ELIZADE UNIVERSITY, ILARA-MOKIN,
ONDO STATE, NIGERIA

DEPARTMENT OF
MECHANICAL, AUTOMOTIVE AND PRODUCTION ENGINEERING

SECOND SEMESTER EXAMINATIONS

2016/2017 ACADEMIC SESSION

HOD'S SIGNATURE

COURSE: GNE 214-Fluid Mechanics (3 Units)

CLASS: 200 Level General Engineering

TIME ALLOWED: 3 Hours

INSTRUCTIONS: Answer any 5 questions of your choice. All questions carry equal marks

Date: July/August, 2017

Question 1

(a) Write short notes on the following:
  (i) Steady uniform flow
  (ii) Steady non-uniform flow
  (iii) Unsteady uniform flow
  (iv) Unsteady non-uniform flow **(2 Marks)**

(b) (i) Distinguish between real and ideal fluids. **(2 Marks)**
  (ii) State the principle of conservation of mass as it is applied to a flowing fluid. **(2 Marks)**

(c) Water flows through a pipe AB of diameter $d_1 = 50$ mm, which is in series with a pipe BC of diameter $d_2 = 75$ mm in which the mean velocity $V_2 = 2$ m/s. At C the pipe folks and one branch CD is of diameter d_3 such that the mean velocity V_3 is 1.5 m/s. the other branch is of diameter $d_4 = 30$ mm and conditions are such that the discharge Q_2 from BC divides so that $Q_4 = \frac{1}{2}Q_3$. Calculate the values of Q_1, V_1, Q_2, Q_3, d_3, Q_4 and V_4 **(6 Marks)**

Question 2

(a) (i) Differentiate between Newtonian and Non-Newtonian fluids with the aid of a diagram **(2 Marks)**
  (ii) List 6 properties of fluid, and explain any 3 **(3 Marks)**

(b) (i) Find the change in volume of 1.00 m^3 of water at 26.7 ^{0}C when subjected to a pressure of 20 bar ($E = 2.24 \times 10^9$ Nm^2) **(2 Marks)**
  (ii) A reservoir of glycerin has a mass of 1200 kg and volume of 0.952 m^3. Find the glycerin's weight, mass density, specific weight and specific gravity. **(2 Marks)**

(c) A liquid compressed in a cylinder has a volume of 1000 cm^3 at 1 MN/m^2 and a volume of 995 cm^3 at 2 MN/m^2. What is the bulk modulus of elasticity? **(3 Marks**

Question 3

(a) If a triangle of height d and base b is vertical and submerged in liquid with its vertex a distance a below the liquid surface as shown in figure Q3 (a). Derive an expression for the depth to its centre of pressure. **(4 Marks)**

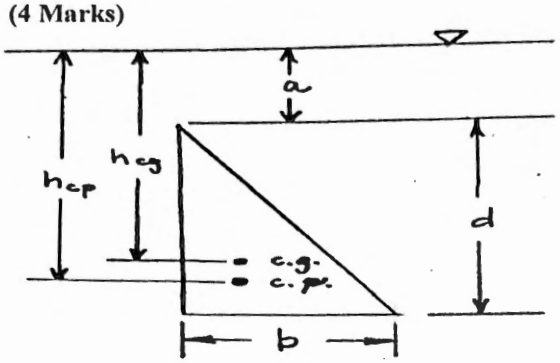

Fig. Q3(a)

(b) A pipe of 90 mm diameter water is flowing with a mean velocity of 2 m/s and at a gauge pressure of 350 kN/m^2. Determine the total head, if the pipe is 8 m above the datum line.

(4 Marks)

(c) Water flows through a galvanized iron pipe at 0.09 m^3/s. Determine the size of the pipe needed to transmit water a distance 200 m with a head loss 10 m. Given that kinematic viscosity of water is 1.14 x 10^{-5} m^2/s and average surface roughness for galvanized iron is 0.15 mm

(4 Marks)

Question 4

(a) State Bernoulli's principle and define each term. **(3 Marks)**

(b) A sluice gate is in the form of a circular arc of radius 6 m as shown in fig. Q4(b) below. Calculate the magnitude and direction of the resultant force on the gate and the location with respect to O of a point on its line of action. **(4 Marks)**

