KENYATTA UNIVERSITY

UNIVERSITY EXAMINATIONS 2011/2012

SECOND SEMESTER EXAMINATION FOR THE DEGREE OF BACHELOR OF ENGINEERING (ELECTRICAL AND ELECTRONICS)

EEE 209: FLUID MECHANICS

DATE: Tuesday, 17th April, 2012 TIME: 11.00 a.m. – 1.00 p.m.

INSTRUCTIONS:

Answer QUESTION 1 and ANY OTHER TWO questions. QUESTION 1 carries 30 marks while the OTHERS carry 20 marks each.

Physical constants

Mass density	1000 kg/m^3
Relative density of Mercury	13.6
Relative density of Oil	0.8

1(a) Define clearly what is meant by the following, and give the appropriate units in each case:

i) Specific weight (1 Marks)
ii) Surface tension (1 Marks)
iii) Kinematic Viscosity (1 Marks)
iv) Bulk modulus (1 Marks)

b) A pitot static tube placed in the centre of a 200 mm pipe line conveying water, has one orifice pointing upstream and the other perpendicular to it. If the pressure differences between the two orifices is 38 mm of water when the discharge through the pipe is 22 dm^3/s .Calculate the meter coefficient .Take the mean velocity in the pipe to be 0.83 of the central velocity. (7 Marks)

c) Distinguish between hydrostatic and hydrodynamic (2 Marks)

d) Name two methods of measuring atmospheric pressure (2 Marks)

f) Name two distinct type of flow and briefly explain each case (4 Marks)

g) Define the following terms as used in connection with the flow of liquid

i) Discharge
ii) Mass flow rate

(2 Marks)

h) State any three way by which loss of head may occur in pipe flow (3 Marks)

i) Explain the following terms as used in flow measurements

i) Small and large orifice
ii) Notches and Weir

(4 Marks)

j) State three possible reasons why a pump may not deliver water when in operation (2 Marks)

2a) Briefly explain the following terms with reference to pressure of fluid on plain surface

i) Total Pressure
ii) Centre of pressure

(2 Marks)

b) Show from first principle that the centre of pressure of plain surface immersed in a static fluid is given by the following equation

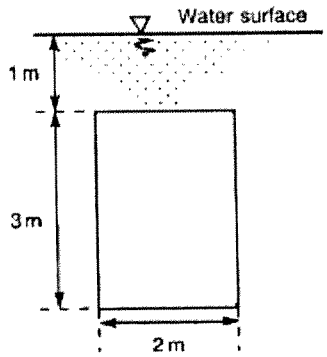
$$y_{c.p} = \frac{I_{c.g}}{A\bar{x}_{c.g}} + \bar{x}_{c.g}$$

Where is $\bar{\mathbf{x}}_{\mathbf{c.g}}$ the centre of gravity of the plain surface, **A** is the area and $\mathbf{I}_{\mathbf{c.g}}$ is the second moment of area about the Centroid axis parallel to the free surface (6 Marks)

c) A rectangular gate is 2m wide and 3m high. It hangs vertically with its top edge 1m below the water surface.

(i) Calculate the pressure at the bottom of the gate
(ii) Calculate the resultant hydrostatic force on the gate
(iii) Determine the depth at which the resultant force acts. Please indicate in the diagram below the depth at which the resultant force acts

(12 Marks)



3 a) List four ways by which fluid flow can be measured (2 Marks)

b) With the aid of a sketch define the following (4 Marks)

i) Coefficient of velocity
ii) Coefficient of contraction
iii) Coefficient of discharge

c) With the aid of a sketch, derive an expression for the theoretical discharge through horizontal venturimeter and show how it must be modified to obtain the actual discharge (8 Marks)

d) The discharge over rectangular notch is to be $0.14\ {}^{m^3}/_{s}$ when the water level is 23cm above the sill. If the coefficient of discharge is 0.6 calculate the width of notch require (6 Marks)

4 a) What is meant by continuity of flow and under what conditions does it occur (4 Marks)

b) State Bernoulli's equation (2 Marks)

c) Explain how a provision can be made in Bernoulli's equation for a loss of energy occurring between two points in stream of liquid (2 Marks)

d) Oil flows along horizontal pipe which varies uniformly in section from 90mm at A to 140mm diameter at B. At A the gauge pressure is $126\ {}^{KN}/_{m^2}$ and at B $140\ {}^{KN}/_{m^2}$ .Find the Discharge and mass flow rate. (12 Marks)

5a) Define the term specific speed of a turbine (2 Marks)

b) Show that the specific speed of a turbine is given by:

$$N_s = \frac{NP^{\frac{1}{2}}}{H^{\frac{5}{4}}}$$

N= rotational speed
P=Power developed
H= the head under which the turbine works

(10 Marks)

c) At a new hydro-electric station the available head is to be 60m and it is anticipated that $32\,^{m^3}/_{s}$ of water will be available. Francis turbines of specific speed of 180 are to be installed and are to run at $300\,^{rev}/_{min}$ with an overall efficiency of 82 per cent. Determine

(1) Maximum power available from the turbine
(2) The number of turbine required

(8 marks)