Department of Mechanical and Industrial Engineering

MIN 304: Fluid Machinery **Tutorial 2**

1. A centrifugal fan supplies air at a rate of 4.5 m^3s^{-1} and total head of 100 mm of water. The outer diameter of the impeller is 50 cm and the outer width is 18 cm. The blades are backward inclined and of negligible thickness. If the fan runs at 1800 rev min^{-1} and assuming that the conversion of velocity head to pressure head in the volute is counter-balanced by the friction losses there and in the runner, determine the blade angle at outlet. Assume zero whirl at inlet and take air density as 1.23 kg m^{-3}. *[27.8°]*

2. Calculate the least diameter of impeller of a centrifugal pump to just start delivering water to a height of 30 m, if the inside diameter of the impeller is half of the outside diameter and the manometric efficiency is 0.8. The pump runs at 1000 rpm. [0.6 m]

3. When working at its best efficiency point, the blading at mean radius, equals to 300 mm, of an axial flow pump deflects a stream approaching it at a relative angle of 60° to the axis through 15°, so that the water leaves it at a relative angle of 45°. Assuming that the water approaches it axially, and that the velocity of flow remains constant, draw inlet and outlet velocity triangles under these conditions for a rotational speed of 6000 rpm and calculate the total head rise through the impeller. [15.3 m]

4. An inward flow turbine has an external diameter of 1 m and its breadth at the inlet is 200 mm. If the velocity of flow at inlet is 3.0 m/s, find the mass of water flowing through the turbine per second. Take 15% of the area of flow is blocked by the blade thickness. If the speed of the runner is 200 rpm and guide blades make an angle of 15° to the wheel tangent, draw the inlet velocity triangle and find,

   (a) The runner vane angle at the inlet

   (b) Velocity of the wheel at inlet

   (c) The absolute velocity of water leaving the guide vanes and

   (d) The relative velocity of water entering the runner blade.

   [1602.2 kg/s, 103.4°, 10.472 m/s, 11.591 m/s, 3.087 m/s]