GANPAT UNIVERSITY

B. TECH SEM- 4TH SEM MECHATRONICS ENGINEERING

REGULAR EXAMINATION APRIL-JUNE 2016

2MC403: FLUID MECHANICS & MACHINES

TIME: 3 HRS TOTAL MARKS: 60

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

SECTION: I

Q.1 (a) Differentiate between (i) Capillary rise and capillary fall (ii) Liquid and gas. (04)

(b) Explain the different types of fluid with neat sketch (04)

(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 sp. gr. 0.9 is flowing. The centre of 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 limb is 20 cm. (02)

OR

Q.1 (a) Prove that the Intensity of pressure in a static liquid is remains same in all directions. (04)

(b) Define: (i) Buoyancy (ii) Centre of buoyancy (iii) Metacenter (iv) Metacentric height (04)

(c) Determine the viscosity of a liquid having kinematic viscosity 6 stokes and specific gravity 1.9. (02)

Q.2 (a) Define and give example of (i) Steady flow (ii) Rotational flow (iii) Turbulent flow (iv) Non uniform flow. (04)

(b) A fluid flow is given by $V = x^2yi + y^2zj - (2xyz + yz^2)k$. Calculate the velocity and acceleration at the point (2,1,3). (04)

(c) A pipe of diameter 30 cm carries water at a velocity of 20 m/s. The pressures at the points A and B are given as 34.335 N/cm^2 and 29.43 N/cm^2 respectively, while the datum head at A and B are 25 m and 28 m. Find the loss of head between A and B. (02)

OR

Q.2 (a) The following cases represent the two velocity components, determine the third component of velocity such that they satisfy the continuity equation. (i) $u = 8x^2y - (8/3)y^3$ and $v = -8xy^3 + (8/3)x^3$ (ii) $u = 4x^2 + 3xy$, $w = z^3 - 4xy - 2yz$. (04)

(b) A pipe AB branches into two pipes C and D at B. The pipe has diameter of 45 cm at A, 30 cm at B, 20 cm at C and 15 cm at D. Determine the discharge at A if the velocity at A is 2 m/s. Also determine the velocities at B and D, if the velocity at C is 4 m/s. (04)

(c) Derive the Euler's equation of motion. (02)

Q.3 **Attempt any two from the following.** (10)

(a) Give the dimensions of (i) Force (ii) Kinematic viscosity (iii) Volumetric strain (iv) Power (v) Torque.

(b) Give the name of device which is used to measure the velocity of flowing fluid. Derive its expression.

(c) Differentiate between venturimeter and orificemeter.

SECTION: II

Q.4 (a) A jet of water of diameter 150 mm strikes a flat plate normally with a velocity of 12 m/s. The plate is moving with a velocity of 6 m/s in the direction of the jet and away from the jet. Find (i) the force exerted by the jet on the plate, (ii) work done by the jet on the plate per second, (iii) power of the jet, and (iv) efficiency of the jet. **(04)**

(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 moving inclined plate. **(02)**

OR

Q.4 (a) 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)**

(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: (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. **(04)**

(c) Explain the method of selecting repeating variables for dimensional analysis. **(02)**

Q.5 (a) Define following terms related to hydraulic turbine: (i) Volumetric efficiency (ii) Net head (iii) Hydraulic efficiency. **(03)**

(b) Prove that the frictional torque T of a disc of diameter D rotating at a speed N in a fluid of viscosity μ and density ρ in a turbulent flow is given by, $T = D^5N^2\rho\varphi\left[\frac{\mu}{D^2N\rho}\right]$. Use Buckingham's π-theorem. **(04)**

(c) A pelton wheel has a mean bucket speed of 10 meters per second 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 160^0. Calculate the power given by water to the runner and the hydraulic efficiency of the turbine. Assume co-efficient of velocity as 0.98. **(03)**

OR

Q.5 (a) Describe briefly the function of various main components of Pelton turbine with neat sketch. **(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.** **(10)**

(a) Define the following terms related to the centrifugal pump: (i) suction head (ii) delivery head (iii) static head (iv) manometric head (v) manometric efficiency.

(b) State the Buckingham's π-theorem. The efficiency η of a fan depends on density ρ, dynamic viscosity μ of the fluid, angular velocity ω, diameter D of the rotor and the discharge Q. Express η in terms of dimensionless parameters with the help of Buckingham's π-theorem.

(c) Write a short note on working and main parts of centrifugal pump.

END OF PAPER