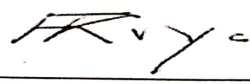## ELIZADE UNIVERSITY, ILARA-MOKIN, ONDO STATE, NIGERIA

DEPARTMENT OF
MECHANICAL, AUTOMOTIVE AND PRODUCTION ENGINEERING

FIRST SEMESTER EXAMINATIONS
2017/2018 ACADEMIC SESSION

COURSE: MEE 405 – Fluid Mechanics II (3 Units)

CLASS: 400 Level Mech. & Automotive Engineering

TIME ALLOWED: 2 Hours:30 Min.

INSTRUCTIONS: Answer any **FOUR** questions

[signature]
HOD'S SIGNATURE

Date: March, 2018

Question 1

(a) With the aid of diagram, describe the development of boundary layer along a flat plate.

(7 Marks)

(b) List and explain 4 factors affecting transition from laminar to turbulent flow regime.

(6 Marks)

(c) Determine the ratio of momentum and displacement thickness to the boundary layer thickness when the layer velocity profile is given by

$$\frac{u}{U_s} = \left(\frac{y}{\delta}\right)^{\frac{1}{2}}$$

Where u is the velocity at a height y above the surface and the flow free stream velocity is U_s

(12 Marks)

Question 2

(a) Differentiate between steady uniform flow and unsteady uniform flow. **(6 Marks)**

(b) Discuss four (4) factors that can reduce the effect of water hammer. **(6 Marks)**

(c) A rectangular cross-section tank, 3 m by 4 m located in Elizade University Senate building is filled with water up to a depth of 3 m. Calculate the time to reduce the volume in the tank by 50% if the discharge is via a 40 mm diameter pipe, 8 m long, for which a friction factor of 0.005 may be assumed and the separation losses may be represented by a k value of 0.9 Assume final discharge of 2 m below tank base level.

(13 Marks)

Question 3

(a) What do you understand by the term 'water hammer'? **(5 Marks)**

(b) Determine the period of oscillation of a U-tube containing 5 litres of water. The cross-sectional area is 270 mm². Neglect friction. **(8 Marks)**

(c) Water at a temperature of 20 ^{0}C flows through a pipe system 15 mm wall, $E = 2.0 \times 10^9$ Nm^{-2}. Assume that the effects of longitudinal strain, as represented by the inclusion of Poisson's ratio may be neglected and wave propagation velocity is 181 ms^{-1}. Calculate the pipe diameter. Take Bulk modulus as 2×10^9 Nm^{-2}. **(12 Marks)**

Question 4

(a) List 6 application areas of Navier-Stoke's equation. **(6 Marks)**

(b) A globe valve (k=3) at the end of a pipe 732 m long is rapidly opened. Where D = 3.5 ft, f =0.019 and H= 85 ft. How long does it take for the discharge to attain 75% of its steady-state value? **(6 Marks)**

(c) Derive Navier-Stoke's equation (3-D) in rectangular coordinates. **(13 Marks)**

Question 5

(a) What do you understand by the term "Open Channel Flow"? **(5 Marks)**

(b) Most flows rarely attain full uniform flow due to several factors. List and explain 3 of these factors. **(9 Marks)**

(c) An open channel has a cross-section in the form of a trapezium as shown in Fig. Q5b with a bottom width B of 4 m and side slopes of 1 vertical to 1.5 horizontal. Assuming the roughness coefficient n is 0.025, the bed slope is 1 in 1500 and the depth of the water is 1.2 m. Find the volume rate of flow Q using Manning formula. **(11 Marks)**
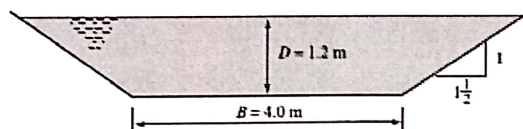

Fig. Q5b