



KNOWLEDGE INCUBATION FOR TEQIP, IIT KANPUR

Short Course on Micromanufacturing

August 31- September 04, 2015

Knowledge Incubation for TEQIP
An IIT Kanpur and MHRD Initiative

A short term course on Micromanufacturing
August 31 to 04 September, 2015

An Intensive course on Micromanufacturing was held from August 31 – September 04, 2015 under the outreach program of the Knowledge Incubation for TEQIP of IIT Kanpur. The course was designed to cater the needs of teachers and research scholars from the various TEQIP institutes, and also professionals from interested R & D houses and labs, and industries. This programme was specifically useful for persons who are concerned with training / teaching, research and industrial applications of micromachining, micro-to nano-finishing, micromodling, microwelding, microcasting, nanometrology, etc.

The basic objective of the present course was to acquaint the participant with the principles, basic machine tools, developments in micro-manufacturing processes, micro and nano metrology and research trends in the area of micro-manufacturing processes. Thus, this short term course dealt with various areas of micromanufacturing including measurements techniques.

TOPIC DISCUSSED

- ❖ Introduction to Micromanufacturing
- ❖ Traditional Micromachining
- ❖ Advanced of Micro/ Nano-Machining
 - Mechanical Micromachining
 - Thermal Micromachining
 - Electrochemical and Chemical Micromachining
 - Ion Beam machining
 - Photochemical Etching
 - X-ray Lithography

- ❖ Nano Finishing
 - Abrasive Flow Finishing
 - Magneting Abrasive Finishing
 - Magnetorheological etc.

- ❖ Microforming
 - Micro-sheet Forming
 - Micro Laser Forming etc.

- ❖ Microjoining Technology
 - Laser Beam Microwelding / Microjoining
 - Electron Beam Microwelding / Microjoining etc.

- ❖ Microcasting
- ❖ Microsensors / Microactuaors
- ❖ Micro / Nano- Metrology

LIST OF SPEAKERS

- Dr. Indranil Manna
- Dr. V.K.Jain
- Dr. J. Ramkumar
- Dr. S. Aravindan
- Dr. Arvind Kumar
- Dr. Ajay Sidpara
- Dr. UdayShanker Dixit
- Dr. KanteshBalani
- Dr. Rakesh G Mote
- Dr. R.K. Thareja
- Dr. Anupam Agrawal
- Dr. AnshudharJayal
- Dr. Niraj Sinha

- Dr. Sameer Khandekar
- Dr. Shantanu Bhattacharya
- Dr. Bijoy Bhattacharya
- Dr. Bishakh Bhattacharya
- Mr. Syed NadeemAktar
- Dr. Ramesh K Singh
- Dr. S.K. Choudhury
- Dr. Gouthama
- Dr. Monica Katiyar
- Dr. SathyanSubbiah
- Dr. S. Anantha Ramakrishna
- Dr. G.L. Samuel
- Dr. Sunil Jha
- Dr. I. A. Palani
- Mr. MayurSudhakarSawant
- Mr. N. Balashanmugam
- Dr. Vinod Yadav

PARTICIPATING INSTITUTE

Institute	Number of Participants
BIET Jhansi	3
Guru Jambheshwar University of Science & Technology, Hisar	1
Lukhdhirji Engineering College, Morbi (Gujarat)	1
MANIT Bhopal	1
MMMUT Gorakhpur	1
UIET (Panjab University)	1
B.T.K.I.T Dwarahat	2
HBTI, Kanpur	3
National Institute of Technical Teacher & Training	1
I.F.T.M.	1
NIT kurukshetra	1
Sant Longowal Institute of Engineering and Technology	1
JNTU College of Engineering, Kakinada	1
MJP Rohilkhand University	1
College of Engineering, Cherthala, Pallippuram	1
SDM College of Engineering and Technology	1
AMU	2
Jadavpur University	2
Rajarambapu Institute of Technology	1
ISM Dhanbad	1
PEC University of Science & Technology Chandigarh	1

