

INDIAN INSTITUTE OF INFORMATION TECHNOLOGY  
DESIGN AND MANUFACTURING (IIITDM)  
KANCHEEPURAM

INTRODUCTION OF NEW COURSE

Course Title	<b>Micro Systems Fabrication</b>	Course Code	<b>ME xxxx</b>			
Dept./ Specialization	Mechanical	Structure (LTPC)	3	1	0	4
To be offered for	UG/PG	Status	Core <input type="checkbox"/>		Elective <input checked="" type="checkbox"/>	
Faculty Proposing the course	Dr. Avinash Kumar	Type	New <input checked="" type="checkbox"/>		Modification <input type="checkbox"/>	
Recommendation from the DAC: Yes		Date of DAC	15/11/2021			
External Expert(s)	Prof. Amit Agrawal (IIT Bombay) .Prof. Suman Chakraborty( IIT Kharagpur)					
Pre-requisite	Basic Manufacturing Courses					
Learning Objectives	This course introduces the students about: (a) Micro- system technology to realize various biologically inspired systems and materials, (b) Micro- fluidic systems, (c)Various aspects of processes and methods derived from the microelectronic industry to realize micro-systems, (d) Lab-on-chip technology, (e) Biological and medical sensors.					
Learning Outcomes	At the end of the course, the students will learn about; (a) Basics of micro system and sensing technologies, (b) Micro system fabrication processes and (c) How to apply these in microfluidics and medical diagnostics.					
Contents of the course (With approximate break-up of hours for L/T/P)	<p><b>Introduction to Microsystems technology: (L6 + T2)</b> Introduction to Fabrication, Sensing and Microfluidics, Basics of sensors, Biochip Sensors &amp; Microarrays, Introduction to device Fabrication, Microfluidics.</p> <p><b>Sensing Technologies: (L9 + T3)</b> Potentiometric and Amperometric sensors, Electrochemistry basics, Nernst Equation, Referencing of electrodes, Nicolskii Eisenmann method of evaluation of electrode potential, Debye Huckel Theory, Zeta Potential on electrode surfaces, Cyclic Voltametry, Ion selectivity analysis, Impedometric sensing, Optical Sensing (Fluorescence, phosphorescence, FRET, Visible range and IR sensing), Mechanical sensing, Microfluidic Sensor design.</p> <p><b>Micro system fabrication processes: (L9 + T3)</b> <u>Silicon processes</u>: Introduction to microelectronic fabrication, Optical lithography, photo-resists, Non optical lithography techniques, LIGA processes, Design Considerations, Vacuum science and plasmas, Etching techniques, Physical vapor deposition (evaporation and sputtering), Chemical vapor deposition.</p> <p><u>Polymers Processes</u>: Polymer materials for micro-systems, Polymeric micromachining technology like softlithography, Bulk and surface micromachining, replication technologies, laser machining, micro-stereo lithography, micro-molding, Assembly and packaging of micro-systems, Biocompatibility of materials and processes.</p> <p><b>Micro systems in Microfluidics: (L9 + T3)</b> Fundamentals of fluid flow, Continuum mechanics at small scales, Derivation of Conservation of Mass and Conservation of Momentum equations, Scaling laws, Low Reynold's no. flows, Entrance effects in micro-fluidic devices, Surface tension driven flows, Electro-kinetic flows, Electrophoresis, Electro-osmosis, Dielectrophoresis, Streaming potential and Sedimentation potential,</p>					

	<p>Micro-fluidics for internal flow control (micro-pumps and micro-valves, device building and characterization), Micromixer design and characterization, Micro-fluidics for life sciences and chemistry.</p> <p><b>Micro systems for medical diagnostics: (L9+ T3)</b></p> <p>Basics of the cell, DNA and proteins, Introduction to Polymerase chain reaction (PCR), Microchip PCR, Design of micro-reactors, Space domain and time domain PCR reactors, Design of DNA microarrays, DNA and protein sensing, Protein structure, Protein transcription and translation (Protein structure coding).</p>
Text Book	<ol style="list-style-type: none"> <li>1. Fundamentals of Microfabrication (Second Edition), Marc J. Madou, CRC press Taylor and Francis Group, 6000 Broken Sound Parkway NW, Suite 300, Boca Raton, FL33487-2724, 2002.</li> </ol>
Reference Books	<ol style="list-style-type: none"> <li>1. BioMEMS Technologies and Applications, Edited by Wanjun Wang, Steven A. Soper, CRC press Taylor and Francis Group, 6000 Broken Sound Parkway NW, Suite 300, Boca Raton, FL33487-2724, 2006.</li> <li>2. Biomolecular sensing, processing and analysis, Rashid Bashir, Steve T. Werely, Mauro Ferrari, Springer Science and Business Media LLC, 233 Spring Street, New York, NY10013, USA, 2006.</li> <li>3. Fundamentals and applications of Microfluidics, Nam-Trung Nguyen, Steve T. Werely, Artech house Inc., 685 Canton Street, Norwood, MA02062, 2002.</li> <li>4. The Science and Engineering of Microelectronic Fabrication (Second Edition), Stephen A. Cambell, Oxford University Press, 198, Madison Avenue, New York 10016, 2001.</li> <li>5. Molecular Biology of the Cell (fourth edition), Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, Kate Roberts, Peter Walter, Garland Sand, Taylor and Francis group, 6000 Broken Sound Parkway NW, Suite 300, Boca Raton, FL33487-2724, 2002.</li> </ol>