Question Paper

Exam Date & Time: 16-Nov-2018 (02:00 PM - 05:00 PM)

MANIPAL ACADEMY OF HIGHER EDUCATION

INTERNATIONAL CENTRE FOR APPLIED SCIENCES
THIRD SEMESTER B.SC. Applied Sciences in Engg.
END - SEMESTER THEORY EXAMINATIONS NOVEMBER - 2018
FLUID MECHANICS [ICE 232 - S2]

Marks: 100 **Duration: 180 mins.**

Answer 5 out of 8 questions.

1) A) Define the terms: (i) Vapour Pressure (ii) Surface Tension (iii) Ideal Fluid (iv) Newtonian Fluid. (4)

B) Derive the expression for pressure difference between inside & outside of, Liquid Jets and Liquid Bubbles. (8)

C) The length of a tainter gate (Fig. 1) is 1m perpendicular to the plane of the paper. Find out the horizontal force and the total hydrostatic force on the gate. (8)

2) Derive the expressions for the rotation components for a 3D flow (8)

A)

B) A conical tube is fixed vertically with its larger diameter at the top and it forms a part of the pipe line carrying kerosene (Sp. Gr. 0.80). The velocity at the smaller end is 3.0 m/s, and at the larger end is 1.5 m/s. The tube is 2.0 m long. At the bottom of the tube the pressure is 50 kPa. The head loss in the tube is assumed to be 0.35 times the difference in the velocity heads at its two ends. Estimate the pressure at the top of the tube when the flow is upwards. How will the pressure change if the flow is downwards? (8)

C) Define the terms: (i) Pipe flow; (ii) Laminar flow; (iii) Turbulent flow; (iv) Transitional flow (4)

3) A) A closed tank contains water to a depth of 2m, oil (0.8) over it to a depth of 1m and air at the top to a depth of 0.7m. If the vacuum gauge at the top of tank reads 7.6 cm of mercury (-ve pressure). Find the pressure at (i) the interface of oil and water and at (ii) the pressure at the bottom of the tank. Express the pressures in kPa both in gauge units and absolute units. (6)

B) In a two dimensional incompressible flow, the fluid velocity components are given by $u = x - 4y$ and $v = - y - 4x$. Show that the velocity potential exists and determine its form. Find also the stream function. (8)

C) Distinguish between: (i) Absolute Pressure and Gauge Pressure (ii) Simple Manometer and Compound Manometer (iii) Open channel flow and pipe flow (6)

4) A) Three pipes of diameters 400mm, 200mm, 300mm and lengths of 400m, 200m, 300m respectively are connected in series to make a compound pipe. The ends of this compound pipe are connected with two tanks whose difference of water levels is 16m. If co-efficient of friction for these pipes is same and equal to 0.02, determine the error in discharge computation if (6)

minor losses are neglected.

B) Derive from first principle Euler's equation of motion along a stream line and obtain Bernoulli's theorem from the same. Mention clearly the assumptions made. (8)

C) Show that in a static fluid, pressure remains constant along a horizontal plane and varies only in the vertical plane. (6)

5) A) A channel of trapezoidal section, having side slope 2H: 1V is to carry a flow of 20 m^3/sec on a longitudinal slope of 1 in 3000. Take Manning's n equal to 0.02. Find the dimensions of the most economical section of the channel. (6)

B) Two reservoirs whose surface levels differ by 30 metres are connected by a pipe of 600 mm diameter and 3000 m long. The pipe line crosses a ridge whose summit is 9 m above the water level and 300 m distant from the U/S reservoir. Find the maximum depth below the ridge at which the pipe must be laid if the absolute pressure head in the pipe is not to fall below 2.5 m of water. Calculate, also, the discharge. Take atmospheric pressure as 10.3 m of water and f as 0.03. Neglect minor losses. (6)

C) Head of water over a mouthpiece (diameter = 75 mm, length = 250mm) is 1.8m. Find the actual discharge, actual velocity and actual C/S area of jet at outlet of the mouthpiece. Take Cv = 0.98. (8)

