THE MOMBASA POLYTECHNIC UNIVERSITY COLLEGE

(A Constituent College of Jkuat)

Faculty of Engineering and Technology

DEPARTMENT OF BUILDING AND CIVIL ENGINEERING

HIGHER DIPLOMA IN BUILDING & CIVIL ENGINEERING

EBC 3106: FLUID MECHANICS I

END OF SEMESTER EXAMINATION

SERIES: AUGUST/SEPTEMBER 2011

TIME: 3 HOURS

Instructions to Candidates:

You should have the following for this examination

- *Answer booklet*

This paper consists of **FIVE** questions

Answer question **ONE (COMPULSRY)** and any other **TWO** questions

This paper consists of **FIVE** printed pages

SECTION A (COMPULSORY)

Question 1 – 30 MARKS

a) $6m^3$ of a certain liquid weighs 44 KN. Determine (in SI units)

(i) Its specific weight
(ii) Its mass density
(iii) Its specific gravity
(iv) The volume of 2000kg of the liquid (8 marks)

b) Define the following terms:

(i) Fluid
(ii) Capillarity
(iii) Cohesion
(iv) Surface tension (8 marks)

c) The cylindrical tank shown in fig 1.0 is filled with two liquids as shown.

Fig 1.0

Atm. Pressure = 101.3 KN/m^2

Determine;

(i) The gauge pressure at the oil-water interface
(ii) Absolute pressure at the base of the tank in terms of
- Metres of water
- Metres of oil
- N/m^2

(iii) The total force (total pressure) experienced by the base of the tank (8 marks)

d) (i) State **TWO** assumptions made in deriving Berhoullis equation

(ii) Name **FOUR** devices used for measuring velocity of a moving liquid (6 marks)

SECTION B (Answer *any TWO questions from this section*) – 40 MARKS

Question 2

a) Make a neat sketch of a Boardon mechanical pressure gauge and explain its working principle (6 marks)

b) Determine the pressure difference for the inverted manometer shown in fig 2.0 (4 marks)

Fig 2.0

c) A closed tank contains 0.6m of mercury, 2m of water, 4m of oil of density 600kg/m^3 and an air space above the oil. If the gauge pressure at the bottom of the tank is 280KN/m^2, determine the pressure of air at the top of the tank (6 marks)

d) Define the following terms
   (i) Atmospheric pressure
   (ii) Vacuum (4 marks)

Question 3

a) A circular plate 1.5m diameter is submerged in water as shown in fig 3.0

Fig 3.0

Water surface

Determine:

(i) The total pressure on one face of the plate

(ii) The depth of centre of pressure (8 marks)

b) Fig 4.0 shows a curved surface LM, which is in the form of a quadrant of a circle that is immersed in water.

Figure 4.0

1m

Determine:

(i) The total force acting per metre width of the curved surface
(ii) The angle that the total force makes with the horizontal (8 marks)

c) Define the following terms

(i) Hydrostatics
(ii) Centre of pressure (4 marks)

Question 4

a) Define the following types of flow
(i) Uniform

(ii) Steady
(iii) Turbulent
(iv) Laminar

(8 marks)

b) A pipe Q, 450mm in diameter branches into two pipes R and S of diameters 300mm and 200mm respectively as shown in fig. 5.0. The velocity in pipe Q is 3m/s and velocity in R is 2.5m/s.

Fig. 5.0

Q

Determine:

(i) Discharge in pipe Q
(ii) Velocity in pipe S
(iii) Discharge in pipe S (8 marks)

c) Water flows down through an inclined tapering pipe AB which has a diameter of 0.3m at A and 0.15m at B. Point A is 10m above B. If the pressure and velocity at A are 260 KN/m^2 and 3m/s respectively, find the pressure at B in KN/m^2. (4 marks)

Question 5

a) Define the following terms

(i) Buoyancy
(ii) Matacentre

(4 marks)

b) Briefly explain the **THREE** conditions of equilibrium of a solid body

(6 marks)

c) Sketch a pitot static tube and label all the parts (4 marks)

d) A pitot tube is installed at the centre of a 200mm diameter pipe. Water rises 400mm and 200mm above the centre line of the pipe in the Pitot tube and static tapping respectively. Assuming that the mean velocity of the water is 0.75 times the central velocity and c = 0.99 for the pitot tube, find the discharge in the pipe (6 marks)