



NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY

FACULTY OF INDUSTRIAL TECHNOLOGY

DEPARTMENT OF CIVIL AND WATER ENGINEERING

FLUID MECHANICS

TCW 2101

Main Examination Paper

DECEMBER 2015

This examination paper consists of 2 pages

Time Allowed: 3 hours

Total Marks: 100

Special Requirements: NONE

Examiner's Name: ELLEN MANGORE/ZENZO SIBANDA

INSTRUCTIONS

1. Answer any four (4) questions
2. Each question carries 25 marks
3. Use of calculators is permissible

MARK ALLOCATION

QUESTION	MARKS
1.	25
2.	25
3.	25
4.	25
5.	25
TOTAL	100

QUESTION 1

Describe with the aid of diagrams the following phenomena explaining why and when they occur.

- The laminar boundary layer
- The turbulent boundary layer
- The laminar sublayer
- Boundary layer separation
- Methods to prevent boundary layer separation (25 marks)

QUESTION 2

- What is meant by stability of floating body? Explain the stability of a floating body with reference to its metacentric height. Provide sketches (10 marks)
- A metal part is hanging by a thin cord from a floating wood block. The wood block has a specific gravity of 0.3 and dimensions 50x50x10 mm. The metal part has a volume of 6600 mm³. Find the mass of the metal part and the tension in the cord (15 marks)

QUESTION 3

- State and prove the Pascal's law for pressure at a point (5 marks)
- A tank with vertical sides contains oil and water. The oil has a depth of 1.5 m and a relative density of 0.8. It floats on top of the water, with which it does not mix. The water has a depth of 2 m and a relative density of 1. The tank is 3 m by 1.8 m in plan and open to the atmosphere. Calculate:
 - the total weight of the contents of the tank
 - the pressure on the base of the tank
 - the pressure intensity with depth
 - the force on the sides of the tank (15 marks)
- Explain the relationship among absolute, gauge and atmospheric pressures with aid of a sketch (5 marks)

QUESTION 4

- A pipeline carries water around a horizontal 45° bend. The entrance diameter of the bend is 500mm and the velocity of flow is 1 m/s. The bend tapers gradually to 200 mm diameter at its exit. If the pressure just upstream of the entrance is measured at 200kN/m², what is the force, and its line of action, exerted by the water on the bend? (15 marks)
- Calculate the force required to hold a fire hose for a discharge of 5 l/s if the nozzle has an inlet diameter of 75 mm and an outlet diameter of 25 mm. (10 marks)

QUESTION 5

- Discuss the phenomenon of surface tension and capillarity (10 marks)
- For Newtonian fluids, shear stresses in different planes are proportional to corresponding shear strain rates. For a simple shear flow with shear strain occurring in one plane only, show that the shear stress τ is proportional to the velocity gradient perpendicular to this plane. (10 marks)
- The velocity distribution over a plate is given by $V = y/3 - y^2$ in which V is the velocity (m/s) at a distance y (m) above the plate. Determine the shear stress at $y = 0$ and $y = 0.1$ m. Take $\mu = 0.835$ Ns/m². (5 marks)