MEAM 5750: **Micro & Nano Fluidics ($\mu_n f$)**

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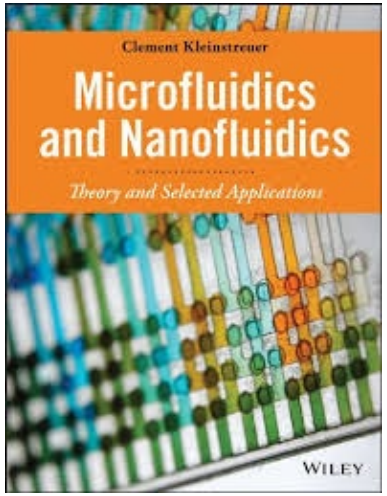
Spring 2025, MW 3:30-5:00 PM

Microfluidics is an emerging, interdisciplinary field with applications in, among other things, medicine, biology, energy conversion, material science, functional and active materials, and soft robotics. This course I about analyzing and designing various small systems. The course is self-contained. Topics covered include:

1. **Introduction and motivation** - lab on chip technology for point-of-need diagnosis and as a discovery platform (digital microfluidics).
2. **Size matters**: the benefits & disadvantages of small scales. Case studies: (A) drop-based microfluidics for discovery and optimization; (**B**) plasmon resonance-based biosensor; and (**C**) topological optimization (of micro heat exchangers)
3. **Micro-swimmers and microrobots.** Life in slow motion.
4. **To slip or not to slip**: superhydrophobic surfaces and their applications for drag-reduction and self-cleaning
5. **Electro kinetics:** a means to transport liquids and particles: the electric double layer, electroosmosis, electrophoresis, stochastic biosensors, pore-based sequencing; energy conversion, supercapacitors for energy storage, and capacitive desalination
6. **Dielectrophoresis (DEP) and Magnetophoresis** and applications in cell sorting, biotechnology, actuation, and soft robotics.
7. **Electrowetting and Digital microfluidics** - drops as reactors, hydrodynamic focusing, and electronic paper
8. **Surface tension and capillary forces**, paper microfluidics
9. **Biosensing and enzymatic amplification** (LAMP, PCR, and programmable endonuclease)



Grading Policy: Weekly HWs (50%), E-Quiz (15%), Term paper (with a class presentation) (30%); and participation (5%). .