METU
NORTHERN CYPRUS CAMPUS

DEPARTMENT OF CIVIL ENGINEERING
CVE 372 HYDROMECHANICS
2011-12 Spring

Due Date: March 13, 2012

ASSIGNMENT - 1
FLOW IN CLOSED CONDUITS
Fully Developed Flows in Closed Conduits

Problem 1

The wall shear stress in a fully developed flow portion of a 30 cm diameter pipe carrying water is 90 N/m^2. Determine the pressure gradient, $\Delta p/\Delta x$, where x is in the flow direction, if the pipe is

(a) horizontal (→),
(b) vertical with flow up (↑), and
(c) vertical with flow down (↓).

Problem 2

The pressure drop needed to force water through a horizontal 2.5 cm diameter pipe is 4000 N/m^2 for every 360 cm length of pipe.

(a) Determine the shear stress on the pipe wall.
(b) Determine the shear stress at distance 0.75 and 1.25 cm away from the pipe wall.

Problem 3

Water flows downhill through a 10 cm diameter steel pipe. The slope of the hill is such that for each 1.5 km of horizontal distance, the change in elevation is Δz meter. Determine the maximum value of Δz if the flow is to remain laminar, with a temperature of T=20°C and pressure all along the pipe is constant.

Problem 4

Determine the thickness of the viscous sublayer in a smooth 20 cm diameter pipe, if the Reynolds number is 25000.

Problem 5

A 20 m long, 1 cm diameter hose with a roughness of ε = 0.2743 mm is fastened to a water faucet where the pressure is p_1. Determine p_1 if there is no nozzle attached and the average velocity in the hose is 1.8 m/s. Neglect minor losses and elevation changes. Take $\nu=10^{-6}$ m^2/s and ρ=1000 kg/m^3.