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MANIPAL INSTITUTE OF TECHNOLOGY
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V SEMESTER B.TECH (MECHANICAL ENGINEERING)
END SEMESTER EXAMINATIONS, DEC 2015/JAN 2016

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) A pipe line carrying oil of specific gravity 0.87 changes in diameter from 200mm diameter at position A to 500 mm diameter at a position B which is 4metres at a higher level. If the pressures at A and B are 9.81N/cm^2 and 5.886 N/cm^2 respectively and the discharge is 200 litres/s determine the loss of head and direction of flow. **(03)**

1B) Derive the Darcy Weisbach equation. **(03)**

1C) A jet of water of diameter 7.5cm strikes a curved plate at its center with a velocity of 20m/s. The curved plate is moving with a velocity of 8m/s in the direction of the jet. The jet is deflected through an angle of 165 $^\circ$. Assuming the plate to be smooth, Find (i) Force in direction of jet (ii) Power (iii) Efficiency. **(04)**

2A) Water is flowing through a pipe of diameter 30cm. The pipe is inclined and a venturimeter is inserted in the pipe. The diameter of venturimeter at throat is 15cm. The difference of pressure between the inlet and throat of the venturimeter is measured by a liquid of specific gravity 0.8 in an inverted U Tube which gives a reading of 40cm. The loss of head between inlet and throat is 0.3 times the kinetic head of pipe. Calculate the discharge. **(03)**

2B) Define manometric, overall and mechanical efficiency of a turbine. **(03)**

2C) A circular opening 3m diameter in a vertical side of a tank is closed by a disc of 3m diameter which can rotate about a horizontal diameter. Calculate: **(04)**

i. Force on the disc

ii. Torque required to maintain the disc in equilibrium in the vertical position when the head of water above the horizontal diameter is 4m.

3A) The force F on the propeller of an aircraft depends upon the linear speed V of the air craft , density of air ρ, viscosity of air μ, diameter of the propeller D and the speed of rotation N. Show that, **(05)**

$$F = \rho V^2 D^2 \phi\left(\frac{\mu}{\rho VD}, \frac{V}{ND}\right)$$

3B) Two pipes have a length l each. One of them has a diameter D, and the other a diameter d.If the pipes are arranged in parallel the loss of head when a total quantity of water Q flows **(05)**

through them is h, but, if the pipes are arranged in series and the same quantity Q flows through them, the loss of head is H. If d=D/2, find the ratio of H to h.Neglect minor losses and assume both pipes have the pipe co-efficient f has a constant value.

4A) A hollow cylinder open at both ends has internal diameter of 30cm,wall thickness of 15cm and a length of 90cm.If it weighs 625N,find whether the cylinder would be stable while floating in water with its axis vertical. **(04)**

4B) Explain the terms: absolute, gauge and vacuum pressure. Barometer reads 75cm of mercury. Calculate (i) Gauge pressure in Kgf/cm^2 (ii) Gauge pressure in cm of water column and (iii) Absolute pressure in Kgf/cm^2. **(03)**

4C) A square plate 50cm X 50cm weighing 200N is allowed to slide down an inclined plane which is laid at a slope of 1 vertical to 2.5 horizontal. What terminal velocity will be attained by the plate if 0.02mm thickness of oil lies interposed between the inclined plane and the plate? The oil has a dynamic viscosity of $2.25X10^{-3}$ Kg-f s/m^2. **(03)**

5A) A Pelton wheel is working under a gross head of 400m.The water is supplied through penstock of diameter 1m and length 4km from reservoir to the Pelton wheel. The coefficient of friction for penstock is given as 0.008.The jet of water of diameter 150mm strikes the buckets of the wheel and gets deflected through an angle of 165^o.The relative velocity of the water at outlet is reduced by 15% due to friction between inside surface of the bucket and water. If the velocity of the buckets is 0.45 times the jet velocity at inlet and mechanical efficiency as 85% determine: **(05)**

(i) Power given to the runner (ii) shaft power (iii) hydraulic and overall efficiency.

5B) The difference in water level in two tanks, which are connected by three pipes in series of lengths are 300m,170m and 210m and of diameters 300mm,200mm and 400mm respectively, is 12m.Determine the rate of flow of water if co-efficient of frictions are 0.005,0.0052 and 0.0048 respectively considering minor losses. **(03)**

5C) What are the assumptions made while deriving the Bernoulli's equation? **(02)**

6A) The outer diameter of an impeller of a centrifugal pump is 400 mm and outlet width 50mm.The pump is running at 800 r.p.m and is working against a total head of 15m.The vane angle at outlet is 40^o and manometric efficiency is 75%.Determine: **(04)**

(i) velocity of flow at outlet (ii) velocity of water leaving he vane

(iii) angle made by the absolute velocity at outlet with the direction of motion at outlet

(iv) discharge

6B) Derive an expression for discharge through a Venturimeter. **(04)**

6C) Differentiate between **(02)**

(i) Lagrangian and Eulerian method

(ii) Laminar flow and turbulent flow