 5:00 PM	<b>Batch - 3</b> PV - 1 2:00 PM – 5:00 PM	<b>Batch - 4</b> Cantilever 1 2:00 PM – 5:00 PM	<b>Batch - 5</b> PV – 1 2:00 PM – 5:00 PM	<b>Batch - 6</b> Cantilever 1 2:00 PM – 5:00 PM
<b>NNFC: 15: Back</b> <b>Metal deposition</b> <b>16: PR strip 17 :</b> <b>Annealing</b>	<b>TEM/Solar</b>	<b>MNCF: FTIR /Zeta</b>	<b>NNFC: 3 :</b> <b>Ellipsometer -</b> <b>Introduction and</b> <b>measurement 4:</b> <b>Lithography (2</b> <b>samples: 1 –</b> <b>cantilever, 2 – use</b> <b>quarter inch</b> <b>substrate, any</b> <b>mask for metal lift</b> <b>off process demo)</b>	<b>Annexe Lab-2 /</b> <b>ZnO synthesis</b>	<b>Gas sensor Lab</b>





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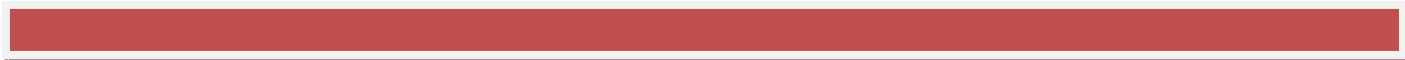


**13<sup>th</sup> Feb 2020 Thursday**

Batch -1 PV 1 9:30 AM – 1:00 PM	Batch -2 Cantilever - 1 9:30 AM – 1:00 PM	Batch - 3 PV - 1 9:30 AM – 1:00 PM	Batch - 4 Cantilever 1 9:30 AM – 1:00 PM	Batch - 5 PV – 1 9:30 AM – 1:00 PM	Batch - 6 Cantilever 1 9:30 AM – 1:00 PM
Thin Films lab	NNFC annexe lab -1	NNFC: 1 : Starting substrate - one um oxide wafer 2: Ellipsometer - Introduction and measurement 3: Lithography for diffusion window	NNFC: 5: Dry etching - SiN etch and silicon etch 6: ashing	MNCF : Probe station 2 /FIB	MNCF : TEM /Solar Simulator

**1:00 PM – 2:00 PM: Lunch Break**

Batch -1 PV 1 2:00 PM – 5:00 PM	Batch -2 Cantilever - 1 2:00 PM – 5:00 PM	Batch - 3 PV - 1 2:00 PM – 5:00 PM	Batch - 4 Cantilever 1 2:00 PM – 5:00 PM	Batch - 5 PV – 1 2:00 PM – 5:00 PM	Batch - 6 Cantilever 1 2:00 PM – 5:00 PM
NNFC annexe lab - 1	Thin Films lab	NNFC: 4 : Wet oxide etching 5: Photo resist strip 6: Dektak measurement	NNFC : 7: Metallization for lift off on quarter substrate - Sputter Cr /Au 10/50 nm 8: Wet etch - Lift off process 9: Inspection	MNCF: AFM /LDV	MNCF : Probe station 2 /FIB





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4<sup>th</sup> Feb – 24<sup>th</sup> Feb 2020

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14<sup>th</sup> Feb 2020 Friday

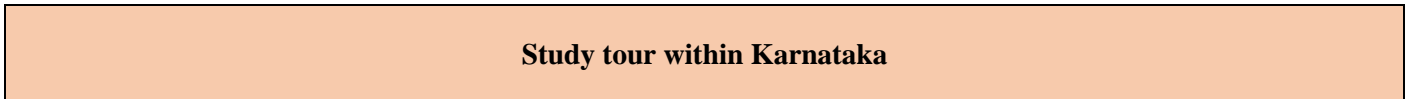
<b>Batch -1 PV 1 9:30 AM – 1:00 PM</b>	<b>Batch -2 Cantilever - 1 9:30 AM – 1:00 PM</b>	<b>Batch - 3 PV - 1 9:30 AM – 1:00 PM</b>	<b>Batch - 4 Cantilever 1 9:30 AM – 1:00 PM</b>	<b>Batch - 5 PV – 1 9:30 AM – 1:00 PM</b>	<b>Batch - 6 Cantilever 1 9:30 AM – 1:00 PM</b>
<b>Packaging Lab</b>	<b>Systems Lab</b>	<b>NNFC: 7 : Wafer cleaning RCA - level 2 - level 1 8: Diffusion</b>	<b>MNCF : XRD /Raman</b>	<b>MNCF : TEM /Solar Simulator</b>	<b>MNCF: AFM /LDV</b>