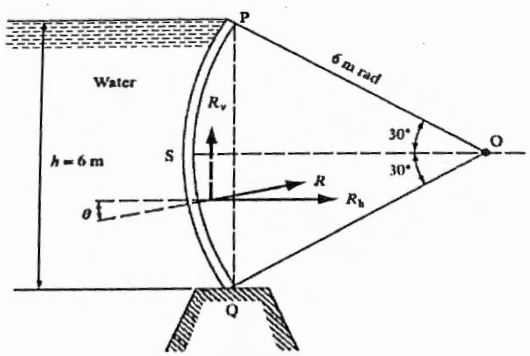

Fig. Q4(b)

(c) Water is flowing through a tapering pipe having diameters 300 mm and 150 mm at sections 1 and 2, respectively. The discharge through the pipe is 40 Litre/s. The Section 1 is 10 m above datum and Section 2 is 6 m above datum. Find the intensity of pressure at Section 2 if that of Section 1 is 400 kN/m^2. **(5 Marks)**

Question 5

(a) State conservation laws as applied to flowing fluid. **(3 Marks)**

(b) A jet of water from a fixed nozzle has a diameter of 5 cm and strikes a flat plate inclined to the jet direction. The velocity of the jet is 5 m/s and the surface of the plate may be assumed frictionless.

(i) Indicate in tabular form the reduction in the force normal to the plate surface as the inclination of the plate to the jet varies from 90^0 to 0^0.

(ii) Determine the force normal to the plate surface as the plate velocity changes to 3 m/s in the direction of the jet, given that the plate is itself at 45^0C to the approaching jet. **(5 Marks)**

(c) A Pitot tube is used to measure the flow rate of water at 20 ^{0}C in the centre of a pipe having an inside diameter of 102.3 mm. The manometer reading is 78 mm of carbon tetrachloride at 20^0 C. The Pitot tube coefficient is 0.98. Calculate the actual velocity at the centre of the tube and the flow rate. **(4 Marks)**

Question 6

(a) If C_d is coefficient of discharge, Qt_h is theoretical discharge and $Q_{act.}$ is actual discharge. Show that in a horizontal Venturi meter

$$Q_{act.} = C_d \times Q_{th.}$$

(4 Marks)

(b) A Venturi meter with a 0.15 m throat is placed on a water line that has an 0.20 m outer diameter. The coefficient of discharge is 0.97. The manometer measures a differential pressure of 0.13 m of mercury. What is the discharge? **(4 Marks)**

(c) A pipeline carrying oil (sp. gr. 0.8) change in diameter from 300 mm at position 1 to 600 mm diameter at position 2 which is 5 m at a higher level. If the pressures at position 1 and 2 are 100 kN/m^2 and 60 kN/m^2 respectively and the discharge is 300 Litre/s. Determine:

(i) Loss of head.

(ii) Direction of flow. **(4 Marks)**

Question 7

(a) State the equation for determining loss of head due to friction and define each term in the equation. **(3 Marks)**

(b) Water at 15^0 C flow through a 200 m long galvanized steel pipe of diameter 250 mm and at 0.225 m^3/s. Note that kinematic viscosity of water at 15^0 C is 1.14 x 10^{-5} m^2/s and average roughness for galvanized steel is 0.15 mm. Determine;

(i) Loss of head.

(ii) Pumping power required to maintain the above flow. **(5 Marks)**

(c) A vertical triangular gate with water on one side is shown in Fig. Q7 (c) below. Determine the total force acting on the gate and the location of the centre of pressure. **(4 Marks)**

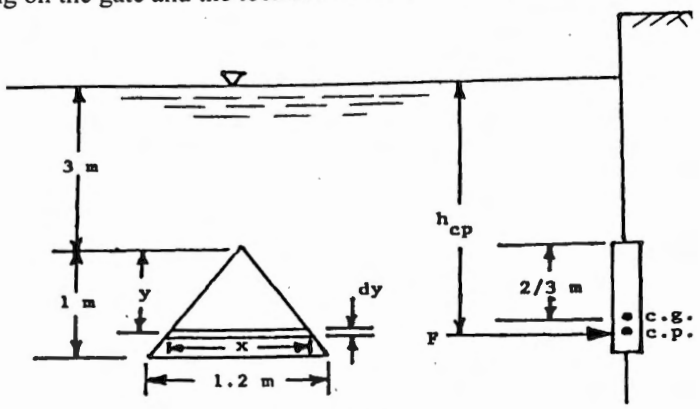

Fig. Q7(c)