

**W1-2-60-1-6**

## JOMO KENYATTA UNIVERSITY

**OF AGRICULTURE AND TECHNOLOGY**

# University Examinations 2016/2017

**YEAR FOUR SEMESTER TWO EXAMINATIONS FOR THE DEGREE OF BACHELOR OF SCIENCE IN MATHEMATICS AND COMPUTER SCIENCE**

**SMA 2425: FLUID MECHANICS III**

**DATE: APRIL 2017 TIME: 2 HOURS**

**INSTRUCTIONS: ANSWER QUESTION ONE (COMPULSORY) AND ANY TWO QUESTIONS**

**QUESTION ONE (30 MARKS)**

a) Explain the meaning of the following terms as applied to boundary layer theory:

i) No slip condition (1 mark)

ii) The boundary layer (2 marks)

iii) Boundary layer separation (2 marks)

b) Explain what you understand by the following terms as applied to fluid mechanics:

i) Dynamics similarity (3 marks)

ii) Kinematic similarity (3 marks)

c) Determine whether the flow is attached, detached or on the verge of separation for the following velocity profiles:

i) (3 marks)

ii) (3 marks)

d) An oil of specific gravity 0.92 and viscosity 0.003Ns/m2 is to be transported at a rate of 2500 litres /sec. through a 1.2cm diameter pipe using water at 20ºC. If the viscosity of water at 20ºC is 0.001NS/M2, find;

i) the velocity of flow in the model (5 marks)

ii) the rate of flow in the model (3 marks)

e) A fluid of density 1200kg/m3 and viscosity 0.05NS/M2 is flowing at a rate of 5M3/min in a circular pipe of cross section 1M2. Is the flow laminar or turbulent? Predict the maximum velocity of the fluid in the pipe (5 marks)

**QUESTION TWO (20 MARKS)**

a) Explain the meaning of the following terms as applied to boundary layer theory:

i) the displacement thickness (2 marks)

ii) the momentum thickness (2 marks)

iii) the energy thickness (2 marks)

b) The velocity distribution in the boundary layer is given by

 being the boundary layer thickness. Calculate:

i) the displacement thickness (2 marks)

ii) the momentum thickness (3 marks)

iii) the energy thickness (3 marks)

c) Describe with sketches any two methods of controlling the separation of boundary layers (6 marks)

**QUESTION THREE (20 MARKS)**

a) i) Define the Reynold’s number (1 mark)

ii) Show that the Reynold’s number is given

by



Where the symbols carry their usual meanings (5 marks)

b) In order to predict the pressure drop in a large air duct a model is constructed with linear dimension that of the prototype, and water is used as the test fluid. If water is 100 times denser than air and has 100 times the viscosity of air, determine the pressure drop in the prototype for the conditions corresponding to a pressure drop of TokPa in the model (6 marks)

c) Find an expression for the power absorbed in overcoming viscous resistance in the case of a journal bearing (8 marks)

**QUESTION FOUR (20 MARKS)**

a) State any three characteristics of laminar flow (3 marks)

b) An oil of viscosity 0.9NS/M2 and density 900kgM3 is flowing through a horizontal pipe of diameter 50mm diameter. If the pressure drop in 100m length of pipe is 1600KN/M2, determine;

i) the rate of flow of oil (3 marks)

ii) the centre line velocity (2 marks)

iii) the velocity gradient at the pipe wall (4 marks)

iv) the Reynold’s number and identify the type of flow (3 marks)

c) The velocity distribution in a pipe is given by



Where, Umax is the maximum velocity at the centre of the pipe, u is the velocity at a distance r from the centre and R is the pipe radius. obtain an expression for mean velocity in terms of Umax and n (5 marks)