

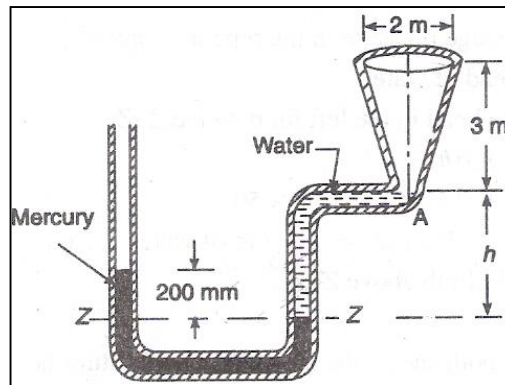
GUJARAT TECHNOLOGICAL UNIVERSITY**BE- SEMESTER-III (NEW) EXAMINATION – WINTER 2020****Subject Code:3134005****Date:05/03/2021****Subject Name:Fluid Mechanics and Hydraulics****Time:10:30 AM TO 12:30 PM****Total Marks:56****Instructions:**

1. Attempt any FOUR questions out of EIGHT questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.

- Q.1**
- (a) What is Euler's equation of motion? Obtain Bernoulli's equation from it. **03**
- (b) Describe Reynolds experiment to demonstrate the laminar, transition and turbulent flow. **04**
- (c) Derive an expression for the difference of pressure between two points in a free vortex flow. Does the difference of pressure satisfy the Bernoulli's equation? Can Bernoulli's equation be applied to a forced vortex flow? **07**
- Q.2**
- (a) Calculate the specific weight, density and specific gravity of two liters of a liquid which weight 15 N. **03**
- (b) Explain the following: **04**
Surface tension, vapour pressure, compressibility and capillarity.
- (c) Explain the principle of orificemeter with a neat sketch and derive the expression for the rate of fluid flow through it. **07**
- Q.3**
- (a) Derive equation for conservation of mass and momentum using Reynolds Transport Theorem. **03**
- (b) A vertical wall is of 7 m in height. A jet of water is coming out from a nozzle with a velocity of 18 m/s. The nozzle is situated at a distance of 18 m from the vertical wall. Find the angle of projection of the nozzle to the horizontal so that the jet of water just clears the top of the wall. **04**
- (c) The force exerted by a flowing fluid on a stationary body depends upon the length of the body, velocity of the fluid, density of fluid, viscosity of the fluid and acceleration due to gravity. Find an expression for the force using dimensional analysis. **07**
- Q.4**
- (a) Draw the velocity distributions for laminar and turbulent flow through pipe and also plot laminar boundary layer for flow over flat plate. **03**
- (b) A horizontal venturimeter with inlet diameter 20 cm and throat diameter 10 cm is used to measure the flow of water. The pressure at inlet is 176 kPa and the vacuum pressure at the throat is 30 cm of mercury. Find the discharge of water through the venturimeter. Consider three percent of the differential head is lost between the gauges. **04**
- (c) Derive an expression for head loss in a sudden expansion in the pipe. List all the assumption made in derivation. **07**
- Q.5**
- (a) Prove that the stream lines and equipotential lines are perpendicular to each other. **03**
- (b) For a two-dimensional flow stream function is given by $\psi = 2xy$, calculate the velocity at the point J (4, 6). Also find the velocity potential function. **04**

- (c) Derive an expression for the force exerted on a sub-merged inclined plane surface by the static liquid and locate the position of center of pressure. **07**

- Q.6** (a) State and prove the Pascal law. **03**
 (b) Figure shows a conical vessel having its outlet at A to which a U-tube manometer is connected. The reading of the manometer given in figure shows when the vessel is empty. Find the reading of the manometer when the vessel is completely filled with water. **04**



- (c) In a two-dimensional, incompressible flow the fluid velocity components are given by: $u = 2x - x^2y + y^3/3$ and $v = xy^2 - 2y - x^3/3$. Show that the flow satisfies the continuity equation and obtain the expression for the stream function. If the flow is potential (irrotational) obtain also the expression for the velocity potential function. **07**

- Q.7** (a) What is cavitation? How can it be avoided in reaction turbine? **03**
 (b) The difference in water surface levels in two tanks, which are connected by three pipes in series of lengths 300 m, 170 m and 210 m and of diameters 300 mm, 200 mm, and 400 mm respectively, is 12 m. Determine the discharge of water if co-efficient of friction are 0.005, 0.0052 and 0.0048 respectively, considering (i) Minor losses and (ii) Neglecting minor losses. **04**
 (c) Explain hydraulic jump. Derive an expression for the depth of hydraulic jump in terms of the upstream Froude number. **07**

- Q.8** (a) Draw specific energy curve and explain its need. **03**
 (b) For open channel flow, differentiate between: (i) Uniform and non-uniform flow; (ii) Laminar and Turbulent flow; (iii) Rapidly varied and gradual varied flow; and (iv) Sub-critical and super-critical flow. **04**
 (c) Draw neat sketch of a centrifugal pump and explain its working principle in detail. **07**
