



TECHNICAL UNIVERSITY OF MOMBASA

FACULTY OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF MECHANICAL & AUTOMOTIVE ENGINEERING

UNIVERSITY EXAMINATION FOR:

**THE DEGREE IN BACHELOR OF TECHNOLOGY IN MECHANICAL
ENGINEERING**

TMC 4225 : FLUID MECHANICS II

END OF SEMESTER EXAMINATION

SERIES: AUGUST 2017

TIME: 2 HOURS

DATE: Pick Date Aug 2017

Instructions to Candidates

You should have the following for this examination

-Answer Booklet, examination pass and student ID

This paper consists of **FIVE** questions. Attempt any **THREE** questions.

Do not write on the question paper.

Question ONE

- a) Define dimensional analysis (2 marks)
- b) State **FOUR** uses and advantages of dimensional analysis (8 marks)
- c) (Explain the term Dimensional Homogeneity (2 marks)
- d) State **FOUR** application of Dimensional Homogeneity (2 marks)
- e) Find an expression for a drag force on smooth sphere of Diameter D moving with a uniform velocity V in a fluid of density ρ and dynamic viscosity μ (6 marks)

Question Two

- a) Define the following terms:-
 - i. Major energy losses in pipes
 - ii. Minor energy losses in pipes

- iii. Hydraulic gradient line
 - iv. Total energy line (6 marks)
- b) In a pipe of 300mm diameter and 800 m length an oil of specific gravity 0.8 is flowing at the rate of 0.45m³/s Find
- i. Head lost due to friction.
 - ii. Power required to maintain the flow.
- Take the kinematic viscosity of oil as 0.3 stoke. (6 marks)
- c) A horizontal pipe 150 mm in diameter, is joined by sudden enlargement to a 225 mm diameter pipe. Water is flowing through it at the rate of 0.05m³/s. Find
- i. Loss of head due to abrupt expansion
 - ii. Pressure difference in the two pipes
 - iii. Change in pressure if the change of section is gradual without any loss. (8 marks)

Question Three

- a) Explain the following terms
- i. Turbulent boundary layer
 - ii. Laminar boundary layer (4marks)
- b) Describe fine the following boundary layer
- i. Displacement thickness
 - ii. Momentum thickness
 - iii. Energy thickness (6 marks)
- a) The velocity distribution in the boundary layer is given by:

$$\frac{u}{U} = 2 \left(\frac{y}{\delta} \right) - \left(\frac{y}{\delta} \right)^2$$

Where u is the velocity at a distance y from the plate and $u = U$ at $y = \delta$, where $\delta =$ boundary layer thickness. Find

- i. The displacement thickness.
- ii. The momentum the thickness.
- iii. The energy thickness. (10 marks)

Question Four

- a) Explain the following types of flow
- i. Steady uniform flow
 - ii. Unsteady non-uniform flow (4 marks)
- b) Show that the work done by a force exerted by a water jet on a moving plate inclined in the direction of the jet is given by

$$F_x = \rho a V^2 \sin^2 \theta$$

Where

ρ = density, a = area of the jet, V = velocity of the jet, θ = inclination of the plate with the jet
(8 marks)

- c) A nozzle of 60mm diameter delivers a stream of water at 24m/s perpendicular to a plate that moves away from the jet at 6 m/s. Calculate
- The force on the plate
 - The work done
 - Efficiency of the jet. (8 marks)

Question Five

- a) Describe the following types of flow
- Steady flow
 - Laminar flow
 - Compressible flow (6 marks)
- b) Explain the water hammer phenomenon. (3 marks)
- c) A 25 cm diameter pipe carries oil of specific gravity of 0.9 at a velocity of 3 m/s. At another section the diameter is 20 cm. Find the velocity at this section and also mass rate flow of oil. (5 marks)
- d) State four factors of which the pressure rise due to water hammer depends. (6 marks)