Reg.No.										

MANIPAL INSTITUTE OF TECHNOLOGY
Manipal University, Manipal – 576 104

V SEMESTER B.TECH (MECHANICAL ENGINEERING)
END SEMESTER EXAMINATIONS, NOV/DEC 2015

SUBJECT: FLUID MECHANICS AND MACHINES (MME 333)

Time: 3 Hours. MAX.MARKS: 50

Instructions to Candidates:

- Answer **ANY FIVE FULL** questions.
- Any missing data can be assumed suitably.

1A) In a Pelton wheel turbine, explain and write the equations for the terms: Speed ratio, Jet ratio, Number of buckets, Number of jets, Mean diameter of the wheel, coefficient of velocity. **(03)**

1B) Calculate the gauge pressure and the absolute pressure within (Surface tension 0.073N/m): **(02)**

i. A droplet of water 0.4cm in diameter
ii. A jet of water 0.4cm in diameter.

1C) A jet of water having velocity 20m/s strikes a curved vane moving with a velocity of 10m/s. The jet makes an angle of 20^o with the direction of motion of vane at inlet and leaves at an angle of 130^o to the direction of motion of vane at outlet. Calculate: **(05)**

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.
iii. Efficiency of the vane.

2A) A U-tube manometer is used to measure the pressure of water in a pipe line, which is in excess of atmospheric pressure. The right limb of the manometer contains mercury and is open to atmosphere. The contact between water and mercury is in the left limb. Determine the pressure of water in the main line, if the difference in level of mercury in the limbs is 10cm and the free surface of mercury is in level with the Centre of the pipe. If the pressure of water in pipeline is reduced to $9810N/m^2$, calculate the new difference in the level of mercury. Sketch the arrangements in both the cases. **(04)**

2B) What is meant by vapor pressure and cavitation? Why is cavitation a serious problem in pumps? **(02)**

2C) A cylindrical gate of 4m diameter 2m long has water on its both sides as shown in figure. **(04)**

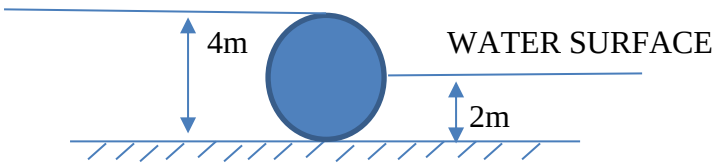

Fig Q-2.C

Determine the magnitude, location and direction of the resultant force exerted by the water on the gate. Find the least weight of the cylinder so that it may not be lifted away from floor.

3A) Derive an expression to obtain the metacenter height of a floating body. **(05)**

3B) The resistance R experienced by a partially submerged body depends upon the velocity V, length of the body l, viscosity of the fluid μ. density of the liquid ρ and acceleration due to gravity g. Obtain a dimensionless expression for R using Buckingham's π Theorem. **(05)**

4A) Show that a cylindrical body of 1m diameter and 2m height weighing 7.848 KN will not float vertically in sea water of density 1030 kg/m^3. Find the force necessary in a vertical chain attached at the center of the base of the body that will keep it vertical. **(04)**

4B) What are the different types of Multistage centrifugal pumps? Differentiate between them. **(03)**
A four stage centrifugal pump has four identical impellers, keyed to the same shaft. Discharge through the pump is 0.2m^3/s and total manometric head of 40m.What is the discharge and Manometric head per stage?

4C) Derive the expression for head loss in a pipe due to sudden enlargement of the pipe. **(03)**

5A) A centrifugal pump has the following dimensions: inlet radius=80mm; outlet radius =160mm; width of impeller at the inlet =50mm; vane angle at inlet is 0.45 radians; vane angle at outlet is 0.25 radians; width of impeller at outlet = 50mm. **(05)**
Assuming shock less entry determine the discharge and the head developed by the pump when the impeller rotates at 90 radians/second.

5B) Differentiate between: **(03)**

i. Reaction Turbine and Impulse Turbine
ii. Lagrangian Approach and Eulerian Approach
iii. Uniform-non steady flow and Non uniform-steady flow

5C) A pitot tube is inserted in a pipe of 300mm diameter. The static pressure in pipe is 100mm of mercury(vacuum).The stagnation pressure at the center of the pipe as recorded by pitot tube is 0.981N/cm^2.Calculate the rate of flow of water through pipe, if the mean velocity of flow is 0.85 times the central velocity. Take C_v=0.98. **(02)**

6A) The three-jet Pelton turbine is required to generate 10,000kW under a net head of 400m.The blade angle at outlet is 15 and the reduction in the relative velocity while passing over the blade is 5%.If the overall efficiency of the wheel is 80%, C_v=0.98 and speed ratio=0.46, then find: (i) the diameter of the jet, (ii) total flow in m^3/s and (iii) the force exerted by a jet on the buckets. **(05)**
If the jet ratio is not to be less than 10, find the speed of the wheel for a frequency of 50 hertz and the corresponding wheel diameter.

6B) Find the head loss due to friction in a pipe of 300 mm diameter and length 50m through which water is flowing at a velocity of 3m/s using i) Darcy's equation and ii) Chezy's equation (C=60 , ν=0.01) **(03)**

6C) Define and explain the significance of the following dimensionless numbers **(02)**

(i) Weber's Number
(ii) Euler's Number