



TECHNICAL UNIVERSITY OF MOMBASA

FACULTY OF ENGINEERING AND TECHNOLOGY
DEPARTMENT OF BUILDING & CIVIL ENGINEERING

UNIVERSITY EXAMINATION FOR:
BACHELOR OF SCIENCE IN CIVIL ENGINEERING

ECE 2203 : FLUID MECHANICS

END OF SEMESTER EXAMINATION

SERIES: DECEMBER 2016

TIME: 2 HOURS

DATE: 15 Dec 2016

Instructions to Candidates

You should have the following for this examination

- Answer Booklet, examination pass and student ID
- Drawing instruments.
- Calculator.

This paper consists of five questions.

Attempt question ONE (Compulsory) and any other TWO questions.

Do not write on the question paper.

Question ONE (Compulsory – 30 Marks)

(a) Define the following types of flows and give typical examples

(i) Steady Uniform Flow

(2 mark)

(ii) Steady Non-Uniform

(2 mark)

(iii) Unsteady Uniform Flow

(2 marks)

(iv) Unsteady Non-Uniform Flow

(2 marks)

(b) From the basic principles derive the Bernoulli's Equation.

(7 marks)

(c) A frictionless siphon has its top point position denoted as A. From point A of the siphon to the water level (Point 1) is 2.40m. From the water level downwards to a point B is 1.20m. From point B downwards to the exit (Point 2) is 0.16m. Determine the discharge and the pressure heads at A and B, given that the pipe diameter is 180mm and the nozzle exit diameter is 140mm. (15 marks)

Question Two (20 Marks)

(a) A pump delivers water from a lower to a higher reservoir. The difference in elevation between the reservoirs is 10m. The pump provides an energy head of 11m and the frictional head losses are 0.7m. If the pipe diameter is 280mm, calculate the discharge.

(5 marks)

(b) Calculate the magnitude and direction of the force exerted by a T-junction if the discharge are $Q_1=0.3\text{m}^3/\text{s}$, $Q_2=0.15\text{m}^3/\text{s}$, $Q_3=0.15\text{m}^3/\text{s}$, the diameters are $D_1=450\text{mm}$, $D_2=300\text{mm}$, $D_3=200\text{mm}$ and the upstream pressure $p_1=500\text{kN}/\text{m}^2$.

(15 marks)

Question Three (20 Marks)

(a) A rock fill dam is inclined at angle of 45 degrees at the upstream side. The reservoir design depth is 12m.

Calculate

(i) The force on the dam per unit width

(4 marks)

(ii) The location of the centre of pressure
(6 marks)

(b) Find the magnitude and direction (angle) of the resultant force of water on a quadrant gate.
The principal dimensions of the gate are:

Radius of gate = 1.5m

Width of gate = 4.0m

Water density = 1000 kg/m³

The position of the centre of gravity is $\frac{4R}{3\pi}$ horizontally from the origin
(10 marks)

Question Four (20 Marks)

(a) Calculate the force required to hold a fire hose for a discharge of 5 l/s if the nozzle has an inlet diameter of 75mm and the an outlet diameter of 25mm
(10 marks)

(b) Calculate the magnitude of the force exerted by 45 degrees gentle pipe bend if the diameter is 550mm, the discharge is 0.35 m³/s and the upstream pressure head is 30m
(10 marks)

Question Five (20 Marks)

(a) An open channel with constant width has its floor raised 5.4 cm at a given section. If the depth of the approaching flow is 60cm. Calculate the rate of flow, indicated by a 8.4 cm drop in the surface elevation over the raised bottom
(10 marks)

(b)(i) Name four devices used to measure pressure
(2 marks)

(ii) What are the limitations of using piezometer in measuring pressure?
(1 mark)

(iii) Define the following parameters; hydrostatics and pressure
(2 marks)

(c) Derive the continuity equation
(5 marks)