6) A) A 30 cm x 15 cm venturimeter is provided in a vertical pipe line carrying oil of specific gravity 0.9, the flow being upwards. The difference in elevation of the throat section and entrance section of the venturimeter is 30 cm. The differential U-tube mercury manometer shows a gauge deflection of 25 cm. Calculate: (i) The discharge of oil; (ii) The pressure difference between the entrance section and the throat section. Take Cd as 0.98 and specific gravity of mercury as 13.6 (8)

B) Define specific energy and specific force as applied to open channel flow. Draw the specific energy and specific force diagram. (6)

C) A liquid (G = 0.9) of viscosity 9.74 poise is flowing through a 10 m long horizontal pipe 100 mm in diameter at the rate of 70 lps. Find the Power required to maintain the flow and sketch the distribution of velocity across the depth of the pipe giving value of maximum velocity and velocity values at 25 mm from pipe wall. Assume flow to be Laminar. (6)

7) A) Water is flowing in a long pipe and is suddenly stopped by closing valve at the discharge end. The diameter of the pipe is 150mm and thickness 6mm. The quantity of water flowing is 18 lps. Determine the pressure rise taking $E=2\times10^5 N/mm^2$ and $K = 2\times10^3 N/mm^2$. (6)

B) Derive the expression 'for Capillary rise of a liquid with a neat sketch showing all the terms involved in the expression. (6)

C) Determine most efficient dimensions for trapezoidal channel (side slope 1V: 2H) carrying a discharge of 12.5 m^3/s, with a velocity of 0.85 m/s. Also, determine the bed slope of the channel, shear stress at channel bed, Reynold's number and comment on the type of flow. Take n = 0.025 and viscosity coefficient 0.00981 Ns/m^2 (8)

8) A) Explain the following flow classification (i) Steady and Uniform Flows (ii) Rotational and Compressible Flows (iii) Subcritical and supercritical flow. (6)

B) The flow in a rectangular channel of flow area 0.27m^2 is measured using a 40cm long suppressed rectangular notch. If the depth of water on its U/S is 22.5 cm above the sill, find the discharge. If the same discharge is to be measured with a 90Â° V-notch, find its required depth and top width. Take Cd = 0.62 and consider velocity of approach for both the notches. (8)

C) Water flows through pipe A and B as shown in Fig.2. The pressure difference of these two points is to be measured by multiple tube manometers. Oil with specific gravity 0.88 is in the upper portion of inverted U-tube and mercury in the bottom of both bends. Determine the pressure difference. (6)

