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**

**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; $\quad P_a - P_b = gR_m(\rho_a - \rho_b)$
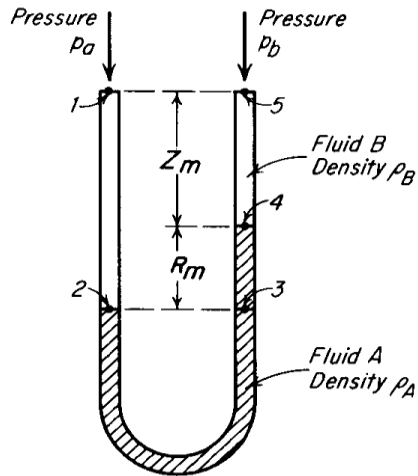
(9 Marks)

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; $F = \dfrac{\rho g b d^2}{2}$; 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°.
    >
    > 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)**