Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE – SEMESTER V • EXAMINATION – WINTER - 2012

Subject code: 152003 Date: 17-01-2013

Subject Name: Fluid Mechanics & Machines

Time: 02:30 pm to 05:00 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 and explain the following terms. **08**

i) Viscosity ii) Cavitation iii) Surface tension iv) Capillarity

(b) Differentiate between the followings. **06**

i) Liquids and gases

ii) Impulse turbine and reaction turbine

Q.2 **(a)** State and prove the Pascal's law. **07**

(b) In a two dimensional incompressible flow, the fluid velocity components are given by **07**

$$u = x-4y \text{ and } v = -y-4x$$

Show that velocity potential exists and determine its form. Find also the stream function.

OR

(b) A circular plate 3m diameter, having a concentric circular hole of diameter 1.5 is immersed in water in such a way that its greatest and least depth below the free surface are 4m and 1.5m respectively. Determine the total pressure on one face of the plate and position of the centre of pressure. **07**

Q.3 **(a)** Explain the principle of orifice meter with neat sketch. Derive an expression for the discharge through orifice meter with usual notations. **07**

(b) A pipeline carrying oil of specific gravity 0.87, changes in diameter from 200mm diameter at position A to 500mm diameter at a position B which is 4 metres at a higher level. If the pressures at A and B are 9.81 N/cm^2 and 5.886 N/cm^2 respectively and the discharge is 200 litres/s. Determine the loss of head and direction of flow. **07**

OR

Q.3 **(a)** What do you understand by the characteristics curves of a pump? What is the significance of the characteristics curves? **07**

(b) Derive an expression for the continuity equation for a three dimensional flow using the control volume approach. **07**

Q.4 **(a)** What do you mean by boundary layer separation? What is the effect of pressure gradient on boundary layer separation? **07**

(b) A plate of 600mm length and 400mm wide is immersed in a fluid of sp.gr. 0.9 and kinematic viscosity 10^{-4} m^2/s. The fluid is moving with a velocity of 6 m/s. Determine **07**

i) boundary layer thickness

ii) shear stress at the end of the plate

iii) drag force on one side of the plate.

OR

Q.4 **(a)** What is draft tube? Why is it used in reaction turbine? Describe with sketch two different types of draft tubes. **07**

(b) A Pelton turbine develops 3000 kW power under a head of 300 m. The overall efficiency of the turbine is 83%. If speed ratio =0.46, Cv=0.98 and specific speed is 16.5, then find i) Diameter of the turbine and ii) Diameter of the jet. **07**

Q.5 **(a)** What are coefficients of drag and lift? Show that these are dependent on Reynolds number and characteristic area of a body immersed in a fluid. **07**

(b) A horizontal pipe line 40 m long is connected to a water tank at one end and discharges freely into the atmosphere at the other end. For the first 25 m of its length from the tank, the pipe is 150 mm diameter and its diameter is suddenly enlarged to 300 mm. The height of water level in the tank is 8 m above the centre of the pipe. Considering all losses of head which occur, determine the rate of flow. Take $f = 0.01$ for both sections of the pipe. **07**

OR

Q.5 **(a)** Obtain an expression for the minimum speed for starting a centrifugal pump. **07**

(b) The cylinder bore diameter of a single acting reciprocating pump is 150 mm and its stroke is 300 mm. The pump runs at 50 r.p.m. and lifts water through a height of 25m. The delivery pipe is 22 m long and 100 mm in diameter. Find the theoretical discharge and the theoretical power required to run the pump. If the actual discharge is 4.2 litres/s, find the percentage slip. Also determine the acceleration head at the beginning and middle of the delivery stroke. **07**

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