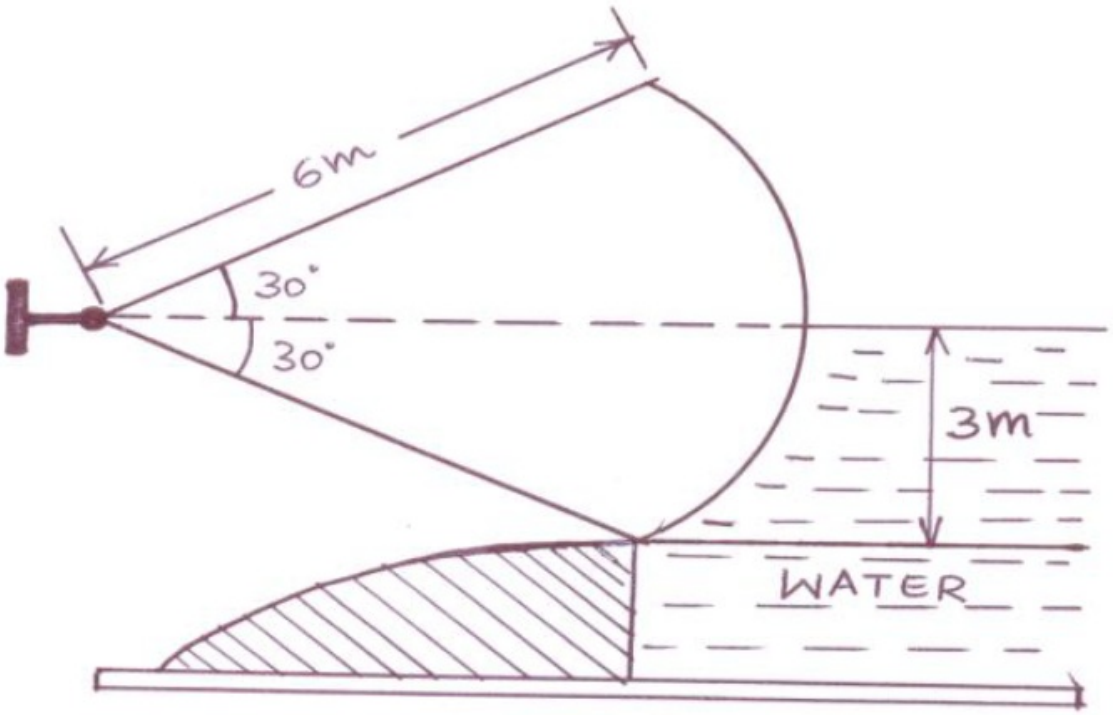

Fig.1

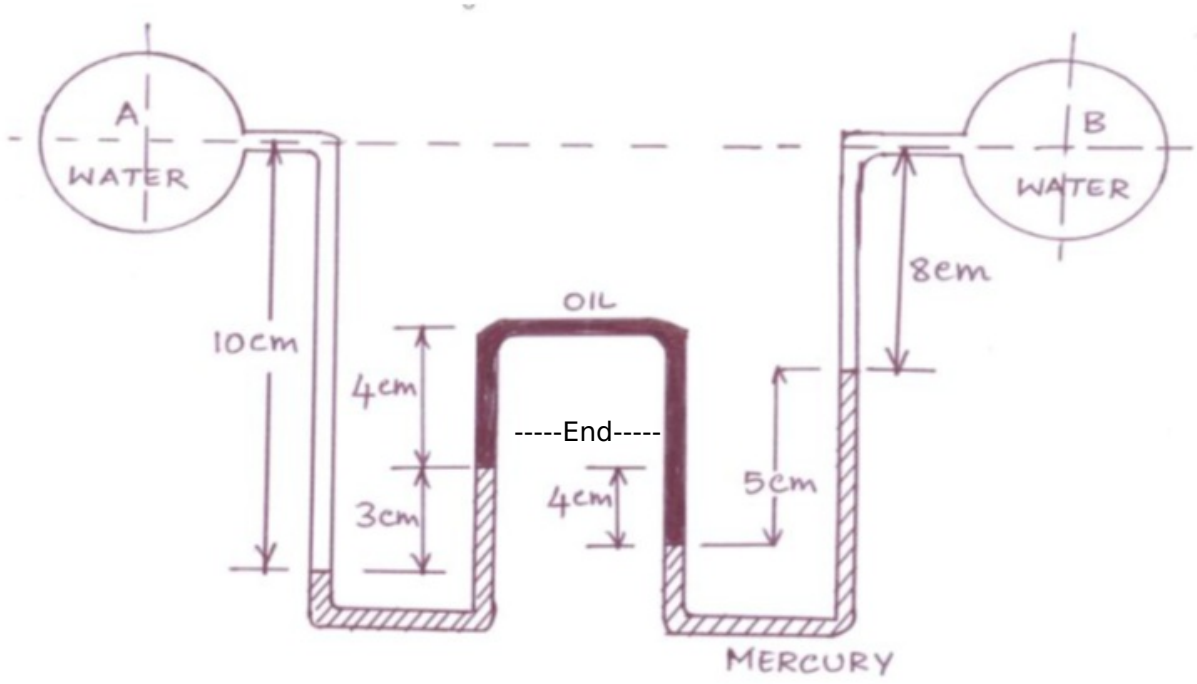

Fig.2

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