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

PCC-ME203 - Fluid Machines

P. Pages : 3 **GUG/W/24/14063**

Time : Three Hours * 5 5 8 0 * Max. Marks : 80

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. 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.

1. 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 jet of water having a velocity of 20 m/sec strikes a curved vane, which is moving with a velocity of 10 m/sec. The jet makes an angle of 20º to the direction of motion of vanes at inlet and leaves at an angle of 130º to the direction of motion of vane at outlet. Calculate. **8**

i) Vane angles so that water enters and leaves without shock

ii) Work done per second per unit weight of water striking.

OR

2. a) Derive the expression for work done by a water jet when it strikes normally series of flat plates mounted on a periphery of a wheel. Also derive the condition for maximum efficiency. **8**

b) A Pelton wheel is supplied with $5 m^3/sec$ when working a under a head of 256 meter. Assuming overall efficiency of 85% and coefficient of velocity for nozzle and speed ratio being 0.98 and 0.46 respectively calculate: **8**

i) Shaft Power

ii) Diameter of the wheel and jet diameter

iii) No. of Buckets and its dimensions

iv) Specific speed

Assume the turbine runs at 500 rpm

3. a) What is a draft tube? Discuss its types and functions. **8**

b) A Kaplan turbine runner is to be designed to develop 9100kW. The net available head is 5.6m. If the speed ratio is 2.09 and flow ratio is 0.68, over all 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) The internal and external diameters 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 $5 m^3/sec$. The width of the runner is constant at inlet and outlet and is equal to 250mm. The head on the turbine is 150m. Neglecting thickness of the vanes and taking discharge radial at outlet determine: **8**

i) Vane angles at inlet and outlet

ii) Velocity of flow at inlet and outlet

b) Explain- **8**

i) Priming

ii) Cavitation

5. a) 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. **10**

i) Vane angle at inlet

ii) Work done by impeller on water per second

iii) Manometric efficiency

b) Derive an expression for the minimum speed for starting a centrifugal pump. **6**

OR

6. a) Derive an expression for the work done by the impeller of a Centrifugal pump on a liquid. **8**

b) What do you understand by multistaging of the centrifugal pump? **8**

7. a) The length and diameter of a suction pipe of a single acting reciprocating pump are 5m and 10cm respectively. The pump has a plunger of diameter 15cm and a stroke length of 35cm. The centre of the pump is 3m above the water surface in the pump. The atmospheric pressure head is 10.3m of water and pump is running at 35 r.p.m. Determine. **8**

i) Pressure head due to acceleration at the beginning of the suction stroke

ii) Maximum pressure head due to acceleration

iii) Pressure head in the cylinder at the beginning and at the end of the suction stroke.

b) Explain with the help of Indicator diagram that work done by pump is directly proportional to area of Indicator diagram. **8**

OR

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) 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) Define similitude. Explain in brief different types of similarities applied to hydraulic machines. **8**

b) Explain- **8**

i) Sliding Vane Pumps

ii) Screw Pumps

With neat sketches

OR

10. Explain with neat sketches following. **16**

i) Regenerative pumps

ii) Bore hole pumps.

iii) Jet Pumps

iv) Hydraulic Rams

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