UCE-305 FLUID MECHANICS

Tutorial No. 8 (Pipe Flow)

Q1: Water is flowing through a pipe of 25 mm diameter and length 200 m with a velocity of 4 m/s. The coefficient of friction for the pipe is given by $\mathbf{f = 0.0015 + (0.08 / Re^{0.3})}$. Find the head lost due to friction and power to maintain the flow. Take kinematic viscosity of water as 0.01 stoke.

Q2: A pipeline 225 mm diameter and 1580 m long has a slope of 1 in 200 for the first 790 m and 1 in 100 for the remaining 790 m. The pressure at the upper end of the pipeline is 107.91 kPa and at the lower end is 53.955 kPa. Taking friction factor = 0.032, determine the discharge through the pipe.

Q3: Water stored in a reservoir to a depth of 3 m above the entrance of a 20 mm diameter pipe is being discharged through the end of the pipe. The length of the pipe is 80 m and is laid at a slope of 1 in 100. Determine the discharge through the pipe. Take coefficient of friction = 0.01.

Q4: A 100 mm diameter pipe has a discharge of 500 litres per min. At a section, the pipe has sudden expansion to a size of 150 mm diameter. If pressure just upstream of the expansion is 22 kN/m^2, calculate the pressure just after the expansion.

Q5: A reservoir discharges its liquid content through a horizontal pipeline into the atmosphere. The pipeline consists of two parts: one of 100 mm diameter and 25 m long and the other of 120 mm diameter and 35 m long, connected in series. The water level in the tank is 10 m above the centre-line of the pipe at the entrance. Calculate discharge when (i) 100 mm diameter pipe is first connected to the reservoir (ii) 120 mm diameter pipe is first connected to the reservoir. Also, draw HGL and TEL for both the cases. Given, $\mathbf{f_1}$ = 0.02 and $\mathbf{C_c}$ = 0.70.

Q6: A siphon pipe of diameter 300 mm is used to connect two reservoirs having level difference of 13 m. Determine the highest point of the siphon pipe, if length of the siphon pipe up to this point is 200 m. The length of the pipe downstream of the highest point is 700 m. What will be the discharge under this condition? The pressure at which dissolved gases from water gets liberated is 2.4 m of water absolute. Assume coefficient of friction = 0.005. Consider all the losses.

Q7: A compound pipe consists of 1800 m of 500 mm, 1200 m of 400 mm and 600 m of 300 mm pipes of the same material connected is series. Determine the equivalent (i) size of a pipe 3600 m long (ii) length of a 400 mm pipe. If the three pipes are laid in parallel, what is the equivalent length of a 500 mm diameter pipe? In all the case, assume equivalent pipe is of the same material.

Q8: A 250 mm diameter and 3 km long straight pipe connects two reservoirs of surface elevation 135 m and 60 m. A 1.5 km long, 300 mm diameter pipe is laid parallel to 250 mm diameter pipe from its mid-point to the lower reservoir. Neglecting minor losses and assuming friction factor as 0.02 for both the pipes. Find the original discharge and the increased discharge.

Q9: The pressure of water at inlet to a 3000 m long, 0.15 m diameter pipe is 10 N/mm^2. What will be the maximum rate at which the energy can be delivered at the outlet from the pipe, if **f** = 0.01.

Q10: A penstock 500 mm diameter and 1 km long has a nozzle attached at its end and is discharging freely on the wheels of Pelton turbine for the generation of hydropower. The head at the inlet of the penstock is 100 m. Determine the diameter of nozzle for maximum transmission of power and the magnitude of power transmitted. Take $\mathbf{f_1}$ = 0.019.

Answers:

Q1: 40.8 m, 78.6 kW **Q2:**0.0489 m^3/s **Q3:** 0.0647 m^3/s **Q4:** 22.285 kPa **Q5:** 0.037 m^3/s, 0.036 m^3/s **Q6:** 4.8 m, 0.144 m^3/s **Q7:** 386 mm, 4318 m, 377.4 m **Q8:** 0.12 m^3/s, 0.16 m^3/s **Q9:** 340 kW **Q10:** 170 mm, 531.6 kW