



**JARAMOGI OGINGA ODINGA UNIVERSITY OF SCIENCE AND
TECHNOLOGY**

UNIVERSITY EXAMINATIONS 2012/2013

**2ND YEAR 1ST SEMESTER EXAMINATION FOR THE DIPLOMA IN
BUILDING AND CIVIL ENGINEERING**

COURSE CODE: TBC 2213:

COURSE TITLE: HYDRAULICS 1

DATE: 17/4/2013

TIME: 11.00-12.30PM

DURATION: 1.5 HOURS

Instructions:

- **Attempt Question One and any Other TWO questions**

SECTION A - Answer ALL the questions – (20 Marks)

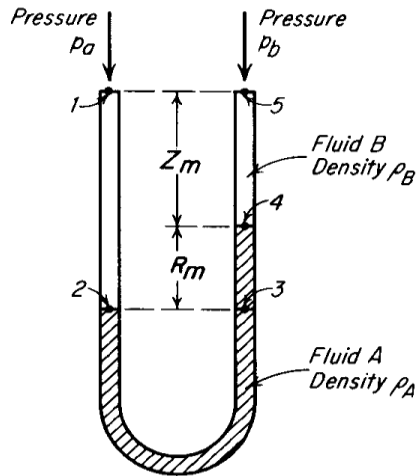
QUESTION ONE (30 MARKS)

- a. Define the following terms as used in fluid mechanics; **(6 Marks)**
- i. Ideal fluid
 - ii. Laminar flow
 - iii. Steady flow
 - iv. Uniform flow
- b. Pascal's principle states that the pressure at a point in a fluid at rest is equal in all directions. In reference to a small element of fluid at rest, show that;

$$P_x = P_y = P_z ; \text{ where P represents the pressure on the element in the directions, } x, y \text{ and } z.$$

(6 Marks)

- c. By use of relevant equations and mentioning any assumptions, illustrate the principles of both Energy and Mass conservation as applied in hydraulics or fluid mechanics. **(9 Marks)**
- d. Given the manometer below, apply the basic equation of static fluids to both legs and show that the pressure difference $P_a - P_b$ is given by; $P_a - P_b = gR_m(\rho_a - \rho_b)$



(9 Marks)

SECTION B Answer any TWO Questions (40 MARKS)

2. a. Show that the hydrostatic thrust F , on a vertical rectangular plane surface with its upper edge in the free surface of a fluid is given by; $F = \frac{\rho g b d^2}{2}$; where ρ is the fluid density, d is the length of the rectangle measured vertically from the fluid surface, b is the width of the rectangle and g is the gravitational acceleration. **(8 Marks)**

b. A rectangular gate is 2 m wide and 3 m high. It hangs vertically with its top edge 1 m below the water surface. **(12 Marks)**

- i. Calculate the pressure at the bottom of the gate
- ii. Calculate the resultant hydrostatic force on the gate
- iii. Determine the depth at which the resultant force acts

3. a. Explain the functions of a Pitot Tube; **(4 Marks)**

Hence; show that the velocity, V , at a point within a pressurized pipeline is given by; $V = \sqrt{2gH}$; where H is the equivalent static head of the liquid. Sketch the scenario for illustration and state any assumptions made. **(6 Marks)**

b. A pitot static tube having a coefficient of 0.98 is used to measure the velocity of water in a pipe. The stagnation pressure recorded is 3m and static pressure 2m. Sketch the set up and determine the velocity it indicates. **(6 Marks)**

4. a. With reference to Newton's Laws of motion, derive expressions for force, F , exerted by a horizontal jet striking a flat plate under the following conditions. (Define all the parameters used)
- i. Plate stationary and normal to the jet
 - ii. Plate stationary but inclined to the jet
 - iii. Plate inclined to the jet and moving towards the jet **(12 Marks)**

b. A jet of water from a fixed nozzle has a diameter of 25mm and strikes a stationary flat plate inclined to the jet direction. The velocity of the jet is 5 ms^{-1} , and the surface of the plate is assumed to be frictionless. **(8 Marks)**

- i. Calculate the force normal to the plate surface if the inclination of the plate to the jet is 60° .
- ii. Calculate the force normal to the plate surface if the plate velocity is 2 ms^{-1} in the direction of the jet, and the plate is itself perpendicular to the approaching jet.

5. Discuss, giving expressions how you would measure discharge through;

a. A pipe by a venturimeter. **(10 Marks)**

b. Triangular notch. **(10 Marks)**