Microfluidics and Lab-on-a-chip Systems

Institution	1) Ecole Normale Supérieure (ENS) 2) University of Paris 11 3) University of Paris 6
Language of instruction	French
ECTS Credits	-
Dates	Jan- Feb, Oct-Nov, Nov-dec in ENS, Paris 11 and Paris 6
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Description of the Course

Aims:
To gain a complete, new and multi-disciplinary knowledge base on microfluidics.

Objectives:
This course was prepared for the master students of ENS and other universities in the Paris area for a quick acquisition of a knowledge base on the conception, device realization, physics as well as advanced research topics of microfluidic systems.

Skills:

1. Lectures

- General introduction to microfluidics and lab on chip systems (general context, history, state of the art, and application perspectives)
- Physics of microfluidics (wetting, electro wetting, hydrodynamics and thermal effect at micro scales, diffusing properties, electro-osmoses, electrophoresis, dielectrophoresis, microfluidics related micro optics, magnetism and micro-mechanics),
- Conventional and non-conventional nanofabrication technologies for the realisation of microfluidic devices (optical lithography, electron beam lithography, focus ion beam lithography, nanoimprint lithography, soft lithography, micro-contact printing, pattern transfer techniques including thin film deposition, wet and dry etching, device assembling, etc),
- Microfluidic techniques (flow control, surface functionalization, droplet, particles handing, mixing, micro reactor, separation, and detection including intracavity laser absorption and electrochemical and nano-pore analysis),
- Application examples (optofluidics, nanopores, cell culture and stem cell differentiation, cell sorting and purification, cell manipulation including electroporation, patch clamp, lying, mechanic and chemical stimuli, protein

crystallization, DNA separation, PCR and RT-PCR, neuro-chips and tissues engineering possibilities).

2. Laboratory (practical work)

A 4 hours laboratory work is programmed at the end of the courses, including

- Optical lithography patterning for the mould fabrication,
- Nano-imprint lithography and soft lithography for structure fabrication
- Microfluidic device assembling including plasma surface activation and thermal bonding
- Characterisation of the fabrication micro and nanostructures as well as observation of microfluidic behaviours in the fabrication device (example: laminar flow, flow focusing, molecular diffusion, micro thermal effect, electrophoresis for DNA stretching).

Didactic material available

Type:	Languages/format:
Handouts (not available on the Internet)	English/PPT

Recommended Books

Authors	Title, edition	Publisher	Year	ISBN	Cost	Code

Codes: A: compulsory; B: strongly recommended C: recommended; D: wider reading

Study Times

Type	Hours
Lectures and tutorials/seminars + ½ day visit	20 hours Typically
Laboratory work	1x4

These times are rough estimates of the work by a typical student.

Assessment

%	Type	Details
100	Written examination	One hour including calculation