Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER-V- EXAMINATION – SUMMER 2016

Subject Code: 152003

Subject Name: Fluid Mechanics & Machines

Time: 02:30 PM to 05:00 PM

Instructions:

- 1. Attempt all questions.
- 2. Make suitable assumptions wherever necessary.
- 3. Figures to the right indicate full marks.
- Q.1 (a) What are the causes of viscosity, (i) in gases, and (ii) in liquids? Explain effect of 07 temperature on viscosity of gases and liquids.
 - (b) (i) Sate and prove hydrostatic law.
 (ii) The left and right limbs of a capillary tube are 1.25 mm and 2.5 mm in diameter. The tube contain a liquid of surface tension 0.05 N/m. Assuming contact angle to be zero, find the specific weight and mass density of the liquid, if the difference in the liquid levels in the two limbs is 10 mm.
- Q.2 (a) Show that the centre of pressure on any plane surface immersed in liquid is always 07 below its centroid.
 - (b) A rectangular box of 7.5 m \times 4 m \times 5 m deep and having a mass of 50 tones is **07** immerged in fresh water (density 1000 kg/m³). Calculate depth of immersion of the block. What additional mass should be placed inside the box so that the box rests on the bottom of water which is 5 m deep, i.e. top surface of the box coincides with the free surface of water ?

OR

- (b) Explain with neat sketches the stability conditions for submerged and floating 07 bodies.
- Q.3 (a) Derive an expression of continuity for a three dimensional flow and reduce it for 07 steady, incompressible two dimensional flow.
 - (b) The stream function for a two dimensional flow is given by $\psi = 2xy + 25$, calculate 07 the velocity at the point A(1, 2). Find the velocity potential function ϕ .

OR

- Q.3 (a) Define the following terms:
 (i) Pathline, (ii) Streamline, (iii) Streakline, and (iv) Stream tube.
 What types of flow has streamline, pathline, and streakline identical?
 - (b) What are the forces considered in Euler's equation of motion? Derive Bernoulli's 07 equation from Euler's equation of motion and state its practical applications.
- Q.4 (a) Derive the Hagen Poiseullie equation stating the assumptions made. Sketch 07 velocity and shear stress distribution in pipe flow.
 - (b) A pipe of 30 cm in diameter and 500 m long is carrying oil of sp. Gravity 0.9 and viscosity 0.08 poise. The oil flow rate is 120 litter per second. Calculate head loss in the pipe and power required to maintain the flow. Assume coefficient of friction $f = 0.079/(\text{Re})^{1/4}$.

07

Total Marks: 70

Date: 09/05/2016

- Q.4 (a) Calculate drag and lift forces on a plate 1.5 m wide and 2 m long placed 07 longitudinally in a stream of air (density = 1.2 kg/m²) flowing with a velocity 45 km/h. The coefficients of drag and lift are 0.2 and 0.8 respectively. Also, calculate the resultant force and its direction, and power exerted by air on the plate.
 - (b) Explain with neat sketches performance characteristic curves of centrifugal 07 pumps.
- Q.5 (a) Compare centrifugal pumps with reciprocating pumps 07
 - (b) Explain main components of Francis turbine with neat sketch. 07

OR

- Q.5 (a) A double acting reciprocating pump running at 50 rpm, delivering 40 liters per second has following specifications: Piston diameter = 300 mm, Piston rod diameter = 50 mm, Stroke = 400 mm, Suction head = 4 m, Delivery head = 8 m. Calculate: (1) slip, (2) force required to operate the pump during forward and reverse stroke of piston, (3) power required to drive the pump.
 - (b) Explain with neat sketch surging and stalling in compressors

07
