NOC:BioMEMS and Microsystems - Video course

NPTEL

http://nptel.ac.in

Mechanical Engineering

COURSE OUTLINE

This course covers topics on Introduction to BioMEMS and microfluidics,Important materials for fabrication of BioMEMS platforms,Design of ISE. Finding selectivity coefficient for a mixed ion system.,Introduction to Cell biology, Basic structure of DNA,Protein charging at different pH range, Amino acids, protein polymerization, Transcription , Translation,Micromixers: Design and mixing principales,Etching techniques, evaporation and sputtering & Photolithography techniques.

COURSE DETAIL

Week. No	Topics
1.	• Introduction to BioMEMS and microfluidics • Introduction to Bio nano technology, Biosensors, fluidics. • Introduction to device fabrication (Silicon and Polymers) • Introduction to device fabrication (Silicon and Polymers) continued.. • Sensors, Transduction and Performance factors. • Sensors, Transduction and Performance factors continued
2.	• Important materials for fabrication of BioMEMS platforms • Introduction to silicon device fabrication • Some Fabrication Methods for soft materials • Transduction Methods. About cell potential and SHEs • Cell reaction, Nernst equation, Construction of Ion selective electrodes • Measurement and calibration of electrodes, ion-solvent interaction

Coordinators:

Dr. Shantanu Bhattacharya
Assistant ProfessorDepartment of Mechanical EngineeringIIT Kanpur

3.	• Design of ISE. Finding selectivity coefficient for a mixed ion system. • ISE continued.. Gas sensing electrodes • Applications for biosensors in Diagnostics , Zeta potential and the model for electrode. • Flow between two fixed plates. Comparison between plug like flow of electro-osmosis Vs parabolic flow. • Electro-kinetic flow in silicon channels. Design of electro-kinetic network. • Design of electro-kinetic network. Flow rate calculations. Selection of good materials, Streaming potential.
4.	• Introduction to Cell biology, Basic structure of DNA • DNA hybridization, , DNA polymerization, PCR • Thermal cycle , Real Time PCR.PCR design • Electrophoresis, Gel and Capillary electrophoresis, Agarose • DNA microarrays (concepts, and utility). Affymetrix and Nanogen approaches in realization of micro-arrays. • DNA sequencing (Sanger's reaction). DNA nano-pores. DNA detection using Mechanical Cantilevers. Basics of Protein structure.
5.	• Protein charging at different pH range, Amino acids, protein polymerization, Transcription , Translation • Antibody, Microencapsulation, Cyclic voltametry • Microfluidics, Similarity of Streamlines, Pathlines, Sreaklines and Timelines for a steady flow • Stress tensor. Viscosity. Newtonian, non-Newtonian fluids, Pseudoplastic, Dilatant, Bingham Plastic materials, Thixotropic fluids. • Flow over infinite plates, laminar and turbulent flow, Compressible and Incompressible flows • Flow over an infinite plate. Types of flows. Types of Fluids. Kinematics of fluids
6.	• Micromixers: Design and mixing principales • Microvalves : Designing of pneumatic and thermo pneumatic valves. • Hydrogel based valves. Electrochemical valves. • Micropumps • Microelectronic-fabrication processes: Review of basic fabrication processes for silicon • Introduction to microelectronic fabrication,

	Optical lithography, photo-resists.
7.	• Etching techniques, evaporation and sputtering. • Vacuum science and plasmas, Theory of plasma • Review of basic fabrication processes for polymers • Polymer materials for microsystems, Polymeric micromachining technology. • Bulk and surface micro machining, Replication technologies, laser machining, • micro-stereo lithography, micro-molding, Assembly and packaging.
8.	• Photolithography techniques • Functionality of Polymer PDMS used in micro technology • Additive techniques, Thermal oxidation • Single crystalline silicon, Subtractive technique. • Overview of Lab-on-chip technology/ biomedical and chemical sensors, specific cases: Integrated gene analysis systems • Chip technology (Integrated analysis of pathogenic bacteria), Electrochemical and optical (labeled and unlabeled).