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 2017/2018 ACADEMIC YEAR

CENTRE: MAIN CAMPUS

COURSE CODE: TET 3213

COURSE TITLE: FLUID MECHANICS I

EXAM VENUE: WS **STREAM: BSc REN ENERGY TECH & MGT**

DATE: 18/12/2017 **EXAM SESSION: 2.00 – 4.00PM**

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. Briefly explain the relevance of Fluid Mechanics to the course, "Renewable Energy Technology and Management" **(4 marks)**

b. Define the following terms (Use a diagram where appropriate); **(6 Marks)**

i. Metacentric height
ii. Centre of pressure
iii. Centroid
iv. Unstable equilibrium

c. Explain what you understand by the following as applied in fluid statics and derive the relevant equations; (Mention any assumptions made to arrive at final expressions)

i. Pascal principle **(5 marks)**
ii. Hydrostatic equations **(5 Marks)**

d. Explain the importance of Parallel Axis Theorem and derive the relevant mathematical equation; **(10 Marks)**

QUESTION 2 (20 MARKS)

a. A manometer is fitted as shown in Fig. Q2 (a). Apply the basic equation of static fluids to both legs and determine the pressure at point A. **(6 Marks)**

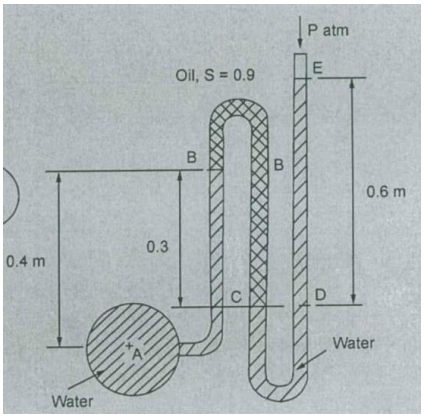

Figure Q2 (a)

b. An inverted U-tube manometer is fitted between two pipes as shown in Fig.Q2(b). Determine the pressure at E if P_A = 0.4 bar (gauge) **(6 Marks)**

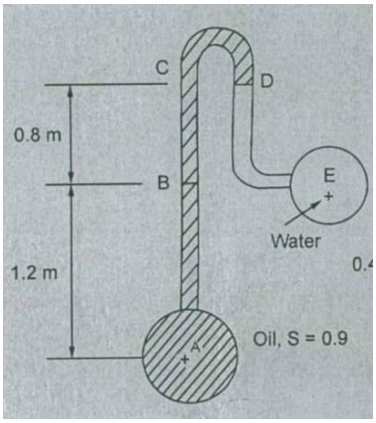

Figure Q2 (b)

c. A rectangle block of wood floats in water with 50 mm projecting above the water surface. When placed in glycerine of relative density 1.35, the block projects 75 mm above the surface of glycerine. Determine the relative density of the wood. **(8 Marks)**

QUESTION 3 (20 MARKS)

a. Show from first principles that the location of the centre of pressure in relation to the centroid of a an inclined submerged surface, 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).

(12 Marks)

b. An oil tank is filled to a height of 7.5 m with an oil of specific gravity 0.9. It has a rectangular gate 1m wide and 1.5 m high provided at the bottom of a side face. Determine the resultant force on the gate and also its point of action. **(8 marks)**

QUESTION 4 (20 MARKS)

a. With reference to specific examples in fluid mechanics, briefly outline the importance of forces due to fluid in floating and submerged bodies. **(2 Marks)**

b. Outline the relationship between Euler's equation and Bernoulli's equation. Define the parameters in the equations and state any assumptions made. **(8 Marks)**

c. Briefly explain the following expressions/terms as used in fluid mechanics. Show possible mathematical formulae used to quantify each of them. **(10 Marks)**

   i. Bulk modulus of elasticity
   ii. Capillary Rise
   iii. Coefficient of surface tension
   iv. Newton law of viscosity
   v. Irrotational Flow

QUESTION 5 (20 MARKS)

a. Discuss, showing appropriate mathematical equations, the basic scientific laws used in the analysis of fluid flow; **(12 Marks)**

b. By use of a labelled diagram, show that the hydrostatic thrust *F*, on a vertical rectangular plane surface with its upper edge in the free surface of a fluid acts at two thirds its depth from the water surface; **(8 marks)**