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) What is dimensional analysis? (2 marks)

b) State the uses of dimensional analysis? (6 marks)

c) Describe any six the advantages dimensional analysis (6 marks)

d) Explain the following similarities in dimensional analysis

i. Geometric similarities

ii. kinematic similarities

iii. dynamic similarities (6 marks)

Question Two

a) Define the terms and give two example of each

i. Major energy losses

ii. Minor energy losses in pipe. (5 marks)

b) Derive formulae for calculating loss of head due to Sudden enlargement (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 m^3/s. Find :

i. Loss of head due to abrupt expansion,
ii. Pressure difference in the two pipes, and
iii. Change in pressure if the change of section is gradual without any loss.

(9 marks)

Question Three

a) Define boundary layer and explain the fundamental causes of its existence.(4 marks)
b) Define momentum thickness and energy thickness. (6 marks)
c) The velocity distribution in the boundary layer is given by

$$\frac{u}{U} = 2\left[\frac{y}{\delta}\right] - \left[\frac{y}{\delta}\right]^2$$

δ being the boundary layer thickness

Calculate the following:

i. Displacement thickness,
ii. Momentum thickness, and
iii. Energy thickness. (10 marks)

Question Four

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

1. $F_X = \rho a(V-u)^2 sin^2\theta$

where, a = Area of jet,
V = Velocity of the jet, and
θ= Inclination of the plate with the jet. (5 marks)

b) A 75 mm diameter jet having a velocity of 30 m/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 15 m/s in the direction of jet, away from the jet.
iii. Also determine the power and efficiency of the jet when the plate is moving.

(7 marks)

c) A jet of water having a velocity of 45 m/s impinges without shock on a series of vanes moving at 15 m/s. The direction of motion of the vanes is inclined at 20° to that of jet. The relative velocity at outlet is 0.9 of that at inlet, and absolute velocity of water at exit is to be normal to the motion of vanes. Find:

i. Vane angles at inlet and outlet,
ii. Work done on vanes per N (newton) of water supplied by the jet, and
iii. Hydraulic efficiency. (8 marks)

Question Five

a. Explain the phenomenon of water hammer in pipes (3 marks)
b. Explain four factors which the magnitude of water depends on (6 marks)
c. What is a surge tank and state two uses? (3 marks)
d. Describe the following types of surge tanks
   i. Simple surge tank
   ii. Incline surge tank
   iii. Restricted orifice surge tank
   iv. Differential surge tank (8 marks)