MULTIMEDIA UNIVERSITY OF KENYA

FACULTY OF ENGINEERING & TECHNOLOGY

UNIVERSITY EXAMINATIONS 2016/2017

SECOND YEAR SECOND SEMESTER EXAMINATION FOR THE DEGREE OF BACHELOR OF SCIENCE IN ELECTRICAL & TELECOMMUNICATION ENGINEERING

ECE 2227: FLUID MECHANICS

DATE: WEDNESDAY 28TH JUNE 2017 TIME: 2 HOURS

INSTRUCTIONS:

ANSWER YOUR QUESTIONS IN ANSWER BOOKLET PROVIDED

ANSWER QUESTION ONE [COMPULSORY] AND ANY OTHER TWO QUESTIONS

QUESTION ONE (THIRTY MARKS)

(a) Differentiate between: (i) Liquids and gases, (ii) real fluid and ideal fluid, (iii) Specific weight and specific volume of a fluid. **(5 marks)**

(b) (i) State Newton's law of viscosity. **(2 marks)**

(ii) The velocity distribution over a plate is given by $u = \frac{2}{3}y - y^2$ in which u is the velocity in metre per second at a distance of y metres above the plate. Determine the shear stress at $y = 0.2$ m. Take $\mu = 0.6$ N s/m^2. Find the distance in metres above the plate, at which the shear stress is zero. **(3 marks)**

(c) For the U tube manometer arranged as shown in figure Q1.1, show that the pressure difference between two points A and B can be expressed as:

Pressure difference $p_A - p_B = \rho g(b-a) + hg(\rho_{man} - \rho)$ **(5 marks)**

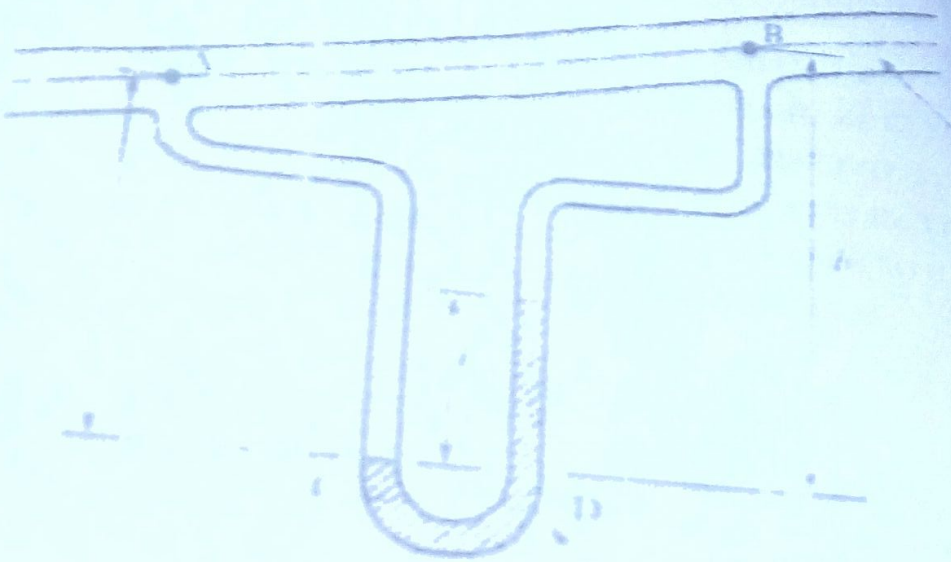

Figure Q 1.1

(c) Explain how you would find the resultant pressure on a curved surface immersed in a liquid. **(6 marks)**

(d) The face of a dam (figure Q1.2) is curved according to the relation $y = x^3/2.4$, where y and x are in metres. The height of the free surface above the horizontal plane through A is 15.25 m.

(i) Calculate the resultant force F due to the fresh water acting on unit breadth of the dam.

(ii) Locate the point of intersection of the horizontal line of action of the horizontal resultant force and the vertical line of action of the vertical resultant force, clearly stating the position of centre of pressure. **(9 Marks)**

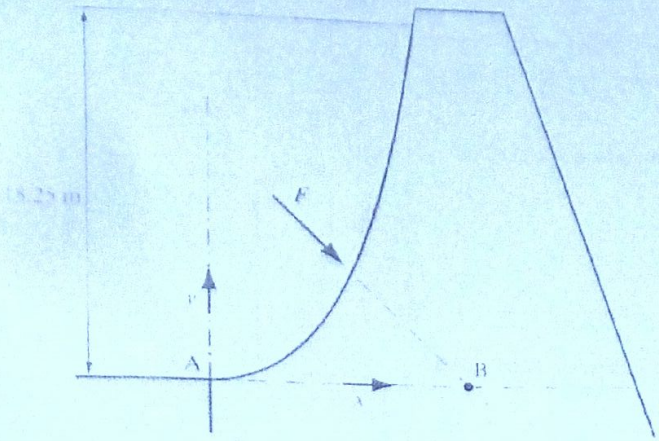

Figure Q 1.2

QUESTION TWO (TWENTY MARKS)

(a) If the velocity of water in a 300mm diameter pipe is 0.50 m/s, what is the velocity in a 75 mm diameter jet issuing from a nozzle attached to the pipe. **(4 marks)**?

