23/5/2017
Morning

Exam No: _____

GANPAT UNIVERSITY

B. TECH SEM- 4TH SEM (MECHATRONICS ENGINEERING)

CBCS (NEW) REGULAR EXAMINATION - MAY-JUNE 2017

2MC403: FLUID MECHANICS & MACHINES

TIME: 3 Hours **TOTAL MARKS: 60**

Instructions: (1) This question paper has two sections. Attempt each section in separate answer book.
(2) Figures on right indicate full marks.
(3) Be precise and to the point in answering the descriptive questions.

SECTION: I

Q.1 (a) Explain the different types of fluids with neat sketch. **(04)**

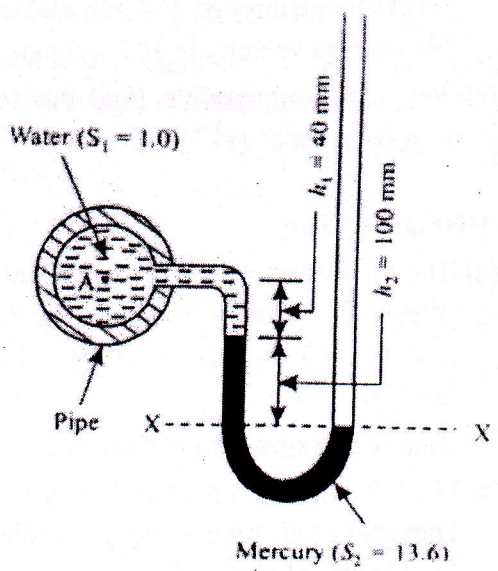
(b) Define capillarity. Derive an expression for capillary rise for a liquid. **(04)**

(c) A U-tube is made up of two capillaries of bores 1.2 mm and 2.4 mm respectively. The tube is held vertical and partially filled with liquid of surface tension 0.06 N/m and zero contact angle. If the estimated difference in the level of two menisci is 15 mm, determine the mass density of the liquid. **(02)**

OR

Q.1 (a) Write a short note on Piezometer and Micro-Manometer with neat sketch. **(04)**

(b) U tube manometer containing mercury was used to find negative pressure in the pipe, containing water. The right limb was open to the atmosphere. Find the vacuum pressure in the pipe, if difference of mercury level in the two limb was 100 mm and height of water in the left limb from the centre of the pipe was found to be 40 mmm below. **(04)**

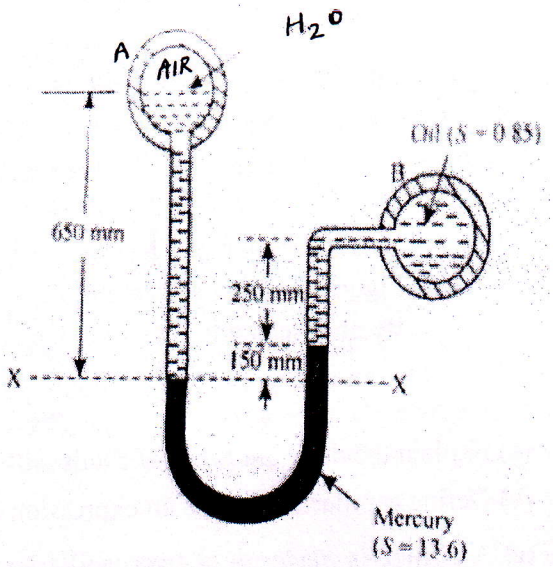


(c) The velocity distribution over a flat plate is given by $u = 3/2\ y - y^{3/2}$, where u is the point velocity in metre per second at a distance y meter above the plate. Determine the shear stress at y=9 cm. Assume dynamic viscosity as 8 poise. **(02)**

Q.2 (a) Derive continuity equation in three dimensions. **(04)**

(b) A fluid flow is given by $V = 4x^3i - 10\ x^2yj + 2tk$. Calculate the velocity and acceleration at the point (2, 1, 3) at time t=1. **(04)**

(c) Figure shows a differential manometer connected at two points A and B. At air pressure is 100 kN/m Find the absolute pressure at B (02)



OR

Q.2 (a) Explain the followings: (04)
(i) Laminar and Turbulent flow (ii) Compressible and incompressible flow

(b) A pipe A 450 mm in diameter branches in to two pipes B and C of diameters 300 mm and 200 mm respectively. If the average velocity in 450 mm diameter pipe is 3 m/s, find: (i) discharge through 450 mm diameter pipe and (ii) velocity in 200 mm diameter pipe if the average velocity in 300 mm pipe is 205 m/s. (04)

(c) For an incompressible fluid the velocity components are: $u = x^3-y^3-z^2x$, $v = y^3-z^3$, $w = -3x^2z-3y^2z+ (z^3/3)$. Determine whether the continuity equation is satisfied. (02)

Q.3 **Attempt any two**

(a) The force exerted by a flowing fluid on a stationary body depends upon the length L of the body, velocity V of the fluid, density ρ of fluid, viscosity μ of the fluid and acceleration due to gravity g. Find an expression for the force using dimensional analysis. (5)

(b) Derive an expression of flow rate for venturi-meter. (5)

(c) The following data related to an orifice-meter. (5)
Diameter of the pipe = 240 mm, diameter of orifice meter = 120 mm
Sp. Gravity of oil = 0.88, Reading of differential manometer = 400 mm of Hg
Co-efficient of discharge of the meter = 0.65,
Determine the rate of flow of oil

SECTION: II

Q.4 (a) 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°. Assuming the plate is smooth find: (i) Force exerted on the plate in the direction of jet, (ii) Power of the jet and (iii) efficiency of the jet. (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) Derive an expression for the force exerted by jet of water on a fixed inclined plate. (03)

OR

Q.4 (a) Derive an expression for the force exerted by jet of water on a moving curved plate. (03)

(b) A jet of water having a velocity of 30 m/s strikes a curved vane, which is moving with a velocity of 15 m/s. The jet makes an angle of 30° with the direction of motion of vane at inlet and leaves at an angle of 120° to the direction of motion of vane at outlet. Calculate vane angles if the water enters and leaves the vane without shock. (04)

(c) State and explain Buckingham's π-theorem. (03)

Q.5 (a) Define specific speed of turbine. Derive an expression for specific speed of hydraulic turbine. (03)

(b) The pressure difference Δp in a pipe of diameter D and length l due to viscous flow depends on the velocity V, viscosity μ and density ρ. Using Buckingham's π-theorem, obtain an expression for Δp. (04)

(c) Define following related to hydraulic turbine: (i) friction head (ii) volumetric efficiency (ii) hydraulic machine. (03)

OR

Q.5 (a) Prove that the maximum efficiency of pelton wheel turbine is $(1+\cos\phi)/2$. (05)

(b) A Pelton wheel is to be designed for the following specifications. Shaft Power =735.75 kW, Head = 200 m, Speed = 800 r.p.m., η_o= 0.86 and jet diameter is not to exceed one-tenth the wheel diameter. Determine: (i) Wheel diameter (ii) The number of jets required, and (iii) Diameter of the jet. Take C_v = 0.98 and speed ratio = 0.45 (05)

Q.6 **Attempt any two.**

(a) The internal and external diameters of the impeller of a centrifugal pump are 200 mm and 400 mm respectively. The pump is running at 1200 r.p.m. The vane angles of the impeller at inlet and outlet are 20° and 30° 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. (5)

(b) Explain the working of reciprocating pump with neat sketch. (5)

(c) Derive an expression for minimum speed required for starting a centrifugal pump. (5)

END OF PAPER