1:00 PM – 2.00 PM: Lunch Break

<b>Batch -1 PV 1 2:00 PM – 5:00 PM</b>	<b>Batch -2 Cantilever - 1 2:00 PM – 5:00 PM</b>	<b>Batch - 3 PV - 1 2:00 PM – 5:00 PM</b>	<b>Batch - 4 Cantilever 1 2:00 PM – 5:00 PM</b>	<b>Batch - 5 PV – 1 2:00 PM – 5:00 PM</b>	<b>Batch - 6 Cantilever 1 2:00 PM – 5:00 PM</b>
<b>Systems Lab</b>	<b>Packaging Lab</b>	<b>NNFC: 9 : PSG etching 10: FPP measurement ( sheet resistance ) 11 : Front metal deposition</b>	<b>Technical Report Preparation</b>	<b>MNCF:SEM/X PS</b>	<b>MNCF : TEM /Solar Simulator</b>



15<sup>th</sup> Feb – 16<sup>th</sup> Feb 2020 Saturday & Sunday



**Study tour within Karnataka**



**Introductory Training Course on Nanofabrication Technologies**  
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**17<sup>th</sup> Feb 2020 Monday**

<b>Batch -1</b> PV 1 9:30 AM – 1:00 PM	<b>Batch -2</b> Cantilever - 1 9:30 AM – 1:00 PM	<b>Batch - 3</b> PV - 1 9:30 AM – 1:00 PM	<b>Batch - 4</b> Cantilever 1 9:30 AM – 1:00 PM	<b>Batch - 5</b> PV – 1 9:30 AM – 1:00 PM	<b>Batch - 6</b> Cantilever 1 9:30 AM – 1:00 PM
Gas sensor Lab	Annexe Lab-2 / ZnO synthesis	NNFC: 12: Lithography ( contact pads) 13: Wet Al etching 14 : Spin coating and back oxide etch	MNCF : FTIR /Zeta	MNCF : XRD /Raman	MNCF : SEM /XPS

**1:00 PM – 2.00 PM: Lunch Break**

<b>Batch -1</b> PV 1 2:00 PM – 5:00 PM	<b>Batch -2</b> Cantilever - 1 2:00 PM – 5:00 PM	<b>Batch - 3</b> PV - 1 2:00 PM – 5:00 PM	<b>Batch - 4</b> Cantilever 1 2:00 PM – 5:00 PM	<b>Batch - 5</b> PV – 1 2:00 PM – 5:00 PM	<b>Batch - 6</b> Cantilever 1 2:00 PM – 5:00 PM
Annexe Lab-2 / ZnO synthesis	Gas sensor Lab	NNFC: 15: Back Metal deposition 16: PR strip 17 : Annealing	MNCF : TEM /Solar Simulator	MNCF : FTIR /Zeta	Technical Report Preparation







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**18<sup>th</sup> Feb 2020 Tuesday**

<b>Batch -1 PV 1 9:30 AM – 1:00 PM</b>	<b>Batch -2 Cantilever - 1 9:30 AM – 1:00 PM</b>	<b>Batch - 3 PV - 1 9:30 AM – 1:00 PM</b>	<b>Batch - 4 Cantilever 1 9:30 AM – 1:00 PM</b>	<b>Batch - 5 PV – 1 9:30 AM – 1:00 PM</b>	<b>Batch - 6 Cantilever 1 9:30 AM – 1:00 PM</b>
MNCF : probe station /Fib	MNCF : XRD/Raman	Thin Films lab	NNFC annexe lab -1	NNFC: 1 : Starting substrate - one um oxide wafer 2: Ellipsometer - Introduction and measurement 3: Lithography for diffusion window	NNFC: 1 : Wafer cleaning ( RCA ) 2: LPCVD ( SiN deposition)

**1:00 PM – 2.00 PM: Lunch Break**

<b>Batch -1 PV 1 2:00 PM – 5:00 PM</b>	<b>Batch -2 Cantilever - 1 2:00 PM – 5:00 PM</b>	<b>Batch - 3 PV - 1 2:00 PM – 5:00 PM</b>	<b>Batch - 4 Cantilever 1 2:00 PM – 5:00 PM</b>	<b>Batch - 5 PV – 1 2:00 PM – 5:00 PM</b>	<b>Batch - 6 Cantilever 1 2:00 PM – 5:00 PM</b>
MNCF : XRD/Raman	MNCF : probe station /Fib	NNFC annexe lab -1	Thin Films lab	NNFC: 4 : Wet oxide etching 5: Photo resist strip 6: Dektak measurement	NNFC: 3 : Ellipsometer - Introduction and measurement 4: Lithography (2 samples: 1 – cantilever, 2 – use quarter inch substrate, any mask for metal lift off process demo)



