KIBABII UNIVERSITY

UNIVERSITY EXAMINATIONS
2016/2017 ACADEMIC YEAR

SECOND YEAR FIRST SEMESTER
SUPPLEMENTARY/SPECIAL EXAMINATIONS

FOR THE DEGREE OF BACHELOR OF SCIENCE IN RENEWABLE ENERGY AND BIOFUELS TECHNOLOGY

COURSE CODE: PRD 232

COURSE TITLE: FLUID MECHANICS I

DURATION: 2 HOURS

DATE: 15TH SEPTEMBER 2017 **TIME:** 2:30 Pm - 5:30 Pm

INSTRUCTIONS TO CANDIDATES

- Answer question **ONE** and any other **THREE** 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 the density of water as 1000 kg/m^3 and acceleration due to gravity as 9.81 m/s^2.

This paper consists of **5** printed pages. Please Turn Over

QUESTION ONE (27 ½ MARKS)

(a) (i) Define specific weight of a fluid and explain why it varies from point to point. (2 marks)

(ii) Give the mathematical relation between the specific weight and the density of a fluid. (1 mark)

(b) (i) Liquid surface behaves as if it were an elastic membrane under tension. This is in contrast to what happens at the interior of the liquid. Explain. ($3^1/_2$ marks)

(ii) What is the effect of surface tension on the surface of a free body of liquid? (3 marks)

(iii) How can surface tension force be reduced? (1 mark)

(c) (i) Distinguish between the coefficient of dynamic viscosity and the kinematic viscosity and provide the mathematical model explaining the relationship between the two types of viscosity. ($3^1/_2$ marks)

(ii) Taking into account the effects of both molecular interchange and cohesion in liquids, explain the variation of viscosity with increasing temperature and pressure. (7 marks)

(d) (i) Water rises to a height h inside a clean glass capillarity tube of radius 0.2 mm when the tube is placed vertically inside a beaker of water. Calculate the value of h if the surface tension of water is $7.0 \times 10^{-2} Nm^{-1}$ and the angle of contact is zero.($2^1/_2$ marks)

(ii) With the aid of diagram explain the action of a hydraulic jack. A force of 200 N is applied to the smaller cylinder of a hydraulic jack. The area of the smaller piston is 15 cm^2 and the area of the larger piston is 150 cm^2. Determine the load that can be lifted on the larger piston if the pistons are at the same level.

($6^1/_2$marks)

QUSTION TWO (17 ½ MARKS)

(a) Distinguish between absolute pressure and gauge pressure in relation to fluids. (4 marks)

(b) With the aid of diagrams describe the following instruments used in measuring fluid pressure:

(i) simple mercury barometer;

(ii) piezometer tube.

($7^1/_2$ marks)

(c) A U-tube manometer shown in figure 1 is used to measure the gauge pressure of a fluid X of density, $800\ kg/m^3$. If the density of the liquid Y is$13.6 \times 10^3\ kg/m^3$, determine the gauge pressure at A if:

(i) $h_1 = 0.4\ m$ and D is 0.8 m above BC;

(ii) $h_1 = 0.1\ m$ and D is 0.2 m below BC.

