

Seat No.: _____

Enrolment No. _____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER-III (NEW) - EXAMINATION – SUMMER 2017

Subject Code: 2130602

Date: 05/06/2017

Subject Name: Fluid Mechanics

Time: 10:30 AM to 01:00 PM

Total Marks: 70

Instructions:

1. Attempt all questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.

- Q.1 Short Questions 14
- 1 What is a Newtonian fluid? [1]
 - 2 Distinguish clearly between an ideal fluid and real fluid. [1]
 - 3 Define dynamic viscosity of fluid. [1]
 - 4 Explain the capillary action of rise and fall of liquid columns. [1]
 - 5 Explain the term Buoyancy and Archimedes principle. [1]
 - 6 A spherical sea mine of diameter 0.9 m is weighing 2300 N. It is chained to the bottom of a harbor. What external force must the chain provide to keep the sea mine floating to the surface? Take mass density of sea water $\rho = 1025 \text{ kg/m}^3$. [1]
 - 7 Calculate the height of capillary rise of water in a glass tube of diameter 1 mm. The air-water surface tension at room temperature is 0.073 N/m. The contact angle for air-water-glass system is taken as 0° . [1]
 - 8 How is the atmospheric pressure measured? [1]
 - 9 What is the difference between gauge and absolute pressure? [1]
 - 10 Why mercury is preferred as an indicating liquid in a U tube manometer? [1]
 - 11 Distinguish between a laminar and turbulent flow. [1]
 - 12 How is the metacentric height calculated experimentally? [1]
 - 13 Write the working principle of a Pitot tube. [1]
 - 14 What do you understand by stagnation pressure? [1]
- Q.2
- (a) Explain with a neat sketch a U-tube differential manometer. When do we use an inverted U-tube manometer? [3]
 - (b) The underground oil storage tank as shown in Figure 1 has developed a leak such that water has entered the tank. The depth of oil is 2.0 m and water depth is 0.5 m. For the dimension given, determine the hydrostatic pressure at the (i) water –oil interface and (ii) at the base of the tank. Take specific gravity of oil = 0.87. [4]

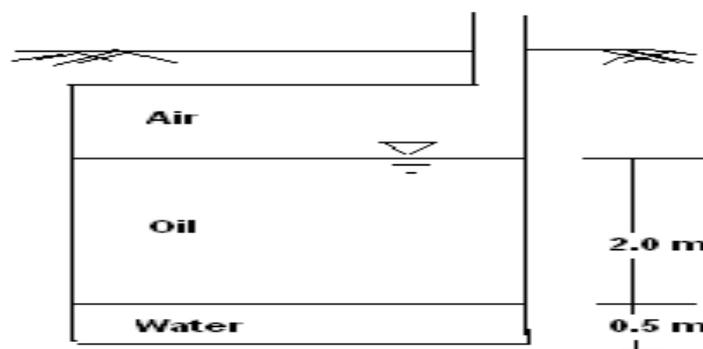


Figure 1

- (c) A circular annular area of 2.0 m outer diameter and 1.0 m inner diameter is immersed [7]

vertically in water with the centre of area at 3.5 m below the water surface. Find (i) the force exerted on one side of the area, and (ii) location of the centre of pressure.

