

GANPAT UNIVERSITY
B.TECH SEM. 4th MECHATRONICS ENGINEERING
REGULAR EXAMINATION MAY/JUNE-2014
FLUID MECHANICS & MACHINES 2MC 405

TIME:-3 HOURS

TOTAL MARKS-70

INSTRUCTIONS: (1) Attempt all questions.

(2) Figure to the right indicates full marks.

(3) Assume required data if necessary.

SECTION-1

Q-1 Answer the following questions.

- (a) Define: (i) Viscosity (ii) Specific gravity (iii) Weight density (iv) Kinematic viscosity. [04]
- (b) Define capillarity. Derive an expression for capillary rise of liquid. [04]
- (c) Find the capillary rise of water in a tube of 0.03 cm diameter. The surface tension of water is 0.0735 N/m. [04]

OR

Q-1 Answer the following questions.

- (a) The velocity distribution for flow over a flat plate is given by $u = \frac{2}{3}y - y^2$, [04]
 where u is the point velocity in meter per second at a distance y meter above the plate. Determine the shear stress at $y=0$, 0.1 cm and 0.2 cm. Assume dynamic viscosity as 6 poise.
- (b) Explain the phenomenon of surface tension with neat sketch. Prove that the relationship between surface tension and pressure inside a droplet of liquid in excess of outside pressure is given by $p = \frac{4\sigma}{d}$ [04]
- (c) Explain the different types of fluids with neat sketch. [04]

Q-2 Answer the following questions.

- (a) With neat sketches explain the conditions of equilibrium for floating and submerged bodies. [05]
- (b) Define meta-centre. Derive an expression for the meta-centric height of a floating body. [06]

OR

Q-2 Answer the following questions.

- (a) State and prove Pascal's law. [04]
- (b) Prove that rate of increase of pressure in a vertical downward direction is equal to weight density of the fluid at that point. [04]
- (c) A simple manometer is used to measure the pressure of oil of sp. Gr. 0.8 flowing in a pipe line. Its right limb is open to the atmosphere and left limb is connected to the pipe. The centre of the pipe is 9 cm below the level of mercury of sp. Gr. 13.6 in the right limb. If the difference of mercury level in the two limbs is 15 cm, determine the absolute pressure of the oil in the pipe in N/cm^2 . [03]

Q-3 Answer the following questions. (Any three) [12]

- (a) What is Pitot tube? Derive an expression for measuring the velocity with the help of Pitot tube.
- (b) Derive the Euler's equation of motion. Also derive the Bernoulli's equation of motion.
- (c) A pipe of 450 mm diameter branches into two pipes 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 (ii) velocity in 200 mm diameter pipe if the average velocity in 300 mm pipe is 2.5 m/s.

- (d) (i) $u=2x^2$, $v=2xyz$ (ii) $u=2x^2 + 2xy$, $w= z^3 - 4xz + 2yz$. Calculate the third velocity component so that they satisfy the continuity equation for three dimensional flow.

SECTION-II

Q-4 Answer the following questions. [12]

- (a) Derive an expression for the force exerted by a jet of water on a (i) fixed vertical plate and (ii) fixed inclined plate.
- (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° with the direction of motion of vane at inlet and leaves at an angle of 130° to the direction of motion of vane an outlet. Calculate: (i) Vane angles, so that the water enters and leaves the vane without shock. (ii) Work done per second per unit weight of water striking the vane per second.

OR

Q-4 Answer the following questions. [12]

- (a) Show that the efficiency of a free jet striking normally on a series of flat plate mounted on the periphery of a wheel can never exceed 50%.
- (b) A nozzle of 50 mm diameter delivers a stream of water at 20 m/s perpendicular to a plate that moves away from the jet at 5 m/s. Find (i) The force on the plate, (ii) the work done, and (iii) the efficiency of jet.

Q-5 Answer the following questions.

- (a) What is draft tube? Describe with neat sketches any two types of draft tube. [04]
- (b) A pelton wheel has a mean bucket speed of 10 m/s with a jet of water flowing at the rate of 700 lit/s under a head of 30 meters. The buckets deflect the jet through an angle of 160° . Calculate the power given by water to the runner and the hydraulic efficiency of the turbine. Assume co-efficient of velocity as 0.98. [04]
- (c) Give the classification of hydraulic turbine. [03]

OR

Q-5 Answer the following questions.

- (a) Draw the general layout of the hydro-electric power plant. Give the function of different components of its. [04]
- (b) A pelton wheel is to be designed for the following specifications: Shaft power = 11,772 kW, Head = 380 m, Speed = 750 r.p.m, Overall efficiency = 86 %, Jet diameter not to be exceed one-sixth of the wheel diameter. Determine: (i) The wheel diameter (ii) Diameter of the jet. (iii) The number of jets required. [04]
- (c) Enlist the different components of pelton wheel turbine. Explain any one in detail. [03]

Q-6 Answer the following questions. (Any two). [12]

- (a) Find the number of pumps required to take water from a deep well under a total head of 89 m. All the pumps are identical and are running at 800 r.p.m. The specific speed of each pump is given as 25 while the rated capacity of each pump is $0.16 \text{ m}^3/\text{s}$.
- (b) Write short note on efficiencies of a centrifugal pump.
- (c) Define (i) Gross head (ii) Net head (iii) Friction head (iv) Hydraulic efficiency (v) Mechanical efficiency (vi) Volumetric efficiency.
- (d) Write a short note on main parts of a centrifugal pump.

END OF PAPER