Student Exam No._____

GANPAT UNIVERSITY

B. Tech. Semester: IV (Mechatronics) Engineering

CBCS Regular Examination April - June 2015

2MC405 FLUID MECHANICS AND MACHINES

Time: 3 Hours **Total Marks:** 70

Instructions:

1. Assume suitable data if necessary.
2. Write your answer to the point and precisely.
3. Draw neat and clean sketch.
4. Use of calculator is permitted.

SECTION - I

Que. 1 **(A)** Due to which property rain drops are spherical? Explain that property with neat sketch. **[04]**

(B) Define: (1) Specific weight (2) Capillarity (3) Vapor pressure (4) Kinematic viscosity **[04]**

(C) If the velocity distribution of a fluid over a plate is given by $u = 3/4y - y^2$, where u is the velocity in meter per second at a distance of y meters above the plate. Determine the shear stress at y=0.15 meter. Take dynamic viscosity of the fluid as 8.5×10^{-5} kg sec/m^2 **[03]**

OR

Que. 1 **(A)** Explain the condition of equilibrium for floating body. **[03]**

(B) Differentiate between (i) Liquid and gases (ii) Ideal fluid and Real fluid. **[04]**

(C) Define: (i) Buoyancy (ii) Centre of Buoyancy (iii) Metacentre (iv) Metacentric height. **[04]**

Que. 2 **(A)** Write a short note about the device which is used to measure the difference of pressure between two pipes. **[04]**

(B) Prove that the intensity of pressure at any point in a static liquid is remains same in all directions. **[04]**

(C) A 25 cm diameter pipe carries oil of sp. Gr. 0.9 at a velocity of 3 m/s. At another section the diameter is 20 cm. Find the velocity at this section and also mass rate of flow of oil. **[04]**

OR

Que. 2 **(A)** Explain the different types of flow of a fluid. **[04]**

(B) A 40 cm diameter pipe, conveying water; branches two pipes of diameters 30 cm and 20 cm respectively. If the average velocity in the 40 cm diameter pipe is 3 m/s. Find the Discharge in this pipe. Also determine the velocity in 20 cm pipe if the average velocity in 30 cm diameter pipe is 2 m/s. **[04]**

(C) Prove that the summation of pressure head, velocity head and potential head for the fluid flowing through the section of pipe is remains constant. State the assumptions for that. **[04]**

Que. 3 **Attempt any three.** **[12]**

(A) Derive continuity equation in three dimensions for Incompressible fluid.

(B) Which device is used to measure the velocity of flowing fluid? Derive its equation.

(C) An orifice meter with orifice diameter 10 cm is inserted in a pipe of 20 cm diameter. The pressure gauges fitted upstream and downstream of the orifice meter give readings of 19.62 N/cm^2 and 9.81 N/cm^2 respectively. Co-efficient of discharge for the meter is given as 0.6. Find the discharge of water through pipe.

(D) Which device is used to measure the discharge through a pipe? Derive its equation.

SECTION – II

Que. 4 (A) Show that the force exerted by a jet of water on an inclined fixed plate in the direction of jet is given by $F_x = \rho a V^2 \sin^2 \theta$. **[03]**

(B) Show that the efficiency of a free jet striking normally on a series of flat plates mounted on the periphery of a wheel can never exceed 50%. **[04]**

(C) A jet of water of diameter 7.5 cm strikes a curved plate at its centre with a velocity of 20 m/s. The curved plate is moving with a velocity of 8 m/s in the direction of the jet. The jet is deflected through an angle of 165^0. Assuming the plate smooth. Find: (i) Force exerted on the plate in the direction of jet, (ii) Power of the jet. (iv) Efficiency of jet. **[04]**

OR

Que. 4 (A) Show that the force exerted by a jet of water on moving inclined plate in the direction of jet is given by $F_x = \rho a(V-u)^2 \sin^2 \theta$. **[03]**

(B) A jet of water having a velocity of 20 m/s strikes a curved vane, which is moving with a velocity of 10 m/s. The jet makes an angle of 20^0 with the direction of motion of vane at inlet and leaves at an angle of 130^0 to the direction of motion of vane at outlet. Calculate: (i) Vane angle, so that the water enters and leaves the vane without shock (ii) Work done per second per unit weight of water striking vane per second. **[04]**

(C) Prove that the work done per second on a series of moving curved vanes by a jet of water striking at one of the tips of the vane is given by $\rho a V_1[V_{w1} \pm V_{w2}] \times u$. **[04]**

Que. 5 (A) The penstock supplies water from a reservoir to the Pelton wheel with a gross head of 500 m. One third of the gross head is lost in friction in the penstock. The rate of flow of water through the nozzle fitted at the end of the penstock is 2.0 m^3/s. The angle of deflection of the jet is 165^0. Determine the power given by the water to the runner and also hydraulic efficiency of the Pelton wheel. Take speed ratio = 0.45 and $C_v = 1.0$ **(06)**

(B) Write a short note about efficiencies of Hydraulic turbine. **(06)**

OR

Que. 5 (A) A Francis turbine with an overall efficiency of 75% is required to produce 148.25 kW power. It is working under a head of 7.62 m. The peripheral velocity = $0.26\ (2gH)^{1/2}$ and the radial velocity of flow at inlet is $0.96\ (2gH)^{1/2}$. The wheel runs at 150 r.p.m. and the hydraulic losses in the turbine are 22% of the available energy. Assuming radial discharge, determine: (i) The guide blade angle (ii) The wheel vane angle at inlet (iii) Diameter of the wheel at inlet and (iv) Width of the wheel at inlet. **(06)**

(B) Define specific speed. Derive an expression for specific speed of Hydraulic turbine. **(06)**

Que. 6 **Attempt any three.** **(12)**

(A) Define: (i) Suction head (ii) Delivery head (iii) Static head (iv) Manometric head

(B) The internal and external diameters of the impeller of a centrifugal pump are 300 mm and 600 mm respectively. The pump is running at 1000 r.p.m. The vane angle at inlet and outlet are 20^0 and 30^0 respectively. The water enters the impeller radially and velocity of flow is constant. Determine the work done by the impeller per unit weight of water

(C) Write a short note about main parts of a centrifugal pump with neat sketch.

(D) A centrifugal pump having outer diameter equal to two times the inner diameter and running at 1000 r.p.m works against a total head of 40 m. The velocity of flow through the impeller is constant and equal to 2.5 m/s. The vanes are set back at an angle of 40^0 at outlet. If the outer diameter of the impeller is 500 mm and width at outlet is 50 mm, determine: (i) Vane angle at inlet, (ii) Work done by impeller on water per second (iii) Manometric efficiency.

********** END OF PAPER **********