Total	28

WORKSHOP SCHEDULE

August 31, 2015

Time	Event
8:00 - 8:30 AM	Registration
8:30 - 9:30 AM	Laser assisted material processing – A modern manufacturing approach. <i>Prof. I Manna</i>
9:30 – 10:30 AM	Micromanufacturing : A Vision <i>Dr. V.K.Jain</i>
10:30 – 11:00 AM	Tea Break
11:00 – 12:00 PM	Micro and nano fabrication by multiple processes (FIB and NPF) <i>Dr. S. Aravindan</i>
12:00 – 1:00 PM	Microcasting : An overview and modelling. <i>Dr. Arvind Kumar</i>
1:00 – 2:30 PM	Lunch Break
2:30 – 3:30 PM	Elastic Emission Machining. <i>Dr. Ajay Sidpara</i>
3:30 – 4:00 PM	Tea Break
4:00 – 5:00 PM	Micro forming using lasers <i>Prof. U. S. Dixit</i>
5:00 – 6:00 PM	Abrasive flow finishing (AFF) process and its variant. <i>Dr. J. Ramkumar</i>

September 01, 2015

Time	Event
8:30 - 9:30 AM	Nano indentation of materials. <i>Dr. KanteshBalani</i>
9:30 – 10:30 AM	Focused Ion Beam Machining <i>Dr. Rakesh G Mote</i>
10:30 – 11:00 AM	Tea Break
11:00 – 12:00 PM	Laser- reliable tools for machining. <i>Dr. R.K. Thareja</i>
12:00 – 1:00 PM	Forming at micro scale: Challenges and

	opportunities. <i>Dr. Anupam Agrawal</i>
1:00 – 2:30 PM	Lunch Break
2:30 – 3:30 PM	Green Manufacturing in micro Domain. <i>Dr. AnshudharJayal</i>
3:30 – 4:00 PM	Tea Break
4:00 – 5:00 PM	Fabrication technology of Bio-medical micro devices. <i>Dr. Niraj Sinha</i>
5:00 – 6:00 PM	Micro fabrication and its impact on Research and Development in thermal fluid sciences. <i>Dr. Sameer Khandekar</i>

September 02, 2015

Time	Event
8:30 - 9:30 AM	BiomadicalMicrodevices and their applications <i>Dr. Shantanu Bhattacharya</i>
9:30 – 10:30 AM	Electrochemical Micro Machining : Present challenges <i>Dr. Bijoy Bhattacharya</i>
10:30 – 11:00 AM	Tea Break
11:00 – 12:00 PM	Smart Materials for Micromachining <i>Dr. Bishakh Bhattacharya</i>
12:00 – 1:00 PM	Excimer Laser Micromachining – Fabrication of micro lens array <i>Mr. Syed NadeemAktar</i>
1:00 – 2:30 PM	Lunch Break
2:30 – 3:30 PM	3 D Printing and the future of Manufacturing <i>Dr. V.K. Jain</i>
3:30 – 4:00 PM	Tea Break
4:00 – 5:00 PM	Machine building issues in micro nano domain <i>Dr. Ramesh K Singh</i>
5:00 – 6:00 PM	Optical spectroscopy and Microscopic Investigations of Dry Micro EDM : Fundamentals and Applications. <i>Dr. J. Ramkumar</i>

September 03, 2015

Time	Event
8:30 - 9:30 AM	Application of Abrasive Water Jet for fabrication of complex 3-D features <i>Dr. S.K. Choudhury</i>
9:30 – 10:30 AM	Electron Microscopy : SEM, TEM and HRTEM

	<i>Dr. Gouthama</i>
10:30 – 11:00 AM	Tea Break
11:00 – 12:00 PM	Thin film deposition <i>Dr. Monica Katiyar</i>
12:00 – 1:00 PM	Mechanical Micro/Nano-Machining <i>Dr. SathyanSubbiah</i>
1:00 – 2:30 PM	Lunch Break
2:30 – 3:30 PM	Imaging of micro- / nano- objects <i>Dr. S. Anantha Ramakrishna</i>
3:30 – 6:00 PM	Lab Visit

