



# TECHNICAL UNIVERSITY OF MOMBASA

FACULTY OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF MECHANICAL & AUTOMOTIVE ENGINEERING

**UNIVERSITY EXAMINATION FOR:**

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

**EMG 2301 : FLUID MECHANICS II**

**END OF SEMESTER EXAMINATION**

**SERIES: APRIL 2016**

**TIME: 2 HOURS**

**DATE: Pick Date May 2016**

## 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) Explain the following types of flow

a. Steady uniform flow

b. Unsteady non-uniform flow

(4 marks)

b) Show the force exerted by a jet of water on moving inclined plate in the direction of jet is given by:

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

$\rho$  = density,  $a$  = area of the jet,  $V$  = velocity of the jet,  $\theta$  = inclination of the plate with the jet (6 marks)

c) A 75mm diameter jet having a velocity of 30m/s strikes a flat plate, the normal of which is inclined at 45° to the axis of the jet. Find the normal pressure on the plate:

i. When the plate is stationary

ii. When the plate is moving with a velocity of 15m/s in the direction away from jet.

iii. Power of the jet and efficiency of the jet when the plate is moving. (10 marks)

## Question TWO

- a) Explain **FOUR** different types of channels and give **TWO** examples of each (4 marks)
- b) Derive the following expression for discharge through a channel by Chezy's formula (6 marks)
- c) Find the velocity of flow and rate of flow of water through a rectangular channel of 6 m wide and 3 m deep, when it is running full. The channel is having bed slope as 1 in 2000. Take Chezy's constant  $C=55$  (5 marks)
- d) A rectangular channel is to be dug in the rocky portion of a terrain. Find its most economical cross-section if it is to convey  $12\text{m}^3/\text{s}$  of water at an average velocity of 3 m/s. Take Chezy constant  $C=50$  (5 marks)

## Question THREE

- 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  $\rho$  and dynamic viscosity  $\mu$  (6 marks)

## Question FOUR

- 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  $0.45\text{m}^3/\text{s}$  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  $0.05\text{m}^3/\text{s}$ . 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 FIVE

- a) Define the following terms
  - i. Velocity gradient
  - ii. Pressure gradient (4 marks)

- b) Derive the equation for the velocity distribution for various flow through a circular pipe  
(8 marks)
- c) An oil of viscosity  $0.1\text{Ns/m}^2$  and relative density 0.9 is flowing through a circular pipe of diameter 50mm and of length 300m. The rate of flow of fluid through the pipe is 3.5 litres/s. Calculate the pressure drop in a length of 300m and also the shear stress at the pipe wall. (8 marks)