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Q.2

Q.3

# **GUJARAT TECHNOLOGICAL UNIVERSITY BE - SEMESTER-IV (New) EXAMINATION - WINTER 2015**

## Subject Code:2141906 Sub Tin Inst

## Date:06/01/2016

| oject Name: Fluid Mechanics |  |  |                 |  |
|-----------------------------|--|--|-----------------|--|
| ne: 2                       | 2:30pm to 5:00pm   | <b>Total Marks: 7</b>  | Total Marks: 70 |  |
| ructio<br>1.<br>2.<br>3.    | <ul> <li>Attempt all questions.</li> <li>Make suitable assumptions wherever no Figures to the right indicate full marks.</li> </ul>  | ecessary.  |                 |  |
| (a)<br>(b)                  | Derive the continuity equation in Cartesian co-ordinates.<br>Define or explain following terms   |  | 07<br>07        |  |
|                             | <ol> <li>Capillarity</li> <li>Hydraulic radius</li> </ol>  | <ol> <li>5. Water hammer</li> <li>6. Summit</li> <li>7. Derived units</li> </ol>   |                 |  |
| (a)                         | Derive the expression for time required to emptying a tank through an orifice at its bottom.   |  | 07              |  |
| (b)                         | A block of wood has a horizontal cross section 500 mm X 500 mm and height h. it floats vertically in water. If the specific gravity of wood is 0.6, find the maximum height of block so that it can remain in stable equilibrium.  |  | 07              |  |
| (b)                         | <b>OR</b><br>A barge in the shape of a rectangular block 8 m wide, 12.8 m long and 3 m deep<br>floats in water with a draft of 1.8 m. the centre of gravity of the barge is 0.3 m<br>above the water surface. State whether the barge is in stable equilibrium.<br>Calculate the righting moment when the barge heels by 10° |  | 07              |  |
| (a)<br>(b)                  | Derive an expression for loss of head de<br>A pipe of diameter 225 m is attached to<br>line by means of a flange. Water flows<br>at transition as indicated by different<br>manometer connected between two pip  | te to friction in pipe flow.<br>to a 150 mm diameter pipe in a straight<br>at the rate of 0.05 m <sup>3</sup> /s. the pressure loss<br>tial gauge length on a water-mercury<br>bes equals 35 mm. calculate the loss of | 07<br>07        |  |

#### OR

- (a) Derive the relation among different energies using Bernoulli's theorem. Q.3 07
  - (b) A supersonic aircraft flies at an altitude of 1.8 km where temperature is 40 C. 07 determine the speed of the aircraft if its sound is heard 4 seconds after its passage over the head of an observer. Take R = 287 J/kg K and  $\gamma = 1.4$ .

#### **Q.4** (a) Define boundary layer thickness and also explain following terms.

- 1. Displacement thickness ( $\delta^*$ )
- 2. Momentum thickness  $(\theta)$
- 3. Energy thickness ( $\delta_e$ )

head due to contraction.

A 150 mm diameter vertical cylinder rotates concentrically inside cylinder of 05 **(b)** diameter 151 mm. both the cylinders are 250 mm high. The space between the cylinders is filled with a liquid whose viscosity is unknown. If a torque of 12

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Nm is required to rotate the inner cylinder at 100 rpm, determine the viscosity of the liquid.

#### OR

- Q.4 (a) Enlist the various Mechanical gauges for pressure measurement and describe 09 their working with suitable diagram.
  - (b) Velocity for a two dimensional flow field is given by  $V = (3 + 2xy + 4t^2)i + (xy^2 + 3t)j$

Find the velocity and acceleration at appoint (1,2) after 2 sec.

- Q.5 (a) State the Karman-Prandtl equation for the velocity distribution near hydro 07 dynamically smooth boundaries.
  - (b) Using the method of dimensional analysis obtain an expression for the 07 discharge Q over a rectangular weir. The discharge depends on the head H over the weir, acceleration due to gravity g, length of the weir crest over the channel bottom Z and the kinematic viscosity v of the liquid.

### OR

- **Q.5** (a) Derive the Euler's equation for motion.
  - (b) A crude oil of viscosity 0.9 poise and relative density 0.9 is flowing through a horizontal circular pipe of diameter 120 mm and length 12 m. calculate the difference of pressure at the two ends of the pipe, if 785 N of the oil is collected in tank in 25 seconds.

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