(b) Develop the general equation of continuity for three – dimensional flow of a compressible fluid for
(i) Unsteady flow
(ii) Steady flow **(12 marks)**

(c) Is the continuity equation for steady incompressible flow satisfied if the following velocity components are involved?

$v_x = 2x^2 - xy + z^2$

$v_y = x^2 - 4xy + y^2$

$v_z = -2xy - yz + y^2$

(4 Marks)

QUESTION THREE (TWENTY MARKS)

(a) (i) Differentiate between gauge and absolute pressure **(2 marks)**

(ii) What do you understand by vacuum pressure? **(1 marks)**

(b) For the open tank, with piezometers attached on the side, containing two different immiscible liquids as shown in figure Q3 , find
(i) The elevation of the liquid surface in piezometer A, **(2 marks)**
(ii) The elevation of the liquid surface in piezometer B, and **(3 marks)**
(iii) The total pressure at the bottom of the tank **(2 marks)**

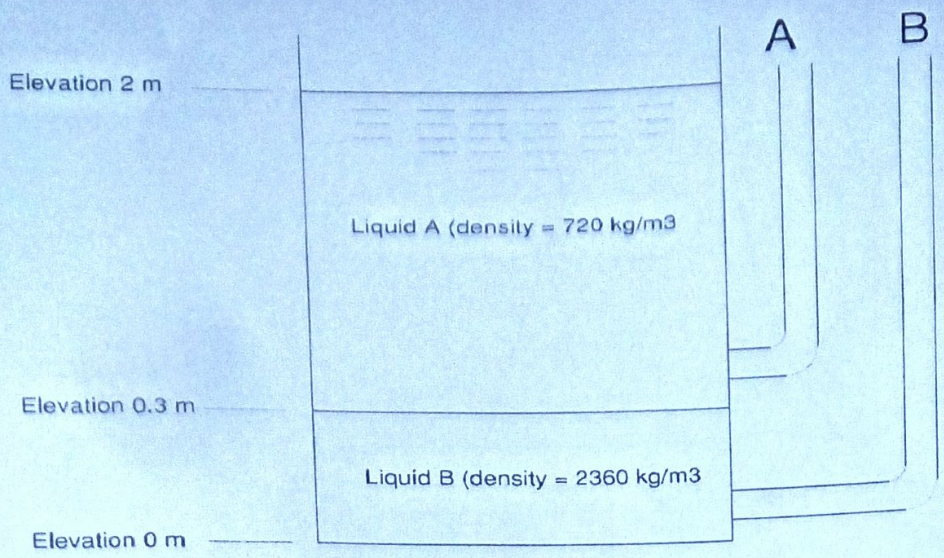

Figure Q3

(c) Derive a general expression for the relation between pressure and elevation for isothermal conditions for a gas, using the relation $dp = -\rho g dz$ **(5 marks)**

(d) At an attitude z_1 of 11 000 m, the atmospheric temperature T is – 56.6° C and the pressure p is 22.4 kN/m^2. Assuming that the temperature remains the same at higher altitudes, calculate the density of the air at an altitude z_2 of 15 000 m. Assume R = 287 J/kg/K. **(5 marks)**

QUESTION FOUR (TWENTY MARKS)

(a) What do you understand by turbulent flow? What factors decide the type of flow in pipes? **(4 marks)**

(b) Derive Euler's equation of motion along a stream line and integrate it to obtain Bernoulli's equation. State all assumption made. **(9 marks)**

(c) Water is flowing through a pipe having diameter $300mm$ and $200mm$ at the bottom and upper end respectively. The intensity of pressure at the bottom end is $24.525 N/cm^2$ and the pressure at the upper end is $9.81 N/cm^2$. Determine the difference in datum head if the rate of flow through pipe is $40 lit/s$. **(7 marks)**

QUESTION FIVE (TWENTY MARKS)

(a) Define velocity of approach. How does the velocity of approach affect the discharge over a weir? **(4 marks)**

(b) What are the advantages of triangular notch over rectangular notch? **(3 marks)**

(c) Prove that the discharge through a triangular notch or weir is given by

$$Q = \frac{8}{15} C_d . \tan\frac{\theta}{2} \sqrt{(2g)} . H^{5/2}$$

Where H = head of water over the notch or weir
θ = angle of notch or weir

(9 marks)

(d) Find the discharge over a triangular notch of angle 60° when the head over the V-notch is 0.3m. Assume $C_d = 0.6$.

(4 marks)