September 04, 2015

Time	Event
8:30 - 9:30 AM	Micro Wire EDM <i>Dr. G.L. Samuel</i>
9:30 – 10:30 AM	Machine building for nano finishing <i>Dr. Sunil Jha</i>
10:30 – 11:00 AM	Tea Break
11:00 – 12:00 PM	Laser assisted Micro and Nano texturing for photovoltaic device development <i>Dr. I. A. Palani</i>
12:00 – 1:00 PM	Additive Layer Manufacturing using Micro- plasma. <i>Mr. MayurSudhakarSawant</i>
1:00 – 2:30 PM	Lunch Break
2:30 – 3:30 PM	Development and Performance of AFF Machine at CMTI <i>Mr. N. Balashanmugam</i>
3:30 – 4:00 PM	Abrasive Hybrid Machining Processes <i>Dr. Vinod Yadava</i>
4:00 – 5:00 PM	Valedictory
5:00 – 6:00 PM	Tea Break

Summary of Faculty Feedback

Workshop

<i>Questions</i>	<i>Excellent</i>	<i>Good</i>	<i>Ordinary</i>
Clarity of communication about workshop	16	1	
Organization of the sessions	12	5	
Quality of lectures	14	3	
Quality of posters	7	4	
Effectiveness of discussions	10	6	
Effectiveness of learning experience	11	3	1
	<i>Appropriate</i>	<i>Short</i>	<i>long</i>
Duration of workshop	12	3	
	<i>Definitely</i>	<i>Maybe</i>	<i>No</i>
Would you like to have more such sessions?	15	1	
Would you like e-lectures by experts on special topics?	14	1	1
Suggest specific topic that you would like additional expert lectures on	<ul style="list-style-type: none"> ➤ How to increase efficiency of micro machine in the field of conventional mode and robotics. ➤ Laser Welding. ➤ Material characterization, Modelling, FMS, CFD and Optimization. ➤ System engineering, Human factors approach in system design. ➤ Role of automation in Micro/Nano Manufacturing. ➤ Interaction between Laser and work piece. Melt pool Kinematics during Laser beam micromachining. ➤ Rapid Prototype and Polishing Fluids. ➤ Advanced research area or the combination of different areas from Mech. Engg. Including design, industries and thermal so the one person get the flavor of all the area and can try to last there area of research. 		

Additional Suggestions	<ul style="list-style-type: none"> ➤ All the PPT should be given to all the participant. ➤ All the materials used in the class-room lectures may be shared. ➤ The presentation should be allowed to the participant as well. ➤ Lectures should be mixed with Lab work. ➤ More lecture content for individual lecture rather than number of experts. ➤ Lesser number of lecture, more depth. ➤ Some changes is essential in the curriculum at B. Tech and M. Tech level. ➤ Courses focussing in need of Industries in present Science.
------------------------	---

Teaching

Which subjects do you teach?	<ul style="list-style-type: none"> ➤ Manufacturing Science, Production ➤ Operational Management ➤ Tribology ➤ Material Science and Design ➤ Advanced Manufacturing processes, Advanced material tech. Engg. Materials, Engg. Mechanics. ➤ Industrial Engg., Operational Research and Ergonomics. ➤ Flexible Mfg System, Computer Integrated Mfg System. ➤ CAD/CAM, NTMP (AMP), Multi Vibration ➤ Metrology for manufacturing. ➤ Fluid Mechanics / Engg. Mechanics 	
What is average student to teacher ratio in your institute?	<ul style="list-style-type: none"> ➤ 1:20 ➤ 1:25 ➤ 1:15 ➤ 1:50 	
Questions	YES	NO
Do you have additional support for teaching (tutors, graders, teaching Assistants, etc)?	5	10
Do you give class projects for UG classes?	14	2
Do you give class projects for PG classes?	13	1
Do you have sufficient resources for laboratory courses?	7	9
	Sufficient	Inadequate

