Seat No.: _____　　　　　　　　　　　　　　Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY
BE - SEMESTER–V • EXAMINATION – WINTER • 2014

Subject Code: 152003　　　　　　　　　　　　**Date: 03-12-2014**
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)**	(i) State the minimum diameter of glass tube to be immersed in water, for which capillary effects are to be limited up to 2.98 mm. Take surface tension of water in contact with air as 0.073 N/m.	**04**
		(ii) What is compressibility? Derive an expression for it?	**03**
	(b)	(i) State and prove Pascal's law.	**04**
		(ii) What is the difference between dynamic viscosity and kinematic viscosity? State their units.	**03**
Q.2	**(a)**	Define buoyant force, center of buoyancy, metacenter and metacentric height. Also describe conditions of equilibrium for floating and submerged bodies.	**07**
	(b)	A rectangular plate 3 m × 5 m is immersed vertically in water such that the 3 m side is parallel to the water surface. Determine the hydrostatic force and the center of pressure if the top edge of the surface is	**07**

1. Flush with the water surface.
2. 2 m below the water surface.

Comment in result.

OR

	(b)	(i) A pontoon has displacement of 20 MN whilst floating in sea water. When a load of 0.25 MN is moved through a distance of 8 m across the deck, there occurs a horizontal displacement of 0.15 cm in a pendulum 3 m long. Compute the metacentric height of the pontoon.	**04**
		(ii) State Bernoulli's theorem.	**03**
Q.3	**(a)**	A stationary bearing of length 30 cm and internal radius 8.025 cm has been used to provide lateral stability to 8 cm radius shaft rotating at constant speed of 200 revolutions per minute. The pace between the shaft and bearing is filled with a lubricant having viscosity 2.5 poise. Find the torque required to overcome the friction in bearing. Take velocity profile as linear	**07**
	(b)	(i) Derive equations for total force and center of pressure for a vertical plane surface immersed in a static liquid.	**04**
		(ii) Differentiate between:	**03**
		Compressible flow and Incompressible flow	

OR

Q.3	**(a)**	Derive Darcy-Weisbach equation for the loss of head due to friction in pipes.	**07**
	(b)	(i) Obtain an expression for capillary rise of liquid?	**07**
		(ii) Describe vertical single column manometer? How will you measure the Fluid pressure with it?	
Q.4	**(a)**	Explain following terms: Net positive suction head, Priming, Cavitation in pump	**07**

(b) A three throw pump has cylinders of 25 cm diameter and stroke of 50 cm each. The pump is required to deliver 100 liters/sec at head of 100 m. friction losses are to be estimated to be 1 m in suction pipe and 19 m in delivery pipe. Velocity of water in the delivery pipe is 1 m/sec, overall pump efficiency is 85% and the slip is 3%. Determine the speed of pump and the power required to run it. **07**

OR

Q.4 **(a)** Explain how hydraulic turbines are classified. **07**

(b) A diffusion type centrifugal pump has a suction lift of 1.5 m and delivery tank is 13.5 m above the pump. The velocity of water in the delivery pipe is 1.5 m/sec. The radial velocity of flow through the wheel is 3 m/sec and the tangent to the vane at exit from the wheel makes and angle of 120^0 with the direction of motion. Assuming that the water enters radially and neglecting friction and other losses, find **07**
(i)   velocity of wheel at exit,
(ii)   velocity and pressure head at exit from the wheel, and
(iii)   Desirable direction of fixed guide vanes.

Q.5 **(a)** State function of draft tube and explain with neat sketch different types of draft tubes. **07**

(b) How the slow, medium and fast runners of a Francis turbine are specified? **07**
A reaction turbine works at450 rpm under head of 120 meters. Its diameters at inlet are 120 cm and the flow area is 0.4 m^2 .the angle made by the absolute and relative velocities at inlet are 20° and $60°$respectively with tangential velocity. Determine
   (i) The volume flow rate
   (ii) Hydraulic power
   (iii)Hydraulic efficiency
Assume whirl at outlet to be zero

OR

Q.5 **(a)** Discuss the various characteristic curves of a centrifugal pump. **07**
(b) (i)Compare Reciprocating pump with Centrifugal pump. **03**
(ii)Draw theoretical indicator diagram of reciprocating pump and explain Function of air vessel. **04**

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