B.E. / B.Tech. Mechanical Engineering (Model Curriculum) Semester-IV

PCC-ME203 - Fluid Machines

P. Pages : 2 **GUG/S/25/14063**

Time : Three Hours * 2 3 8 0 * Max. Marks : 80

Notes :
1. All questions carry equal marks / marks as indicated.
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. Solve 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.
8. Non-programmable Electronic Calculator is allowed.

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

b) A jet of water of diameter 10 cm strikes a flat plate normally with a velocity of 15 m/s. The plate is moving with a velocity of 6 m/s in the direction of jet and away from jet. **8**
Find:
i) The force exerted by the jet on the plate.
ii) Work done by the jet on the plate per second.

OR

2. a) Draw a general layout of a Hydro-Electric power Plant and mention all the essential elements of it including efficiencies of Pelton wheel. **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: **8**
i) Discharge required
ii) Diameter of the wheel
iii) Diameter and number of Jets required &
iv) Specific speed
Assume mechanical efficiency 75%

3. a) A Kaplan turbine runner is to be designed to develop 9000 kW. The net available head is 6m. if the speed ratio is 2.0 and flow ratio is 0.7, overall efficiency 87% 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**

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

OR

4. a) Explain- **8**
i) Priming

ii) Cavitation

b) The internal and external diameter of an outward flow reaction turbine are 2m and 2.75m respectively. The turbine is running at 250 r.p.m. And rate of flow of water through the turbine is $5 m^3/s$. The width of the runner is constant at inlet and outlet and is equal to 250mm. The head on the turbine is 150m. Neglecting the thickness of vanes and taking radial discharge at outlet determine: **8**

i) Vane angles at inlet and outlet
ii) Velocity of flow at inlet and outlet

5. a) Derive an expression for the minimum speed for starting a centrifugal pump. **8**

b) A centrifugal pump Having outer diameter equal to two times the inner diameter and running at 1000rpm. Works against ahead of 40m. The velocity of flow through the impeller is constant and equal to 2.5m/s. The vanes are set back at an angle of 40º at outlet. If the outer diameter of the impeller is 500mm. and width at outlet is 50mm, determine. **8**

i) Vane angle at inlet
ii) Work done by impeller on water per second
iii) Manometric efficiency

OR

6. a) Explain : Cavitation in centrifugal Pump. **6**

b) A three stage centrifugal pump has impeller 40 cm in diameter and 2 cm wide at outlet. The vanes are curved back at the outlet at 45º and reduce the circumferential area by 10% at outlet. The manometric efficiency is 90% and overall efficiency is 80% . Determine the head generated by the pump when running at 1000 rpm delivering 50 litres per second. What will be the shaft power? **10**

7. 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 double acting reciprocating piston pump runs at a speed of 40 r.p.m. and discharging $1.0 m^3$ of water per minute. The pump has a stroke of 400 mm. The diameter of the piston is 200 mm. The delivery and suction heads are 20 m and 5 m respectively. Determine the slip of the pump and power required to drive the pump. **8**

OR

8. a) Explain the construction and working of a Reciprocating pump. **8**

b) The cylinder bore diameter of single acting reciprocating pump is 150mm and its stroke is 300mm. The pump runs at 50 r.p.m. and lift water through height of 25m. The delivery pipe is 22m long and 100mm 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**

9. a) Explain the term similitude and various types of similarities. **8**

b) Explain : **8**

i) Hydraulic Rams ii) Regenerative pumps.

OR

10. Explain with neat sketches following water lifting devices: **16**

i) Gear pump ii) Bore hole pumps
iii) Jet pumps iv) Rotary Pump

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