Is the library/journal/e-connection support adequate?	7		9	
	<i>Definitely</i>	<i>May be</i>		<i>No</i>
Would you like to have common (TEQIP) repository of course material?	12	3		
Would you like to visit IITK to participate in and develop course material (existing or new)	15	1		
Would you like to participate in creation of the repository material (course files/lab. Manuals/question bank/etc)	12	3		
	<i>e-courses</i>	<i>Workshops</i>	<i>Content</i>	<i>none</i>
How can IITK effectively help you prepare for teaching?	9	13	5	

<p>How can TEQIP help improve your teaching?</p>	<ul style="list-style-type: none"> ➤ This kind of workshop should be organized regularly. ➤ With the use of e-courses. ➤ Listening to the experts and understanding their way of teaching. ➤ The exploring of new areas that was untouched by us will help in effective teaching. ➤ By attending , learning and interacting through this kinds of STS/Workshops. ➤ IITK can help in collaborative Research. ➤ Through more workshops and seminars. ➤ Providing Resources , Literature and provide facilities for experimentation, lab development support guidance. ➤ Developing the lab facility and basic infrastructure by visiting the state institute and suggesting to institute and department in a uniform manner. ➤ Organizing seminar and workshops at workplace so that PG and Ph. D student may be beneficial. ➤ Guiding and implementing live projects by the students at UG/PG level. ➤ Controlling and monitoring the effective use of TEQIP funds in the interest of students and Institute. ➤ Conducting more courses and workshops from time to time. Specially, can organize summer school during vacations or also provide small project to the faculty which they didn't have in their institute. ➤ TEQIP can provide facility to interchange laboratory facilities. Any faculty can do labs or experiments in any TEQIP funded institute wherever facilities are available.
--	---

Research

<i>Questions</i>	<i>Definitely</i>	<i>Maybe</i>	<i>No</i>
Would you like to visit an IIT for a visiting-faculty/ post-doctoral fellow, if offered (via-TEQIP)?	16	1	
Would you like to share/use research infrastructure at IITK, if made available?	17		
Would you like to conduct collaborative research with IITK?	17		

Would you like lectures by experts (Indian and international) on niche research areas/topics?	14	3	
Do you want special-topic conferences?	13	3	1
How can TEQIP help improve your research?	<ul style="list-style-type: none"> ➤ TEQIP can provide platform to faculty to work with IIT people. ➤ Permit to organize for funding in the area of lab at our organization. ➤ Providing a basic uniform infrastructure to all institutions at a level of NIT/IIT. ➤ Providing support resources and experimentation facilities, Lab development support guidance. ➤ By making contact with experts of domain in such kind of workshops. ➤ By creating new vision and mission and ultimately by proper planning and implementation of research quality can be improve in future. ➤ The new area will add a diameter to my research in future. ➤ Better and useful interaction with the leaders, exposure to the niche areas. ➤ Steps made by TEQIP to the explore the knowledge is very useful. ➤ TEQIP can provide platform to faculty to work with IIT people. ➤ By promoting us with respect to availability of journals and books , computer peripherals, net connect, printing devices. ➤ By funding the specific projects idea submitted by the researchers, after checking there viability aspects. ➤ Collaboration between different research role and institute. 		

OUTCOME

The short course on Micromanufacturing brought together experts, faculty members and participants to learn about micromanufacturing and their applications. This course has been successfully conducted by the joint efforts of thirty one eminent speakers from different reputed academic institutions, scientists from R & D houses, and practicing engineers from industries. Participants were exposed to important practical topics like metrology for measurement of micro and nano features using SEM, TEM, EDAX etc. Emerging thermal micromachining processes which include electric discharge micromachining, laser beam micromachining, ion beam micro-/nano- machining as well as chemical micromachining, electrochemical micromachining and their variants were also discussed in detail with many applications. Experts also emphasized on the need for better understanding of these micromanufacturing techniques to better utilize them. As a part of the course, the participants had lab visit to several micro manufacturing facilities available in the institute and were exposed to the various capabilities existing in IIT Kanpur which can be useful for their research.

