Microfluidics and BioMEMS, Design task 1. 20.1.2021

Design task instructions:

Return as a single pdf document to the return box in my courses. **Maximum length of the answer is 1 page.** Formulae written with word or other text editor are preferred but I will accept hand written formulas and answers. If you do not have a scanner, then if you can take a good photograph and make a good looking pdf out of that then that is acceptable.

This task is worth 4 points on the course. Grading will be based on the following: 1pt the answer is correct, 1pt the presentation is clear, 1pt the reasoning and justification is clear and 1pt optimization of the design and other merits.

The main answer that you are returning is the design of a microfluidic chip that fits the criteria given in the task. The design means the dimensions of the microfluidic channel, and its architecture.

There is no single correct solution. You will get good points (about 3pt) if your design roughly satisfies the criteria and you have presented and justified the design well. You will get perfect points (4 pt) if I get the understanding that your design is close to optimal for the given task. **It is possible that satisfying all criteria given is impossible**, i.e. it is not possible to fulfill all of them. In that case, make your own best compromise and make it clear you have understood that this is the case.

In addition to just given the dimensions, add your calculations and reasoning to prove to me that your design is correct and that you have thought about the problem correctly. For example, if the instructions call that the maximum pressure can be 50 kPa, then have a pressure calculation to show that in your system the pressure is only 20 kPa, hence satisfies that criteria.

Task 1: The deadline is 27.1.2021 10:00 (right before next weeks session).

You want to design a channel for high-throughput screening of cells.

You have a technique to make rectangular cross section channels (including square cross section of course).

Your pump can handle a maximum of 100 kPa of pressure.

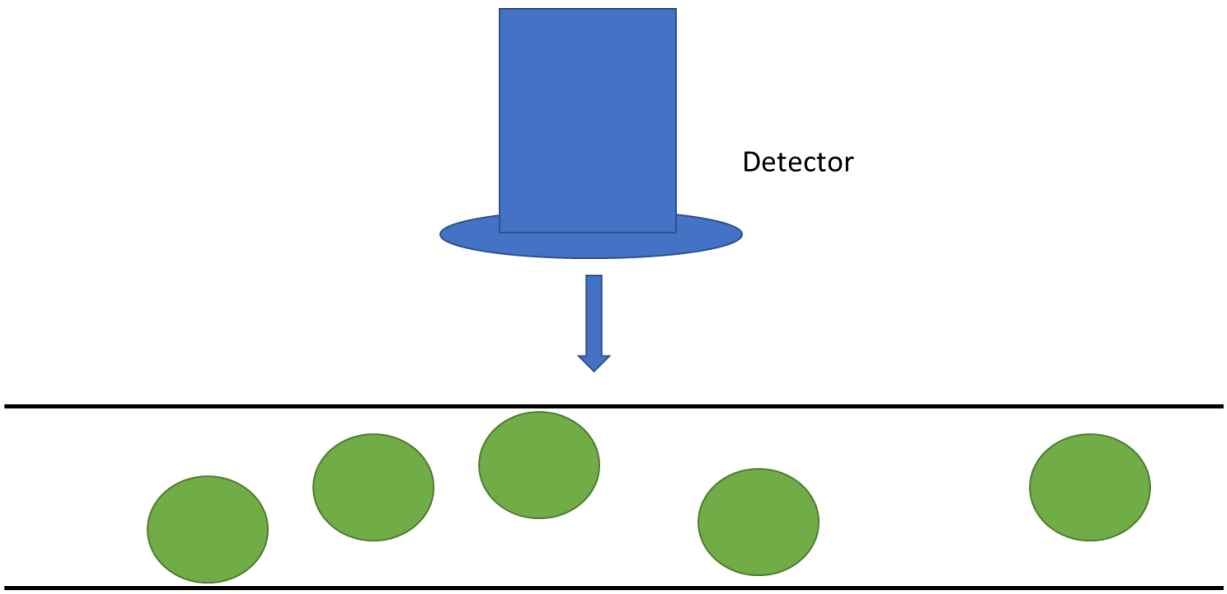
The cell size is 10 µm and we want the cells to pass by a detector one by one so both channel width and height need to be between 12 µm and 18 µm.

The application benefits from high average velocity, up to 10 mm/s, at which point the detector is no longer fast enough. It is also a benefit for the application if the channel is as long as possible.

Design a simple microfluidic chip to satisfy the above criteria.

Hints: Choose initial channel width and height to satisfy that criteria. Choose initial channel length, make a guess. Calculate how fast volumetric flow rate you can get with the pump available and how that translates to the average linear velocity. Assess the results you obtained and think about if you can improve the performance (in this task, good performance is high linear velocity, up to 10 mm/s and the length of the chip).

Hint 2: I plan to make Hagen-Poiseuille's law calculations also part of other design tasks. You might save a lot of time by developing an Excel calculator into which you can put dimensions instead of calculating by hand everytime you change something in the design.



Channel to make cells go past the detector 1 by 1