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

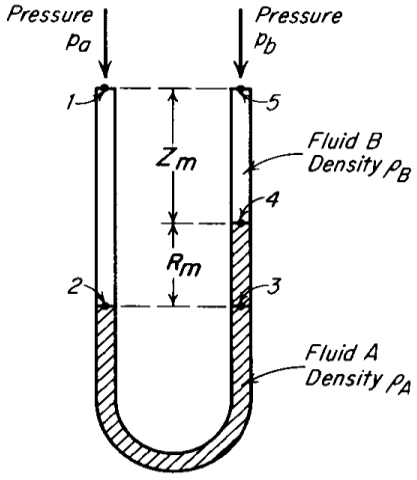
b. Pascal's principle states that the pressure at a point in a fluid at rest is equal in all directions. In reference to a small element of fluid at rest, show that;

   $P_x = P_y = P_z$; where P represents the pressure on the element in the directions, *x*, *y* 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 appoint 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 stationery and normal to the jet

   ii. Plate stationery 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 stationery 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^o.

   ii. Calculate the force normal to the plate surface if the plate velocity is 2ms^{-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)**