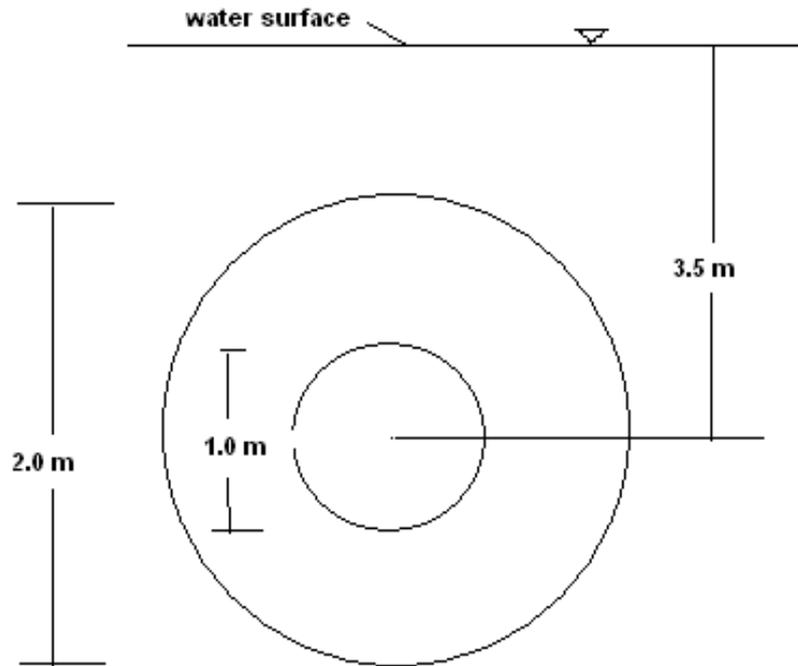


Figure 2: Annular Ring

OR

- (c) An open cylindrical tank of 0.9 m in diameter and 2 m high contains water up to 1.5 m depth. If the cylinder rotates about its vertical axis what maximum angular velocity can be attained without spilling any water? [7]

Q.3

- (a) Explain free and forced vortex with suitable examples. [3]
 (b) Explain the use of flow net for a two dimensional flow. [4]
 (c) Sketch the jet trajectory from a small circular orifice located on the side wall of a liquid container. Show the vena contracta. What do you understand by coefficient of contraction? Give typical values of C_c for small circular orifice. [7]

OR

Q.3

- (a) What is the difference between Euler equation and Bernoulli's equation? [3]
 (b) Explain the components of a venturimeter with a neat proportionate sketch. [4]
 (c) A pitot tube is inserted in a pipe of 30 cm diameter. The static pressure of the tube is 10 cm of mercury, vacuum. The stagnation pressure at the centre of the pipe recorded by the pitot tube is 1.1 N/cm^2 . Calculate the rate of flow of water through the pipe if mean velocity of flow is 0.85 times centre line velocity. Take coefficient of pitot tube = 0.98. [7]

Q.4

- (a) Verify whether the given stream function $\psi = y^2 - x^2$ represent irrotational flow. [3]
 (b) Write the Bernoulli's equation for ideal fluid and real fluid. Also list the applications where Bernoulli's equation is used. [4]
 (c) Estimate the discharge over a 90° triangular notch having head over crest as 45 cm. The coefficient of discharge $C_d = 0.62$. If the head over crest becomes 55 cm calculate the percentage increase in discharge. [7]

OR

Q.4

- (a) What is the difference between a mouthpiece and an orifice? [3]
 (b) Explain the terms Total drag, Frictional drag, pressure drag with suitable examples. [4]

- (c) A car has frontal projected area of 1.5 m^2 and travels at 55 km/h . Calculate the power required to overcome wind resistance if coefficient of drag is 0.35 . If the drag coefficient is reduced by streamlining to 0.25 what speed of the car is possible? Take $\rho_{\text{air}} = 1.2 \text{ kg/m}^3$ [7]

Q.5

- (a) Distinguish between subsonic and supersonic flow. [3]
(b) Explain with neat sketches the Convergent-Divergent mouthpiece and the Borda's mouthpiece [4]
(c) Define Mach number. A supersonic plane in its flight has a Mach angle of 40° and is flying in air with -20°C . Calculate the speed of plane. Assume $k = 1.4$ and $R = 287 \text{ J/Kg.K}$ [7]

OR

Q.5

- (a) Calculate the discharge for flow passing through a trapezoidal notch having base width of 0.75 m and side slope of $1:1$. Take the head over crest of notch = 50 cm . The coefficient of discharge $C_d = 0.63$. [3]
(b) Explain with neat sketches the contracted rectangular notch and Cippoletti notch. [4]
(c) Derive the equation for time (T) required to empty a rectangular tank filled with liquid. [7]
The tank has an orifice at its bottom. The initial depth of water in the tank is H_1 .