TECHNICAL UNIVERSITY OF MOMBASA

Faculty of Engineering & Technology

DEPARTMENT OF BUILDING & CIVIL ENGINEERING

UNIVERSITY EXAMINATION FOR DECREE IN:

BACHELOR OF SCIENCE IN CIVIL ENGINEERING (BSCE – Y2 S1)

ECE 2203: FLUID MECHANICS I

END OF SEMESTER EXAMINATION
SERIES: DECEMBER 2014
TIME ALLOWED: 2 HOURS

Instructions to Candidates:
You should have the following for this examination
- *Answer Booklet*
- *Pocket Calculator*

This paper consists of **FIVE** questions. Answer any **THREE** questions
Maximum marks for each part of a question are as shown
Use neat, large and well labeled diagrams where required
This paper consists of **THREE** printed pages

Question One

a) Explain the following terms used in fluid mechanics:
   (i) Kinematic viscosity
   (ii) Archimedes principle
   (iii) Specific Weight **(6 marks)**

b) Two large fixed parallel planes are 12mm apart. The space between the surface is filled with oil of viscosity $0.972 N.s/m^2$. A flat thin plate $0.25m^2$ are moves through the oil at a velocity of 0.3m/s. Calculate the drag force.
   (i) When the plate is equidistant from both the planes
   (ii) When the thin plate is at a distance of 4mm from one of the plane surfaces. **(8 marks)**

c) In the back of a lorry cement mixture is poured to a height $h_1 = 0.4m$. Find the least length needed to bring the lorry to a halt from a velocity V = 36km/h so that the cement mixture does not pour out of the back. The back has a rectangular base with length of l = 2.5m and width w = 1.8m and a height of h = 0.8m. Assume that the lorry is uniformly decelerating. Ref to figure 1(c) **(10 marks)**

Figure 1 (c)

d) Sketch a labeled diagram showing relations of absolute and gauge pressures. Also indicate their mathematical relations. **(6 marks)**

Question Two

Elaborate with the use of a diagram and formuli for the determination of the metacentre for a body immersed in a liquid. **(20 marks)**

Question Three

An open cylindrical vessel 180mm in diameter and 450mm deep is filled with water up to the top. Estimate the volume of water left in the vessel when its rotated about its vertical axis:

a) With a speed of 200r.p.m
b) With a speed of 400 r.p.m **(20 marks)**

Question Four

a) Explain the following types of fluid flow:
- **(i)** Uniform flow
- **(ii)** Steady flow
- **(iii)** Steady non-uniform flow
- **(iv)** Unsteady uniform flow **(8 marks)**

b) Water flows in a circular pipe, at one section the diameter is 0.3m, the static pressure is 260kPa gauge, the velocity 3m/s and elevation of 10m above ground level. The elevation at a section downstream is O metres and the pipe diameter is 0.15m. Find the gauge pressure at the downstream end. Frictional effects may be neglected. Refer to figure 4(b) **(12 marks)**

$$\rho_{H_2O} = 999 kg/m^3$$

Assume

Question Five

a) Sketch and label a vertical single column manometer and show the relevant derivation for the formula to determine pressure difference between two sections. **(8 marks)**

b) A rectangular pontoon 12m long, 9m wide and 3m deep weighs 1380KN and floats in sea water. The pontoon carries on its upper deck a boiler 6m diameter and weighing 864KN. The centre of gravity of each unit coincide with geometrical centre of the arrangement and lies in the same vertical line.

- **(i)** What is the metacentric height
- **(ii)** Is the arrangement stable?

Take specific weight of sea water = $10 KN/m^3$

Refer to figure 5(b) **(12 marks)**

Figure 5(b)