

Birla Institute of Technology and Science, Pilani

ME F341 Prime Movers & Fluid Machines

Mid Sem (Open Book)

Time: 90 minutes

Weightage: 30%

Date: 10/03/2017

Note: State clearly assumptions you make. Underline the answers and the assumptions you make.

- Q.1. A Pelton wheel is working under a gross head of 400m. The water is supplied through the penstock of diameter 1 m and length 4 km from the reservoir to the Pelton wheel. The coefficient of friction is given as 0.008. The jet of water of 150mm strikes the buckets of the wheel and gets deflected through an angle of 165° . The relative velocity at outlet is reduced by 15% due to friction between inside surface of bucket and water. The leakage losses are one percent through the turbine and the mechanical efficiency is 85%. If the turbine is running at maximum efficiency, determine a) Power given to the runner b) shaft power and c) hydraulic efficiency and overall efficiency. [15]
- Q.2. A Francis turbine has a constant flow velocity of 2.5 m/s through the turbine and discharge is such that the absolute velocity at outlet is optimum. Width of the turbine at inlet is 22cm and the guide blade angle is 15° to the tangent of the wheel. Diameters at the inlet and outlet are 0.8 and 0.6 m respectively. The turbine runs at 200 rpm. Determine a) absolute velocity of water at inlet b) runner blade angles c) power developed and d) hydraulic efficiency of the turbine. [12]
- Q.3 Name the turbines used in BASPA-II and KARCHAM-WANGTOO hydroelectric power plants as discussed in class. If you exchange the turbines of both the plants, what kind of problems you will face. Elaborate each point for both the power plants. [6]
- Q.4 A hydroelectric plant operating with a Kaplan turbine delivers 30 MW of power. The turbine is running at 175 rpm with a discharge of $140 \text{ m}^3/\text{s}$. The overall efficiency is 85%, hydraulic efficiency is 90% and generator efficiency is 95%. The hub and tip diameters are 2m and 5m respectively. Draw the velocity triangles and state the type of runner. Determine the operating head. Also determine all the angles (inlet and outlet) at mid radius. [12]
- Q.5. A three throw reciprocating pump, has a cylinder bore of 30 cm and stroke of 45 cm, required to deliver 0.12 cumec of water. The pump lifts water from the sump 5m below and delivers it to the tank at height of 90 m above the cylinder axis. The suction and delivery pipes are of the length 6m and 160m respectively and the diameter of the suction and delivery pipe is 10cm. Take coefficient of friction as 0.00125. Neglect piston rod. The overall efficiency is 88% and slip is 2.5%. Calculate the power required to run the pump and draw the indicator diagram. If air vessel is connected on suction side then determine the power required. [15]

*****BEST LUCK*****

P.T.O