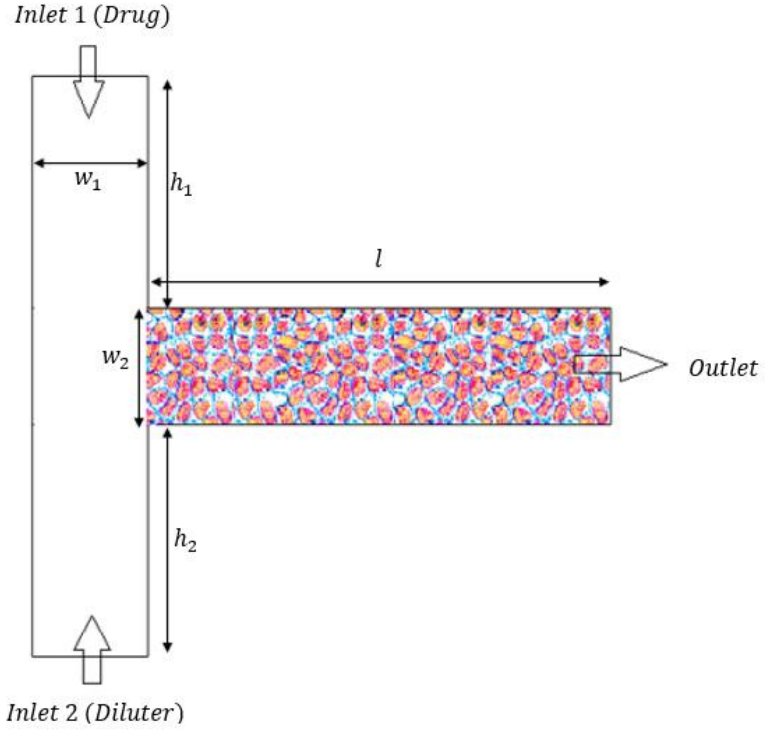
Computational Fluid Dynamics

Final Project **Due date: End of semester**

A multiport chip has been designed to test diluted concentrations of drugs on cell monolayers. The simplified 2D model is shown in the figure below. Drug and diluter are introduced at the inlets and the diluted drug will leave the platform from the outlet. Cells are loaded on the cell culture medium (the colored part in the figure). Cells consumes the drug at a constant rate. The goal of this project is to find the drug concentration distribution in the fluidic chip by solving the laminar flow equations and the equation of the transport of the dilute species in the computational domain using one way-coupled approach.



Part A

Full discretization process and specifying coefficients are required.

Requirements:

Tabulate the coefficients for each part separately.

Part B
Find the pressure and the velocity field

Requirements:
1. Grid Study
2. Residual-Iteration Plot
3. Velocity and Pressure Contours

Part C
Use the calculated velocity field of the previous part to solve the transport equation of Concentration.

Requirements:
1. Grid Study
2. Residual-Iteration Plot
3. Concentration Contour

Each student must **develop his own code** based on the following features:
1- Finite volume method
2- Staggered grid
3- Structured grid
4- Cartesian coordinate system
5- Incompressible flow
6- SIMPLE algorithm family
7- Introducing ghost cells for boundary condition treatment

Properties of the fluid:
$\rho = 1000 \frac{kg}{m^3}$, $\mu = 0.0007\ Pa.s$

	Numerical Method	Discretization Scheme	Inlet Velocity	Diffusion Coefficient $(\frac{m^2}{s})$
ابراهیم پور	SIMPLE	Hybrid	Triangular	5E-8
حجازی	SIMPLEC	UDS	Parabolic	4E-8
حمیدی زاده	SIMPLER	Power Law	Flat	3E-8
صدیقی	SIMPLE	Power Law	Parabolic	4E-8
عبداللهی اشنانی	SIMPLEC	Hybrid	Triangular	5E-8
فخری	SIMPLER	Hybrid	Parabolic	4E-8
گلاب	SIMPLE	UDS	Flat	3E-8

	Flow rate $(\frac{\mu l}{min})$		Concentration $(\frac{mol}{m^3})$		Drug consume rate (by cells) $(\frac{mol}{m^3 s})$
	Inlet 1	Inlet 2	Inlet 1	Inlet 2	
ابراهیم پور	1	1.2	1000	0	1
حجازی	1	0.8	1100	0	1.1
حمیدی زاده	0.8	1	1200	0	0.9
صدیقی	1.2	1	1300	0	1
عبداللهی اشنانی	1.1	1	1000	0	1.1
فخری	1	0.9	1100	0	0.9
گلاب	0.9	1	1200	0	1

	h_1 (mm)	h_2 (mm)	w_1 (mm)	w_2 (mm)	l (mm)
ابراهیم پور	1	1.1	0.5	0.5	2
حجازی	1	0.9	0.5	0.45	1.9
حمیدی زاده	1	1	0.45	0.5	2.1
صدیقی	1.1	1.1	0.45	0.55	2
عبداللهی اشنانی	1.1	1	0.55	0.45	1.9
فخری	0.9	0.9	0.55	0.5	2.1
گلاب	0.9	1	0.5	0.55	2