ELIZADE UNIVERSITY, ILARA-MOKIN,
ONDO STATE, NIGERIA

DEPARTMENT OF MECHANICAL ENGINEERING

FIRST SEMESTER EXAMINATION
2020/2021 ACADEMIC SESSION

COURSE: MEE 307 – Fluid Mechanics 1 (2 Units)
CLASS: 300 Level Mechanical & Automotive Engineering
TIME ALLOWED: 2 Hours:15 Minutes
INSTRUCTIONS: Answer question 1 and any other three questions.
Date: March, 2021

HOD'S SIGNATURE

Question 1 [15 Marks]

a) Differentiate between the following:
(i) Steady and Unsteady Flows
(ii) Compressible and Incompressible Flows
(iii) Laminar and Turbulent Flows
(iv) Eulerian and Lagrangian methods of representing fluid flow
(v) Path line and Stream line.

b) State Continuity equation.
c) The diameter of a pipe at section 1 and 2 are 20 cm and 300 mm, respectively. If the velocity of water flowing through the pipe at section 1 is 4 m/s, find:
(i) Flow rate through the pipe.
(ii) Velocity of water at section 2.

Question 2 [15 Marks]

a) Differentiate between Vorticity and Circulation.
b) The velocity potential function ($\emptyset$) is given by $\emptyset = -\frac{xy^3}{3} - x^3 + \frac{x^3y}{3} + y^2$. Determine the velocity components in x and y directions.
c) In an incompressible flow, the velocity is given by: $V = (6xt + yz^2)i + (3t + xy^2)j + (xy - 2xyz - 6tz)k$. Verify whether the continuity equation is satisfied and determine the acceleration vector at point (2,2,2), at t = 2 sec.

Question 3 [15 Marks]

a) State Bernoulli's theorem and its mathematical expression.
b) State flow measurement equipment that applies Bernoulli's equation.
c) The water is flowing through a 6 m pipe long having diameters 100 mm and 200 mm at section 1 and 2, respectively and the rate of flow is 35 litres/sec. Section 1 is 4 m above datum and inclined at 20^0 with the horizontal. If the pressure at section 2 is 400 KN/m^2, find the intensity of pressure at section 1.

Question 4 [15 Marks]

a) The diameter of a horizontal pipe which is 300 mm is suddenly enlarged to 600 mm. The rate of flow of water through this pipe is 0.4 m^3/s. If the intensity of pressure in the smaller pipe is 125 kN/m^2. Calculate:
   i. Loss of head due to sudden enlargement
   ii. Intensity of pressure due to enlargement

b) In a pipe of 300 mm diameter and 800 mm long, oil is flowing at the rate of 0.45 m3/s. Find the head lost due to friction. Take the kinematic viscosity of oil as 0.3 stroke (1 stroke = $10^{-4}\ m^2/s$).

Question 5 [15 Marks]

a) Draw the sectional view of Venturimeter and Orifice-meter.
b) State one difference between a Venturimeter and Orifice meter.
c) A horizontal venturimeter with inlet diameter 200 mm and throat diameter 100 mm is employed to measure the flow of water. The reading of the differential manometer connected to the inlet is 180 mm of mercury. If the coefficient of discharge is 0.98, determine the rate of flow.

Question 6 [15 Marks]

a) Differentiate between a free vortex and forced vortex. Give two examples each.
b) State three uses of dimensional analysis.
c) A partially submerged body is towed in water. The resistance R, to its motion depends on the density ρ, the viscosity μ of water, length l of the body, velocity V of the body and acceleration due to gravity, g. Show that the resistance to motion can be expressed in the form:

$$R = \rho L^2 V^2 \emptyset\left[\left(\frac{\mu}{\rho LV}\right), \left(\frac{lg}{V^2}\right)\right]$$