

Seat No.: _____

Enrolment No. _____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER-V (NEW) EXAMINATION – WINTER 2023

Subject Code:3152003

Date:13-12-2023

Subject Name:Fluid Mechanics & Machines

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.
4. Simple and non-programmable scientific calculators are allowed.

	Marks
Q.1 (a) State and explain Newton's law of viscosity.	03
(b) The capillary rise in the glass tube is not to exceed 0.5 mm of water. Determine its minimum size, given that surface tension for water in contact with air $\sigma = 0.0722 \text{ N/m}$ and contact angle $\theta = 25^\circ$.	04
(c) A body has the cylindrical upper portion of 4m diameter and 2.4m deep. The lower portion, which is curved, displaces a volume of 800 litres of water and its centre of buoyancy is situated 2.6m below the top of the cylinder. The centre of gravity of the whole body is 1.6m below the top of the cylinder and the total displacement of water is 52 kN. Find the metacentric height of the body.	07
Q.2 (a) State hydrostatic law.	03
(b) Define the following terms: 1) Weight density, 2) Dynamic viscosity, 3) Surface tension, 4) Cohesion.	04
(c) Explain force on a curved surface due to hydrostatic pressure. Derive an expression of resulting horizontal, vertical and resultant force on a curved surface immersed in a liquid.	07
OR	
(c) Explain method for determination of metacentric height.	07
Q.3 (a) Determine whether the following flows are rotational or ir-rotational (1) $u = -2y$, $v = 3x$. (2) $u = 0$, $v = 3xy$. (3) $u = 2x$, $v = -2y$.	03
(b) Define: - (i) path line (ii) Stream function (iii) Velocity potential function (iv) ir-rotational flow.	04
(c) Define and explain circulation. What is the importance of concept of circulation? Prove that circulation $\Gamma = \oint \xi \, dA$ with usual notations.	07
OR	
Q.3 (a) Explain Control volume and control surface.	03
(b) State and derive moment of momentum equation.	04
(c) State Bernoulli's theorem. Derive expression for Bernoulli's theorem for stream line flow. Also write assumption for the same.	07
Q.4 (a) List Major and Minor head losses in a pipe flow.	03
(b) Explain boundary layer theory.	04

- (c) Derive Darcy-Weisbach equation for the co-efficient of friction in pipes. 07

OR

- Q.4** (a) Explain following terms: Priming, slip factor, Pre-whirl. 03
(b) Discuss the ANY FOUR characteristic curves of a centrifugal pump. 04
(c) Derive expression for the minimum starting speed of the centrifugal pump. 07

- Q.5** (a) Write full classification of Reciprocating pump. 03
(b) What is an air vessel? Explain with a neat sketch the working of air vessels in a reciprocating pump. 04
(c) A pelton wheel is required to develop 1000 kW under a net head of 100 m at a speed of 400 rpm. 07

Assuming the following data: Co-efficient of velocity jet = 0.95, Speed ratio= 0.42, overall efficiency= 80 % , The jet diameter d to be 1/10 of the mean diameter of the wheel D.

Calculate:

- (i) The mean diameter of the wheel.
(ii) The diameter of the jet.
(iii) The number of jets required.

OR

- Q.5** (a) State advantages and disadvantages of Francis turbine over Pelton turbine. 03
(b) What are the ill effects of cavitation in turbine? Give causes and remedies to avoid cavitation in a hydraulic turbine. 04
(c) State the functions of a draft tube and Explain with neat sketches different types of draft tubes. 07
