



**The American University of Iraq- Sulaimaniah**

**Wet Lab**

**Hydrostatic Pressure and Manometry**

**Experiment I:**

- I. Objective:** The objective of this experiment is to measure differential pressure using piezometric and manometric tubes with different shapes and angles of inclination. It shall be proved that the level of a free surface is not affected by the size or the shape of the tube.
- II. Theory:** Refer to Fluid Mechanics, 7<sup>th</sup> Edition, by Frank M. White, section 2.4.
- III. Procedure:**
  1. Make sure the valves on the top and bottom of the tubes are all open.
  2. Ensure the tank and tubes all have water in them.
  3. Set the adjustable tube to an angle of your choice, between 30° and 60°.
  4. Record the level of water inside all the tubes.
  5. Connect the pump to the upper plug of the tank with the non-return valve and pressurize the tank.
  6. Make sure that the plug is in the tank so that air cannot leak through the orifice, to be able to pressurize the tank with a manual pump.
  7. Observe if the water level in the piezometric tube rises as we increase the pressure.
  8. When the water levels in the tubes stabilize, record the water level in all the tubes.
  9. Observe if the level of water is the same in all the tubes.



**IV. Calculations:** The pressure can be expressed in terms of the height of the column of fluid as:

$$P_{gage} = \gamma \Delta z$$

where

$P_{gage}$  is the gage pressure.

$\Delta z$  is the absolute change in height of the fluid in the tubes.

$\gamma$  is the specific weight of the fluid.

**V. Questions:**

- a) Why is the pressure measured called gage pressure?
- b) Calculate the air pressure inside the tank after pressurizing using the pump. Note that trigonometry must be used to calculate the change in height of the fluid in the adjustable tube when it is inclined.
- c) Explain the benefit of utilizing a tube with tilting capability.
- d) Express your observations of the water level and the calculated pressures between the variable section manometer and the vertical manometers. Does the water head (level) change as the diameter of the tube changes?



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**Experiment II:**

Use of manometric tubes to measure the differential pressure.

- I. **Objective:** The objective of this practical exercise is to study the use of manometric tubes to measure the differential pressure.
- II. **Theory:** Refer to Fluid Mechanics, 7<sup>th</sup> Edition, by Frank M. White, section 2.4.
- III. **Procedure:**
  - The U shape tube will be used to carry out this practical exercise. Let water enter this U-shaped tube until water stabilizes in both tubes of the U-shaped tube. Then close its manifold entrance valve (the lower valve) so that water cannot leak.
  - Connect the manual pump to one of the upper valves of the U tube. Leave the other tube top open to the atmosphere.
  - Slowly introduce pressure with the pump so that the water head in the tubes varies, creating a pressure difference in the tube.
  - Close the valve to which the pump is connected.
  - For a different pressure, open slightly the valve to let air enters to change the height difference between the two tubes of the U-shaped tube.
- IV. **Calculations:** The pressure can be expressed in terms of the height of the column of fluid as:

$$P_{gage} = \gamma \Delta z$$

where

$P_{gage}$  is the gage pressure.

$\Delta z$  is the difference in height of the fluid in the tubes.

$\gamma$  is the specific weight of the fluid.

- V. **Questions:**
  - a) Determine the value of the pressure of the air used to pressurize the U-shaped manometer.
  - b) What is the primary difference between the U-shaped manometer used in this experiment, and the manometers used in the first experiment?