Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–V • EXAMINATION – SUMMER • 2014

Subject Code: 152003 **Date: 19-06-2014**

Subject Name: Fluid Mechanics and Machines

Time: 10.30 am - 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 **(a)** Define following fluid properties and give their units. **07**

(i) Viscosity (ii) Capillarity (iii) Surface tension
(iv) Bulk modulus of elasticity (v) Specific volume
(vi) Specific Weight (vii) Compressibility

(b) (i) State and prove the hydrostatic law. **04**

(ii)The space between two square flat parallel plates is filled with oil. Each side of the plate is 720 mm. The thickness of the oil film is 15 mm.The upper plate, which moves at 3m/s requires a force of 120N to maintain the speed. Determine:- **03**

(i) The dynamic viscosity of the oil
(ii) The kinematic viscosity of oil if the specific gravity of oil is 0.95.

Q.2 **(a)** State and derive Bernoulli's theorem, state its application and assumptions made. **07**

(b) Draw Venturi meter and manometer arrangement, apply the steady flow energy equation and derive an expression for the actual flow rate of an incompressible fluid. **07**

OR

(b) 1m wide and 1.5m deep rectangular plane surface lies in water in such a way that its plane makes an angle of 30^0 with free water surface. Determine the total pressure and position of centre of pressure when the upper edge is 0.75m below the free water surface. **07**

Q.3 **(a)** Differentiate between, **07**

(i) Rotational and Irrotational flow.
(ii) Velocity potential function and stream function
(iii) Steady flow and unsteady flow

(b) Given that $u=-4ax(x^2-3y^2)$, $v=4ay(3x^2-y^2)$ **07**

Examine whether these velocity components represent a physically 2-dimensional flow, if so the flow is rotational or irrotational?

OR

Q.3 **(a)** (1) Derive an expression for head loss when the flow is passing through Sudden contraction of pipe **04**

(2) What do you understand by laminar flow and turbulent flow? **03**

(b) Two reservoirs are connected by a pipeline consisting of two pipes, one of 150mm diameter and length 6m and the other of diameter 225mm and 16m length. If the difference of water levels in the two reservoirs is 6m, calculate the discharge and draw the energy gradient line. Take friction co-efficient f = 0.04. **07**

Q.4	**(a)**	(1) State advantages and disadvantages of a Francis turbine over a Pelton wheel. (2) Draw and state function of guide vane in Francis turbine.	**07**
	(b)	A Pelton wheel is to be designed for the following specification: Power =9560kw, Head=350m, Speed=750 rpm Overall efficiency=85%, Jet ratio=6 Determine (i) The wheel diameter , (ii) Diameter of jet, (iii) The no of jets required. Take c_v=0.985 & Speed Ratio k_u=0.45.	**07**

OR

Q.4	**(a)**	What is draft tube? Why is it used in reaction turbine? Describe with sketch different types of draft tubes.	**07**
	(b)	(1) Give differences between Francis turbine and Kaplan turbine. (2) Define specific speed for turbine and state its usefulness.	**04** **03**
Q.5	**(a)**	(1) What is the effect of variation of discharge on the pump efficiency? (2) Compare multistage pumps in series with pumps in parallel.	**04** **03**
	(b)	The impeller of a centrifugal pump has an external diameter of 450 mm and internal diameter of 250 mm and it runs at 1440 rpm. Assuming a constant flow velocity through the impeller at 2.5m/s, and that the vanes at exit are setback at an angle of 25^0. Determine, (1) Inlet vane angle (2) The angle, absolute velocity of water makes with the tangent at exit and (3) The work done per unit weight of water.	**07**

OR

Q.5	**(a)**	(1) Explain the principle and working of a reciprocating pump. (2) What is the function of Air vessels in reciprocating pump?	**07**
	(b)	What is boundary layer separation? State factors affecting the boundary layer separation. Explain methods adopted to arrest boundary layer separation.	**07**

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