THE MOMBASA POLYTECHNIC UNIVERSITY COLLEGE

(A Constituent College of JKUAT)

(A Centre of Excellence)

Faculty of Engineering & Technology

DEPARTMENT OF BUILDING & CIVIL ENGINEERING

UNIVERSITY EXAMINATION FOR BACHELOR OF SCIENCE IN CIVIL ENGINEERING

EBC 4308: FLUID MECHANICS II

SPECIAL/SUPPLEMENTARY EXAMINATION
SERIES: OCTOBER 2012
TIME: 2 HOURS

Instructions to Candidates:
You should have the following for this examination
- *Answer Booklet*
- *Mathematical Table/Scientific Calculator*

This paper consists of **FIVE** questions.
Answer question **ONE (COMPULSORY)** and any other **TWO** questions
Maximum marks for each part of a question are as shown
This paper consists of **THREE** printed pages

Question One (COMPULSORY - 30 marks)

a) Explain the following terms as applied to fluid flow:
- **i)** Boundary layer
- **ii)** Continuity of flow **(5 marks)**

b) Describe the **TWO** forms of drag that occur in fluid flow **(5 marks)**

c) A needle value has outlet diameter of 2.0m. The pressure upstream of the value is 250KN/m^2. Determine the discharge. Take Cd = 0.67 **(5 marks)**

d) The cubic law for velocity distribution inside a laminar BL bounces on a flat plate is of the form:

$$\frac{u}{u1} = a_0 + a, y + a_2 y^2 + a_3 y^3$$

$$\frac{390}{280}$$

Show that the momentum thickness is expressed as **(15 marks)**

Question Two (20 Marks)

a) 150KN is to be transmitted to a machine located 4.5km from a power station at a feed pressure of 5000KN/m^2. Find the least number of 140mm diameter pipes that can be used.

Take; transmission efficiency = 95%
f = 0.0072 **(8 marks)**

b) Three parallel pipes of equal length and diameter connect a junction box to a single jet pelton wheel machine.

i) Derive an expression for the diameter of the theoretical best nozzle through which the joint flow in the pipes should be discharged from the function box to give maximum power output.

ii) If the pipes were 1300m long and had a diameter of 150mm, determine the diameter of the nozzle.
Take: Gross available head of 200m

f = 0.0075 **(12 marks)**

Question Three (20 Marks)

a) Water is filled in a cylindrical tank that is positioned vertically. Discharge occurs through an orifice at the bottom of the tank. Derive an expression for the time to be taken for emptying the tank. **(12 marks)**

b) The tank in (a) has a diameter of 1.75m, 2.8m of water is to flow out in 380 seconds through the orifice. Calculate the initial height of the water above the orifice.
Take: Diameter of the orifice to be 50mm
Coefficient for discharge Cd = 0.65 **(8 marks)**

Question Four (20 Marks)

a) The velocity and pressure for water flowing at an altitude of 35m above sea level are 20m/s and 300KN/m^2. Calculate the total energy per Newton. **(6 marks)**

b) A liquid of density 800kg/m^3 flows at a velocity of 30m/s parallel to a thin smooth plate. The plate is 3m long and 1.5m wide. Calculate the drag force developed. Take dynamic viscosity = 0.008 **(8 marks)**

c) A reservoir discharges over a weir 3.5m long. The initial sill is 0.65m above the surface. Determine the time required to reduce the level of water in the reservoir by 0.45m
Take: Area of the reservoir = 3500m^2
Discharge of weir, Q = 1.75 h3/
Ch is the head measured above the sill. **(6 marks)**

Question Five (20 Marks)

a) A cylinder 150mm long and 60mm in diameter is placed in a stream of fluid flowing at a velocity of 0.45m/s. The axis of the cylinder is normal to the direction of flow. Pressure is measured at a point on the surface and found to be 5 Pa above the ambient level. Calculate the velocity at the pint.

Take: Density of the liquid = 800kg/m^3W
Drag force measure = 50N **(6 marks)**

b) Show that the mean velocity in a pipe with fully developed turbulent flow is 49/60 of the maximum velocity. Assume the $1/7^{th}$ law. **(8 marks)**

c) Figure 1 shows the action of a tapering pipe

a_1, a_2 - cross section areas
v_1, v_2 - flow velocities

Derive an expression for rate of change of momentum for a fluid that flows between the two sections.
(6 marks)