UNIVERSITY OF PETROLEUM AND ENERGY STUDIES

End Semester Examination, December 2017

Program: **B. Tech. [(Mechanical Engineering), (ME) MSNT, (ME) MD, (ME) PRO, (ME) (THE)**]

Semester – III

Subject (Course): Fluid Mechanics — Max. Marks : 100

Course Code : GNEG223 — Duration : 3 Hrs

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SECTION A (4x5=20)

Q1. Answer following

a) Enlist the major losses and minors losses in a flow through the pipes.

b) Define the Reynold's Number and explain the criteria of laminar flow, transient flow, and turbulent flow.

c) Differentiate between the forced and free vortex flow

d) State and explain the Newton's law of viscosity.

SECTION B (4x 10=40)

Q2. The viscosity of a fluid is to be measured by a viscometer constructed of two 75-cm-long concentric cylinders as shown in Fig. 1. The outer diameter of the inner cylinder is 15 cm, and the gap between the two cylinders is 0.12 cm. The inner cylinder is rotated at 200 rpm, and the torque is measured to be 0.8 N m. Determine the viscosity of the fluid.

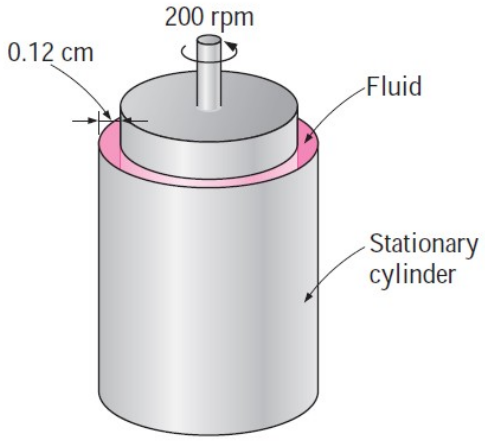

Fig. 1: Viscometer

Q3. Two reservoir are connected by a pipe 2250 m long and 0.225 in diameter, the difference in water level being 7.5 m. determine the flow through the pipe in liters per minute if f = 0.12. Also find the percentage increase in the discharge if for the last 600 m a second pipe of the same diameter is laid alongside the first.

Q4. Derive Euler's equation of motion is Cartesian coordinates.

Q5. The water is flowing through a tapering pipe having diameters 300 mm and 150mm at section 1 and 2 respectively. The discharge through the pipe is 40 lites/sec. the section 1 is 10m above the datum and section 2 is 6 m above the datum. Find the intensity of pressure at section 2 if that at section 1 is 400kN/m2.

OR

A horizontal venturimeter with inlet diameter 200mm and throat diameter 100mm is used to measure the flow of water. The pressure at inlet is 0.18 N/mm^2 and the vacuum pressure at the throat is 280 mm of mercury. Find the rate flow. The value of Cd may be taken as 0.98.

SECTION C (2x20=40)

Q6. (a) An open tank 6m long, 2.4 m deep and 3.6 m wide contains oil of specific gravity 0.85 to a depth of 1.2 m, if the tank is accelerated along its length on a horizontal track at a constant acceleration 3.2 m/s^2.Determine:

a. The new position of the oil surface
b. Pressure at the bottom of the tank at the front and rear edges

(b). Compute the horizontal and vertical components of the hydrostatic force on the quartercircle panel at the bottom of the water tank in Fig. 2.

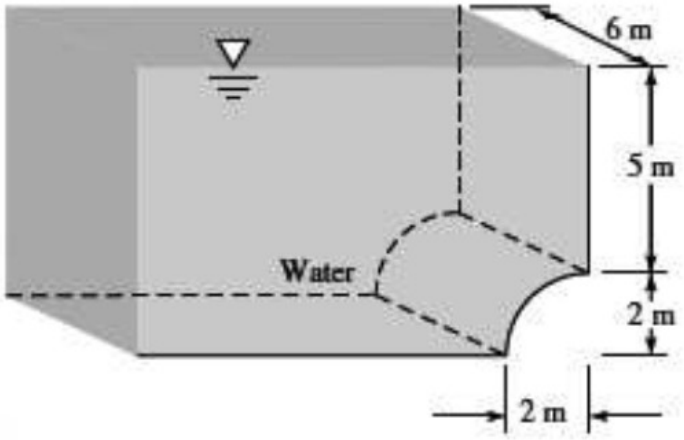

Figure 2: Hydrostatic force at the bottom of water tank

Q7. (a) Derive Hagen Poiseuille equation for the viscous flow. Also give the assumption for the same

(b) The velocity components in a two-dimensional flow are

$$u = y^3/3 + 2x - x^2y \text{ and } v = xy^2 - 2y - x^3/3$$

Show that these components represent a possible case of an irrotational flow.

OR

(a). Derive Darcy Weisbach equation for the pipe friction losses.

(b). A rectangular plate, weighing 60 N is suspended vertically by a hinge on the top horizontal edge. The Centre of gravity of the plate is 100mm from the hinge. A horizontal jet of water 20mm diameter, whose axis is 150mm below the hinge impinges normally on the plate with a velocity of 5m/s. determine;

I. The horizontal force applied at the Centre of gravity to maintain the plate in its vertical portion.
II. The corresponding velocity of the jet, if the plate is deflected through 300 and the same force continues to act at the Centre of gravity of the plate.