MARMARA UNIVERSITY
FACULTY OF ENGINEERING
DEPARTMENT OF MECHANICAL ENGINEERING

ME4111/ME4011/ME411 EXPERIMENTAL METHODS IN MECHANICAL ENGINEERING

EXPERIMENT NO. 7

DESIGN OF AN EXPERIMENT FOR DETERMINING THE FLOW CHARACTERISTICS IN A PIPING SYSTEM: CONTINUED WITH HEAD LOSS CALCULATIONS

1. Objective

This experiment is a continuation of Experiment No. 6 with a focus on head losses. The working fluid is tap water.

2. Introduction

The working fluid is fed by a centrifugal pump into a system consisting of identical plastic pipes that have the same inner diameter. The volumetric flow rate is to be measured using a flowmeter. The pressures before and after a valve are to be measured using pressure transducers.

3. Theoretical background

The total head loss is given by

$$\underbrace{h_L}_{\text{total head loss}} = \underbrace{f \frac{L}{D} \frac{V^2}{2g}}_{\text{major head loss}} + \underbrace{K \frac{V^2}{2g}}_{\text{minor head loss}} \qquad (1)$$

where f is the friction factor, L the length, D the diameter, $\frac{V^2}{2g}$ the velocity head, and K the minor loss coefficient.

4. Experimental procedure
- Measure and record the pipe inner diameter.
- Measure and record the length L.
- Record the fluid temperature.
- Record the pump input voltage and current.
- Record the volumetric flow rate.
- Record the pressures before and after the valve.
- Repeat the third, fourth, fifth and sixth steps for different valve openings.

5. Required calculations
For each measurement repetition, calculate
- the corresponding flow velocity,

- the corresponding Reynolds number, friction factor, and major head loss,
- the corresponding minor loss coefficient.

Also comment on your results.

6. Required report format

- The report should be organized as follows: Title Page, Introduction, Experimental Setup and Procedure, Theoretical Background and Calculation Details, Results and Discussion, Conclusions, References and Appendices (if any).
- Measured and calculated quantities should be presented in tabular form.
- Show all details of your calculations.
- Discuss the possible sources of errors.
- Make recommendations for improving the experimental procedure.