TECHNICAL UNIVERSITY OF MOMBASA

Faculty of Engineering & Technology

DEPARTMENT OF BUILDING & CIVIL ENGINEERING

DIPLOMA IN BUILDING & CIVIL ENGINEERING (DBCE 13J/DBCE 13M)

ECV 2201: FLUID MECHANICS I

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

Instructions to Candidates:
You should have the following for this examination

- *Answer booklet*
- *Drawing Paper*
- *Drawing Instruments*

This paper consists of **FIVE** questions. Answer any **THREE** questions of the **FIVE** questions
All questions carry equal marks
Maximum marks for each part of a question are as shown
This paper consists of **THREE** printed pages

Question One

a) Define the following::
   (i) Dynamic viscosity
   (ii) Kinematic viscosity
   (iii) Adhesion
   (iv) Cohesion
   (v) Surface tension **(10 marks)**

b) A liquid has a mass of 4080kg and volume v = $0.3m^3$. Determine:
   (i) The volume of 5000kg of the liquid
   (ii) The weight of 0.5m3 of the liquid
   (iii) The mass density of the liquid
   (iv) The unit weight of the liquid. **(5 marks)**

c) With the aid of a sketch, outline the working of bourdon's pressure gauge **(5 marks)**

Question Two

a) The U-tube manometer in figure 1 measures the pressure difference between two points A and B in water. The manometer liquid is mercury. Calculate the difference of pressure between A and B. Specific gravity of mercury is 13.6 **(6 marks)**

Figure 1

b) Define the following:
   (i) Total pressure
   (ii) Centre of pressure **(4 marks)**

c) (i) Derive an expression for the total pressure on a horizontal surface of area "A" immersed in a liquid of specific weight 'ω' in terms of $\bar{y}$.

(ii) A cylindrical tank 60cm in diameter with its axis vertical is filled to a depth of 250cm with water. Determine the total pressure at the bottom. **(10 marks)**

Question Three

a) Using standard notations, derive expressions for calculating the following for an immersed, inclined plane surface:-
   (i) The total pressure
   (ii) The depth of centre of pressure **(10 marks)**

b) The gate shown in figure 2 is a quadrant of a circle. Calculate:
   (i) The resultant pressure due to the water per metre run
   (ii) The angle at which it acts. **(10 marks)**

Radius

Question Four

a) State the assumptions made when deriving Bernoulli's equation. **(5 marks)**

b) Using formula, briefly explain the following as used in the energy of a flowing liquid:
   i. Potential energy
   ii. Kinetic energy
   iii. Pressure energy
   iv. Total energy **(8 marks)**

c) A jet of water from 25mm diameter nozzle is directed vertically upwards. Assuming that the jet remains circular and neglecting any loss of energy, determine the diameter of the jet at a point 4.5m above the nozzle if the velocity the jet leaves the nozzle is 12m/s **(7 marks)**

Question Five

a) Define the following:
   (i) Turbulent flow
   (ii) Lamind flow
   (iii) Steady flow
   (iv) Unsteady flow
   (v) Non-uniform flow **(10 marks)**

b) (i) Derive an expression for the force exerted by a jet of area 'a' which strikes a flat plate at an angle θ to the normal to the plate with a velocity 'V' if the plate is moving in the direction of jet with a velocity 'U'

(ii) A jet of water 22.5cm diameter impinges normally on a flat plate moving at 0.6m/s in the same direction as the jet. If the discharge is 0.14m3/s, find the force and work done per second on the plate. **(10 marks)**