PCCME203 - Fluid Machines

P. Pages : 2

Time : Three Hours

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GUG/W/23/14063

Max. Marks : 80

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Notes :
1. All questions carry equal marks.
2. Due credit will be given to neatness and adequate dimensions.
3. Assume suitable data wherever necessary.
4. Diagrams and Chemical equation should be given wherever necessary.
5. Illustrate your answers wherever necessary with the help of neat sketches.
6. Use of slide rule, Logarithmic tables, Steam tables, Mollier's chart, Drawing instruments, Thermodynamic tables for moist air, Psychrometric charts and Refrigeration charts is permitted.
7. Attempt Q.1 or Q.2, Q.3 or Q.4, Q.5 or Q.6, Q.7 or Q.8, Q.9 or Q.10.

1. a) Derive an expression for the force exerted by a jet of water on an stationary inclined plate in the direction of the jet. **8**

b) A jet of water having a velocity of 35 m/sec impinges on series of vanes moving with a velocity of 20 m/sec. The jet makes an angle of 30° to the direction of motion of vanes when entering and leaves at an angle of 120°. Draw the velocity triangles and find-
i) the angles of vane tips so that water enters and leaves without shock
ii) work done/kg of water striking the vanes. **8**

OR

2. a) Explain main parts of Pelton wheel with their functions. **8**

b) A Pelton wheel develops 8000 kW under a net head of 130 m at a speed of 200 r.p.m. Assuming the coefficient of velocity for nozzle 0.98 hydraulic efficiency 87%, speed ratio 0.46 and Jet diameter to wheel diameter ratio 1/9, determine:
i) Discharge required
ii) Diameter of the wheel
iii) Diameter and number of Jets required &
iv) Specific speed
Assume mechanical efficiency 75%. **8**

3. a) Compare Inward and outward flow reaction turbines, with the help of neat sketches. **8**

b) A Kaplan turbine runner is to be designed to develop 9100 kW. The net available head is 5.6m. If the speed ratio is 2.09 and flow ratio is 0.68, overall efficiency 86% and the diameter of boss being 1/3 of the diameter of the runner. Find the diameter of the runner, its speed and specific speed of the turbine. **8**

OR

4. a) A reaction turbine works at 450 rpm. Its diameter at inlet is 120 meter and the flow area is $0.4\,m^2$. The angle made by the absolute and relative velocities at inlet are 20° and 60° respectively with the tangential velocity. The discharge at outlet of the Turbine is radial. Calculate:
i) The volume flow rate
ii) Power developed
iii) Head at inlet
iv) Hydraulic Efficiency
Assume velocity of flow to be constant. **8**

	b)	What is cavitation? How can it be avoided at design and operational stage?	**8**
5.	a)	Derive an expression for the minimum speed for starting a centrifugal pump.	**6**
	b)	The internal and external diameters of the impeller of a centrifugal pump are 200 mm and 400 mm respectively. The pump is running at 1200 rpm. The vane angles of the impeller at inlet and outlet are 20º and 30º respectively. The water enters the impeller radially and velocity of flow is constant. Determine the work done by impeller per unit weight of water.	**10**

<div align="center">**OR**</div>

6.	a)	Derive an expression for the work done by the impeller of a Centrifugal pump on a liquid.	**10**
	b)	What do you understand by priming of the centrifugal pump?	**6**
7.	a)	The cylinder bore diameter of single acting reciprocating pump is 150 mm and its stroke is 300 mm. The pump runs at 50 r.p.m. and lift water through height of 25 m. The delivery pipe is 22 m long and 100 mm in diameter. Find the theoretical discharge and theoretical power required to run the pump. If the actual discharge is 4.2 litres/s. Find the % slip. Also, determine the acceleration head at the beginning and middle of delivery stroke.	**8**
	b)	Explain with the help of indicator diagram that work done by pump is directly proportional to area of indicator diagram.	**8**

<div align="center">**OR**</div>

8.	a)	What do you understand by coefficient of discharge of a reciprocating pump? What is its relationship with slip? Can slip be negative? If yes how?	**8**
	b)	A single acting reciprocating piston pump runs at a speed of 50 rpm and delivers 0.01m^3 of water per second. The diameter of the piston is 200 mm and its stroke is 400 mm. Determine: i) The theoretical discharge of the pump ii) The coefficient of discharge of the pump iii) The slip of the pump iv) The percentage slip of the pump.	**8**
9.	a)	What do you understand by the term similitude? Explain various types of similarities.	**8**
	b)	Explain: Model testing of centrifugal pump.	**8**

<div align="center">**OR**</div>

10.	a)	Explain with neat sketch the construction and operation of Air Lift Pump?	**4**
	b)	Discuss in brief with neat sketch the working principle of Bore Hole Pump.	**4**
	c)	Explain the construction and operation of Hydraulic Ram and derive the expression for efficiency of the same.	**8**

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