KIBABII UNIVERSITY

UNIVERSITY EXAMINATIONS
2017/2018 ACADEMIC YEAR

SECOND YEAR FIRST SEMESTER

SPECIAL/SUPPLEMENTARY EXAMINATIONS

FOR THE BACHELOR OF RENEWABLE ENERGY AND BIOFUELS TECHNOLOGY

COURSE CODE   :   PRD 232

COURSE TITLE   :   FLUID MECHANICS I

DURATION   :   2 HOURS

DATE : **05/10/2018**   TIME: **3:00-5:00PM**

INSTRUCTIONS TO CANDIDATES

- Answer QUESTION ONE (Compulsory) and any other TWO (2) Questions.
- Indicate **answered questions** on the front cover.
- Start every question on a new page and make sure question's number is written on each page
- Take $g = 9.81 m/s^2$, density of water $= 1000 kg/m^3$, density of air $= 1.18 kg/m^3$

QUESTION ONE (20 MARKS)

a) i) State the meaning of viscosity   (1 ½ marks)

  ii) Explain how pressure affects the viscosity of a liquid   (1 ½ marks)

b) A vessel of 4m³ volume contains an oil which weighs 30.2 KN. Determine the specific gravity of the oil   (2 ½ marks)

c) Differentiate between:

  i)   Rotational and Irrotational flows
  ii)   Laminar and turbulent flows   (8 marks)

d) The critical velocity of air in a pipe of 125 mm diameter is 0.234m/s
   Calculate:

  i)   The critical Reynold's number
  ii)   The critical velocity of water in the same pipe

(Take the kinematic viscosity of air as $1.46 \times 10^{-5} m^2/s$ and of water as $1.10 \times 10^{-6} m^2/s$; the density of air = 1.18 kg/m³)

                (4 ½ marks)

e) i) State the principle of transmission of liquid pressure
   (1 ½ marks)
   ii) With the aid of a clear sketch, describe the operation principle of a simple hydraulic press   (7 marks)
f) i) State two properties of mercury that make it suitable for use in a simple barometer
                (1 mark)
   ii) Describe the operation of a piezometer tube in the measurement of liquid pressure
   (2 ½ marks)

QUESTION TWO (20 MARKS)

A pipe AB of diameter 1200mm conveys oil at a velocity of 3m/s to pipe BC of diameter 1500 mm. At C, the pipe forks. Branch CD is 800mm in diameter and carries one third of the flow in AB. The velocity in branch CE is 2.5 m/s. Determine:

i) the velocity in BC and CD

ii) the diameter of CE   (20 marks)

QUESTION THREE (20 MARKS)

a) State THREE assumptions made when deriving the Darcy formula for head lost due to friction.   (3 marks)

b) Water is flowing through a pipe 1500mm long with a velocity of 0.8m/s. What should be the diameter of the pipe if the loss of head due to friction is 8.7m. Take f of the pipe as 0.01.   (6 marks)

c) Starting from first principles, derive Chezy's formula for discharge through an open channel.   (11 marks)

QUESTION FOUR (20 MARKS)

a) A rectangular channel is 1.5 metres deep and 6 metres wide. Find the discharge through the channel, when it runs full. Take slope of the bed as 1 in 900 and Chezy's constant as 50.

(7 marks)

b) i) State Newton's law of Resistance as applied to fluid flow around immersed bodies.

(2 marks)

ii) State the assumptions made with respect to Newton's law of resistance. (2½ marks)

c) A circular disc 3m in diameter is held normal to a 15m/s wind having specific weight of 11.8N/m³. If the drag coefficient is 0.4, find the force required to hold it.   (3½ marks)

d) i) What is an open channel?   (2 marks)

ii) Give THREE examples of open channels.   (1½ marks)

iii) Explain the main design consideration when constructing an open channel. (1½ marks)

QUESTION FIVE (20 MARKS)

a) Explain why and how a stream tube behaves like an ordinary closed conduit.   (8 marks)

b) Derive Euler's equation of motion along a streamline.   (12 marks)