Student Exam No._____

GANPAT UNIVERSITY

B. Tech. Semester: IV Mechatronics Engineering

CBCS Regular Examination May– June 2013

Fluid Mechanics and Machines (2MC405)

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

Instruction: 1. Attempt all questions.
2. Assume suitable data if required.
3. Figures to the right indicate full marks.

Section - I

Q– 1	(A)	Define and explain (i) Viscosity (ii) Vapour pressure.	4
	(B)	Explain the phenomenon of surface tension. Prove the relationship between surface tension and pressure for a hollow bubble.	4
	(C)	The dynamic viscosity of an oil, used for lubrication between shaft and sleeve is 6 poise. The shaft is of diameter 0.4 m and rotates at 190 rpm. Calculate power lost in the bearing for a sleeve length of 90 mm. Thickness of oil film is 1.5 mm.	4

OR

Q– 1	(A)	Explain the phenomenon of capillarity. Also derive the expression for capillary rise and fall.	4
	(B)	State and prove pascal's law.	4
	(C)	The right limb of a simple U-tube manometer containing mercury is open to the atmosphere while the left limb is connected to a pipe in which a fluid of specific gravity 0.9 is flowing. The centre of the pipe is 12 cm below the level of mercury in the right limb. Find the pressure of fluid in the pipe if the difference of mercury level in the two limbs is 20 cm.	4
Q– 2	(A)	What do you mean by buoyancy, centre of buoyancy and metacentre.	3
	(B)	With neat sketch explain the conditions of equilibrium for floating and submerged body.	4
	(C)	A rectangular plane surface is 2 m wide and 3 m deep. It lies in vertical plane in water. Determine total pressure and position of centre of pressure on plane surface when its upper edge is horizontal. (a) Coincides with water surface (b) 2.5 m below free water surface.	4

OR

Q– 2	(A)	Find the volume of water displaced and position of centre of buoyancy for a wooden block of width 2.5 m and depth 1.5 m, when it floats horizontally in water. The density of wooden block is 650 kg/m^3 and its length 6 m.	3
	(B)	The water is flowing through a pipe having diameters 20 cm and 10 cm at sections 1 and 2 respectively. The rate of flow through pipe is 35 litres/s. The section 1 is 6 m above the datum and section 2 is 4 m above the datum. If the pressure at section 1 is 39.24 N/cm^2, find the intensity of pressure at section 2.	4
	(C)	Derive the equation for the force exerted on a submerged inclined plane surface by the static liquid and locate the centre of pressure.	4

Q– 3 **Attempt any three** 12

(A) What is Euler's equation of motion? How will you obtain Bernoulli's equation from it?

(B) Explain different types of fluid flow.

(C) Write a short note on different types of manometers.

(D) Define and explain (i) Rate of flow (ii) continuity equation (iii) hydraulic machines and (iv) impact of jet.

Section – II

Q– 4 (A) Give complete classification of turbines. 4

(B) Explain with neat sketch components of Pelton turbines. 4

(C) A Pelton turbine is to be designed for a head of 60 m when running at 200 rpm. The pelton turbine develops 95.6475 kW shaft power. The velocity of the buckets = 0.45 times the velocity of the jet, overall efficiency = 0.85 and co-efficient of the velocity is equal to 0.98. 4

OR

Q– 4 (A) Derive the equation of specific speed for hydraulic turbines. 4

(B) Differentiate between impulse and reaction turbines. 4

(C) The following data is given for a francis turbine. Net head H = 60 m, N = 700 rpm; shaft power = 294.3 kW; η_0 = 84%; η_h = 93%; flow ratio = 0.20; breadth ratio n = 0.1; outer diameter of the runner = 2 × inner diameter of runner. The thickness of vanes occupy 5 % of circumferential area of the runner, velocity of flow is constant at inlet and outlet and discharge is radial at outlet. Determine: (i) Guide blade angle (ii) Runner vane angles at inlet and outlet (iii) Diameters of runner at inlet and outlet (iv) Width of wheel at outlet. 4

Q– 5 (A) 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%. 5

(B) A jet of water of 60 mm diameter strikes a curved vane at its centre with a velocity of 18 m/s. The curved vane is moving with a velocity of 6 m/s in the direction of jet. The jet is deflected through an angle of 165°. Assuming the plate to be smooth find (i) force on the plate in the direction of jet (ii) power of jet (iii) efficiency of jet. 6

OR

Q– 5 (A) How will you obtain an expression for the minimum speed of starting a centrifugal pump? 5

(B) A centrifugal pump delivers water against a net head of 14.5 m and a design speed of 1000 rpm. The vanes are curved back to an angle of 30° with the periphery. The impeller diameter is 300 mm and outlet width 50 mm. Determine the discharge of the pump if manometric efficiency is 95%. 6

Q– 6 **Attempt any three** 12

(A) By means of neat sketch explain the governing mechanism of Francis turbine.

(B) What do you understand by characteristics curves of a turbine?

(C) What is cavitation? What are the effects of cavitation?

(D) Derive the equation of velocity of sound or pressure wave in a fluid.

END OF PAPER