JARAMOGI OGINGA ODINGA UNIVERSITY OF SCIENCE AND TECHNOLOGY

SCHOOL OF ENGINEERING AND TECHNOLOGY

UNIVERSITY EXAMINATIONS   FOR THE DEGREE IN SCIENCE IN RENEWABLE ENERGY TECHNOLOGY AND MANAGMENT

2ND YEAR 1ST SEMESTER 2018/2019 ACADEMIC YEAR

CENTRE: MAIN CAMPUS

COURSE CODE: TET 3213

COURSE TITLE: FLUID MECHANICS   I

EXAM VENUE: STREAM: BSc REN ENERGY TECH & MGT

DATE: ../12/2018   EXAM SESSION:

DURATION: 2 HOURS


Instructions

1. **Answer question 1 (Compulsory) and ANY other two questions**
2. **Candidates are advised not to write on question paper**
3. **Candidates must hand in their answer booklets to the invigilator while in the examination room**

QUESTION 1 (30 MARKS)

a. i. Briefly explain the importance of **"fluid mechanics"** to you as a student studying BSc. in Renewable energy Technology and Management. **(2 Marks)**

ii. Describe Pascal Principle; hence how that the pressure at appoint in a fluid at rest is the same in all directions.

(4 marks)

b. Briefly explain the laws of mass conservation and energy conservation as applied in fluid mechanics. (Show relevant equations and any assumptions) **(6 Marks)**

c. Describe the following terms as used in fluid mechanics. **(6 Marks)**
   i. Vapour pressure
   ii. Viscosity
   iii. Surface tension

d. The degree to which a fluid offers resistance to compression is expressed by its bulk modulus of elasticity, K. Show that; $K = \rho \dfrac{dp}{d\rho}$; where dp is change in pressure, ρ is density and $d\rho$ is change in density. **(6 Marks)**

e. Outline the purpose of an inclined Manometer; hence referring to the diagram below, show that the pressure difference between the two sides of the manometer (containing two different fluids) is given by; $P_a - p_b = gR_1(\rho_a - \rho_b)\sin\alpha$

(6 Marks)
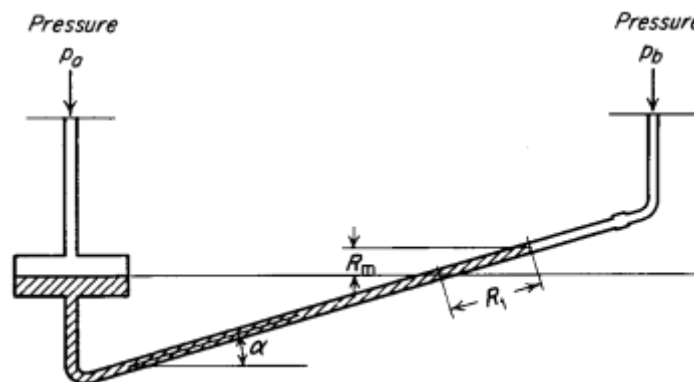
QUESTION 2 (20 MARKS)

a. Explain the parallel axes theorem and how it is applied to determine the centre of Force acting on an object immersed in a fluid. **(6 Marks)**

b. For a plane surface of area A, inclined to the horizontal at an angle θ in a fluid of uniform density ρ. Show that the vertical depth of the centre of force, h_C, is given by;

$$h_C = \bar{h} + \frac{I_G Sin^2\theta}{A\bar{h}},$$

Where; $\bar{h}$ is the vertical depth of the centroid, θ is the plane angle of inclination with fluid surface. A is the area of the horizontal, I_G is the second moment of area about the centre of the centroid. (Mention any assumptions made). **(10 Marks)**

c. With reference to the expression in Question 2b above, show that the vertical depth of the centre of force, h_C, of a vertical rectangular plane surface with its upper edge in the free surface of a fluid acts at two thirds its vertical length. **(4 Marks)**

QUESTION 3 (20 MARKS)

a. Differentiate between the centre of buoyancy and the centre of gravity of a floating body.

(4 Marks)

b. Define the term "metacentre" and show how stability of a floating body depends upon the position of the metacentre and the centre of gravity. Use sketches where appropriate.

(6 Marks)

c. Ship weighing 4000 tons and having an area of 465 m2 at water line submerging to depth of 4.5 m in sea water with a density of 1024 kg/m3 moves to fresh water. Determine the depth of submergence in fresh water. Assume that sides are vertical at the water line.

(4 Marks)

d. A bathy sphere of mass 6800 kg (empty) and having a diameter of 1.8 m is to be used in an ocean exploration. It is supported by a cylindrical tank of 3 m dia and 6 m length of mass 4500 kg when empty and filled with oil of specific gravity 0.7. Determine the maximum mass of equipment that can be supported in the bathy sphere. Assume density of sea water as 1024 kg/m3. Neglect metal thickness. **(6 Marks)**

QUESTION 4 (20 MARKS)

a. A tank 20 m deep and 7 m wide is layered with 8 m of oil, 6 m of water and 4 m of mercury. Determine the total hydrostatic force and resultant centre of pressure on the side. Specific gravity of oil is 0.881 and that of mercury is 13.6. **(10 Marks)**

b. The wall of a reservoir is inclined at 30° to the vertical. A sluice 1m long along the slope and 0.8 m wide is closed by a plate. The top of the opening is 8 m below the water level. Determine the location of the centre of pressure and the total force on the plate. Use appropriate sketches where necessary. **(10 Marks)**

QUESTION 5 (20 MARKS)

Derive Euler's equation as applied in Fluid Mechanics. Explain the parameters and state any assumptions made in the derivation process. Explain its relationship with Bernoulli's equation. **(20 Marks)**