7.7 Problems

Problem 7.1: A horizontal pipeline has a diameter of 0.1 m. Water is pumped through this pipeline with a mean velocity $V=1.35$ m/sec. Kinematic viscosity index of water $\nu=10^{-6}$ m$^2$/sec. Roughness of the boundary $a=1.5 \times 10^{-4}$ m.

a) What difference in head can be read from two manometers that are connected to the pipe and of which the distance between the points of connection equals to 100 m.

b) Same question for a liquid with a viscosity index. $\nu=10^{-5}$ m$^2$/s

c) Same question for a liquid with a viscosity index. $\nu=10^{-4}$ m$^2$/s

Problem 7.2: In a welded steel oil line (diameter 0.6m), pumps are spaced 10 km apart. The pumps are working a difference in pressure head of 25 m oil column. Calculate the discharge. Density of the oil is $\rho=800$ kg/m$^3$, kinematic viscosity is $\nu=10^{-4}$ m$^2$/s, boundary roughness is $a=5\times10^{-5}$ m. In the course of time, the roughness of the pipe (expressed in terms of roughness length will grow $3\times10^2$ times the original value. Will the discharge be influenced by this? If so, how much (in %) will the reduction (approximate) be?

Problem 7.3: Find the discharge of the pipe system shown in Fig.p7.1 and if the diameter of the system is converted into $\phi 150$ mm find the length of the pipe of the system.

![Figure p7.1](image-url)
Problem 7.4: A fluid with a kinematic viscosity $\nu = 15 \times 10^{-7}$ m$^2$/s flows in the pipe system in Fig. p7.2. The roughness of the pipe is $k = 0.001$ m and the minor head loss coefficients of the system are known as $K_{dar} = 0.21$, $K_e = 0.05$. Find the discharge of the system by using Moody diagram.

![Figure p7.2](image-url)

Problem 7.5: Water flows from the reservoir A to reservoir B in the Fig. p7.3. The elevation difference between the reservoirs is $\Delta h = 5.00$ m. Find the discharge. Draw the energy and hydraulic grade line. ($g = 10$ m/s$^2$, $\nu = 10^{-6}$ m$^2$/s)

![Figure p7.3](image-url)

Problem 7.6: A fluid is pumped from a pressurized tank with a pump that is placed 4.5 m higher elevation from the fluid surface of the pressurized tank to an open tank 3 m below the fluid surface of the pressurized tank. If the pump adds 1.5 kW to the system determine the discharge and the pressure at point A. If the vaporization pressure of the fluid is 3 N/cm$^2$ (absolute pressure), show if the fluid evaporate or not at this point.
**Problem 7.7:** The discharge from the reservoir A to reservoir C is 400 lt/s in Fig. p7.5. The pressure at the outlet of the turbine DE is –5 mwc. Find the power which could be obtained from the turbine and draw the energy grade line of the system.

**Problem 7.8:** The fluid flows from reservoirs (1) and (2) to valve at M. The Manning roughness coefficient for the pipes are n=0.014.

a) The piezometer height at M is 112 m,

b) And when the valve is opened at M determine the discharge.

c) Draw the energy grade line for both cases.
Problem 7.9: Determine the discharge at each pipe when the friction head loss in the pipe AD is 14 m in Fig. p7.7 and find the elevation of the reservoir E, draw the energy grade line of the system.
**Problem 7.10:** Draw the energy grade lines of the systems below since the flow directions are known.

**Solution:** The energy grade lines have shown on the systems with dotted lines.

![Figure p7.8a](image1)

![Figure p7.8b](image2)

![Figure p7.8c](image3)
Figure p7.8d

Figure p7.8e

Figure p7.8f

Figure p7.8g
**Problem 7.11:** Determine the discharges in the parallel pipes and the pressure at A if the pressure at point B is 8 N/cm² and at C the pipe is open to the atmosphere in Fig. p7.9. For all pipes the Manning’s roughness coefficient will be n=0.016.

![Figure p7.8h](image)

**Problem 7.12:** In the system shown in Fig.7.10 water is pumped from A to reservoir B, find the power of the pump and draw the energy grade line of the system. The pipe length, discharge pumped from the pump, diameters of the pipes, and Kutter numbers were given in the figure.

![Figure p7.9](image)

**Problem 7.13:** The discharge of the pipe DC is 300 lt/s and the pipe is open to atmosphere at C in the system shown in Fig. p7.11. If the outlet of the pipe is at 100m;

Find the elevation of the reservoir A and the discharges of pipes (1) and (2). Draw the energy grade line of the system.
Problem 7.14: Solve the system by using Hardy-Cross method in Fig.p7.12 ($\lambda=0.02$).