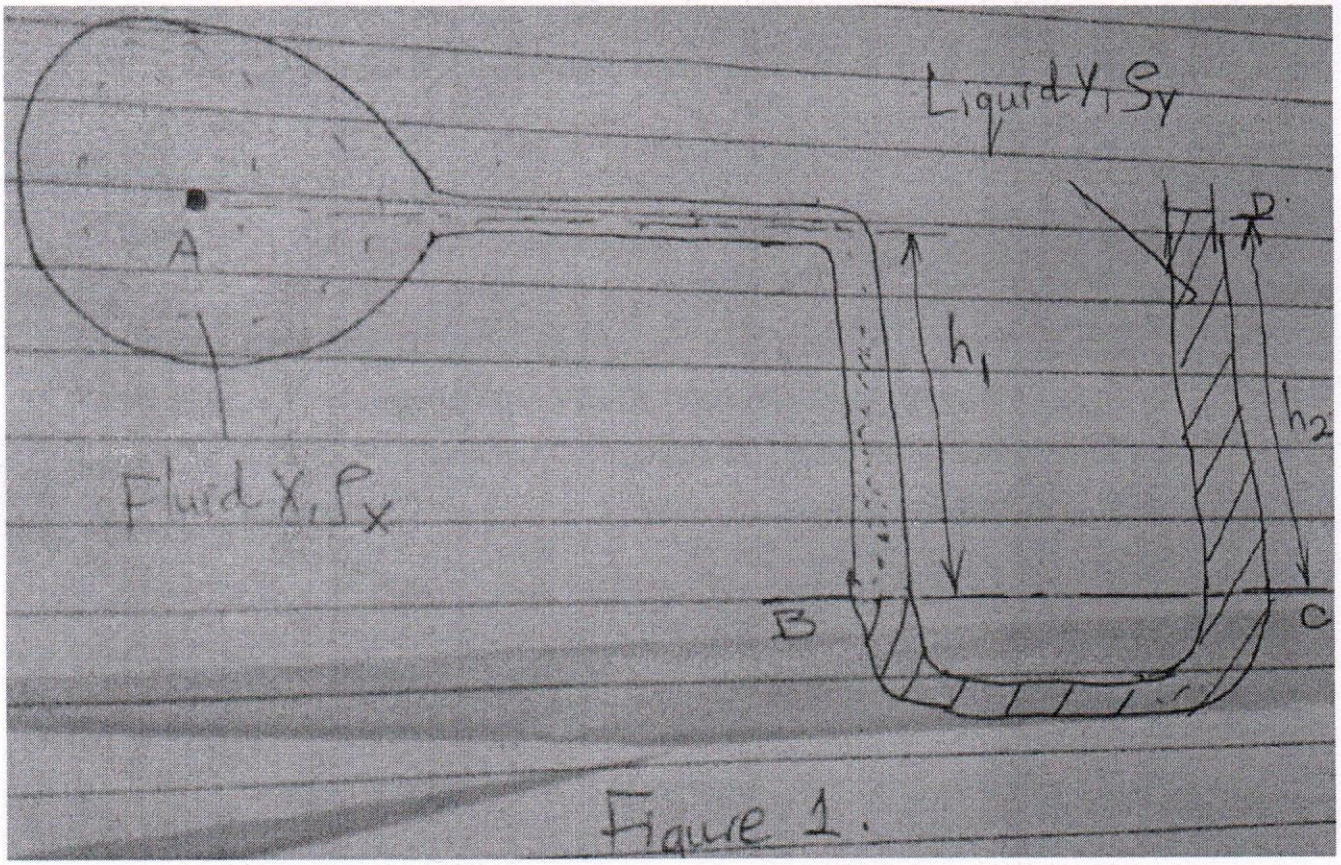

Figure 1.

(6 marks

QUESTION THREE (17 ½ MARKS)

(a)Define the following terms in connection with fluid flow:

(i) steady flow;

(ii) unsteady flow;

(iii)uniform flow;

(iv)non-uniform flow. (6 marks)

(b) Water flows through a pipe AB of diameter 60 mm which is in series with a pipe BC of diameter 80 mm in which the mean velocity is 3 m/s. At C, the pipe forks and in one branch CD, the mean velocity is 1.5 m/s and in the other branch CE, the diameter is 40 mm. The conditions are such that the discharge through CE is a half the discharge through CD. Determine the discharges and the mean velocities of flow in each section of the pipeline.

($11^1/_2$ marks)

QUESTION FOUR (17 ½ MARKS)

(a) State the **three** forms of energy that a flowing fluid may possess.(3 marks)

(b) Explain the uses of the following instruments in fluid flow measurements.

(i) Pitot tube;

(ii) Venturi meter.

(3 marks)

(c)Water flows down a sloping pipe which has one end 1.3 m above the other. The pipe section tapers from 0.9 m diameter at the top end A to 0.45 m diameter at the lower end B. The flow of water is 9t/min. Find the difference in pressure between A and B.

($11^1/_2$marks)

QUESTION FIVE (17 ½ MARKS)

(a) Moving from first principles show that the frictional head loss h_f, of a fluid flowing at a velocity v, in apipe of length L, and diameter d, is given by;

$$h_f = \frac{4fL}{d}\frac{v^2}{2g}$$

Where;

g is the gravitational acceleration; and

f is the friction coefficient

(9 marks)

(c) Two reservoirs are connected by a 21m pipeline which is 150 mm diameter for the first 6 m and 225 mm diameter for the remaining 15 m. The entrance and exit are sharp and the change of section is sudden. The water surface in the upper reservoir is 6 m above that of the lower. If the coefficient of friction f = 0.01 for both pipes, determine the rate of flow in m^3/s.

($8^1/_2$marks)

QUESTION SIX (17 ½ MARKS)

(a) Distinguish betweena notch and a weir. (2 marks)

(b) Explain the following termsused in connection with flow through orifices.

(i) coefficient of velocity;

(ii) coefficient of contraction;

(iii)coefficient of discharge.

($4^1/_2$marks)

(c) It is proposed to use a notch to measure the flow of water from a reservoir and it is estimated that the error in measuring the head above the bottom of the notch could be 1.5 mm. For a discharge of 0.32 m^3/s, determine from first principles, the percentage error which may occur using a right-angled triangular notch with a coefficient of discharge of 0.8.

(11 marks)