**Introductory Training Course on Nanofabrication Technologies**  
**4<sup>th</sup> Feb – 24<sup>th</sup> Feb 2020**  
 (Supported by ITEC, MEA, GoI)



**19<sup>th</sup> Feb 2020 Wednesday**

Batch -1 PV 1 9:30 AM – 1:00 PM	Batch -2 Cantilever - 1 9:30 AM – 1:00 PM	Batch - 3 PV - 1 9:30 AM – 1:00 PM	Batch - 4 Cantilever 1 9:30 AM – 1:00 PM	Batch - 5 PV – 1 9:30 AM – 1:00 PM	Batch - 6 Cantilever 1 9:30 AM – 1:00 PM
MNCF : AFM/LDV	Technical Report Preparation	Packaging Lab	Systems Lab	NNFC: 7 : Wafer cleaning RCA - level 2 - level 1 8: Diffusion	NNFC: 5: Dry etching - SiN etch and silicon etch 6: ashing

**1:00 PM – 2.00 PM: Lunch Break**

Batch -1 PV 1 2:00 PM – 5:00 PM	Batch -2 Cantilever - 1 2:00 PM – 5:00 PM	Batch - 3 PV - 1 2:00 PM – 5:00 PM	Batch - 4 Cantilever 1 2:00 PM – 5:00 PM	Batch - 5 PV – 1 2:00 PM – 5:00 PM	Batch - 6 Cantilever 1 2:00 PM – 5:00 PM
MNCF : SEM/XPS	MNCF : AFM/LDV	Systems Lab	Packaging Lab	NNFC: 9 : PSG etching 10: FPP measurement ( sheet resistance ) 11 : Front metal deposition	NNFC : 7: Metallization for lift off on quarter substrate - Sputter Cr /Au 10/50 nm 8: Wet etch - Lift off process 9: Inspection





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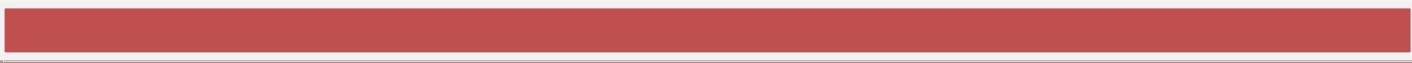


**20<sup>th</sup> Feb 2020 Thursday**

<b>Batch -1 PV 1 9:30 AM – 1:00 PM</b>	<b>Batch -2 Cantilever - 1 9:30 AM – 1:00 PM</b>	<b>Batch - 3 PV - 1 9:30 AM – 1:00 PM</b>	<b>Batch - 4 Cantilever 1 9:30 AM – 1:00 PM</b>	<b>Batch - 5 PV – 1 9:30 AM – 1:00 PM</b>	<b>Batch - 6 Cantilever 1 9:30 AM – 1:00 PM</b>
<b>MNCF : FTIR /Zeta</b>	<b>MNCF : SEM/XPS</b>	<b>Gas sensor Lab</b>	<b>Annexe Lab-2 / ZnO synthesis</b>	<b>NNFC: 12: Lithography ( contact pads) 13: Wet Al etching 14 : Spin coating and back oxide etch</b>	<b>MNCF : XRD /Raman</b>

**1:00 PM – 2.00 PM: Lunch Break**

<b>Batch -1 PV 1 2:00 PM – 5:00 PM</b>	<b>Batch -2 Cantilever - 1 2:00 PM – 5:00 PM</b>	<b>Batch - 3 PV - 1 2:00 PM – 5:00 PM</b>	<b>Batch - 4 Cantilever 1 2:00 PM – 5:00 PM</b>	<b>Batch - 5 PV – 1 2:00 PM – 5:00 PM</b>	<b>Batch - 6 Cantilever 1 2:00 PM – 5:00 PM</b>
<b>MNCF : TEM /Solar Simulator</b>	<b>Technical Report Preparation</b>	<b>Annexe Lab-2 / ZnO synthesis</b>	<b>Gas sensor Lab</b>	<b>NNFC: 15: Back Metal deposition 16: PR strip 17 : Annealing</b>	<b>MNCF : FTIR /Zeta</b>





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**21<sup>th</sup> Feb 2020 Friday**

**Presentation by Participants**

**22<sup>nd</sup> Feb – 23<sup>rd</sup> Feb 2020 Saturday & Sunday**

**Study tour within Karnataka**

**24<sup>th</sup> Feb 2020 Monday**

**Valedictory, Feedback and Certificate Distribution**