



TECHNICAL UNIVERSITY OF MOMBASA

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Faculty of Engineering and Technology

Department of Mechanical & Automotive Engineering

UNIVERSITY EXAMINATION FOR:

BSc. Mechanical Engineering

EMG 2301 : FLUID MECHANICS II

END OF SEMESTER EXAMINATION

SERIES: DECEMBER 2016

TIME: 2 HOURS

DATE: Pick Date Dec 2016

**Instruction to Candidates:**

You should have the following for this examination

- *Answer booklet*
- *Non-Programmable scientific calculator*

This paper consists of **FIVE** questions. Attempt question **ONE** and any other **TWO** questions.

Maximum marks for each part of a question are as shown.

**Do not write on the question paper.**

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**Question One**

a. Explain the following terms

- Top width
- Hydraulic radius
- Hydraulic depth

(3marks)

b. Describe the following non-uniform flows in open channels

- Rapidly varied flow

- ii. Gradually varied flow (4marks)
- c. Find the bed slope of trapezoidal channel of bed width 6m, depth of water 3 m and side slope of 3 horizontal to 4 vertical, when the discharge through the channel is 30 m<sup>3</sup>/s. Take chezy's constant to be C=70  
(6 marks)
- d. A rectangular channel 4 m wide has depth of water 1.5m. The slope of the bed of the channel is 1 in 1000 and value of chezy's constant C=55 It is desired to increase the discharge to a maximum by changing the dimension of the section for constant area of the cross-section, slope of the bed and roughness of the channel. Find the new dimensions of the channel and increase in discharge (7marks)

### Question Two

- a. Explain the following types of flow
- i. Uniform flow
  - ii. Unsteady flow (3 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
- $$\text{Work done} = \rho g (V-U)^2 \sin^2 \theta U$$
- Where
- P= density a=area of the jet
- V= velocity of the jet, u= velocity of plate in the direction of jet  
(5 marks)
- c. A 75mm diameter jet having a velocity of 30m/s strikes a flat plate 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 a velocity of 15m/s in the direction away from the jet. (6 marks)
- d. A nozzle of 50mm diameter delivers a stream of water at 20m/s perpendicular to a plate that moves away from the jet at 5m/s. Find
- i. The force on the plate
  - ii. Work done
  - iii. Efficient of the jet (6 marks)

### Question Three

- a. Define dimensional analysis and four of its uses (6marks)
- b. State for advantages of dimensional analysis (6marks)
- c. What are the advantages of model testing (6marks)
- d. Determine the dimensions of the following quantities
  - i. Discharge
  - ii. Force (2marks)

#### Question Four

- a. Derive an expression for the velocity distributed for viscous flow through a circular pipe. Also sketch the distribution of velocity and shear stress across a section of the pipe (8marks)
- b. A fluid of viscosity  $0.7 \text{ Ns/m}^2$  and specific gravity 1.3 is flowing through a horizontal circular pipe of 100mm diameter. The maximum shear stress at the pipe wall is 196.2. Calculate
  - i. The pressure gradient
  - ii. Average velocity ( 6 marks)
- c. A crude oil of viscosity 0.97 poise and specific gravity 0.9 is flowing through a horizontal circular pipe of diameter 100mm and of length 10m. Calculate the difference of pressure at the two ends of the pipe, if 100kg of the oil is collected in a tank in 30seconds. ( 6 marks)

#### Question Five

- a. Explain the following terms
  - i. Major energy losses in pipe
  - ii. Minor energy losses in pipe (4marks)
- b. A horizontal pipe 150mm in diameter is joined by sudden enlargement to a 225mm diameter. 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 losses. (7 marks)

- c. Explain the water hammer phenomena (5marks)
- d. State the factors of which the magnitude of the pressure in a water hammer depends (4marks.)