Exercises

Problem (5.1) An impulse turbine is supplied with steam at a pressure of 1.6 MPa and temperature of 250°C. The back pressure is 0.012 MPa. Nozzle efficiency is 0.9. Blade velocity coefficient *K*=0.8, mechanical efficiency=0.9, nozzle angle =20°. Symmetrical blades with angle =30°. Find the revolution per minute if the mean diameter of wheel is 75 cm, the blade efficiency, axial thrust per kg steam, exit loss and the stage efficiency.

Problem (5.2) An impulse turbine has a number of pressure stages (pressure compounded turbine). The nozzle angle in the first stage is 20° and the blade exit angle =30°. The blade speed =120 m/s and the velocity of steam leaving nozzle =300 m/s. If the blade velocity coefficient =0.8 and the nozzle efficiency =0.85, find the work done per kg steam and the stage efficiency. If the steam supplied to the first stage is at 2 MPa and 250°C and the condenser pressure =0.01 MPa estimate the number of stages required.

Ans. [36 kJ/kg, 68 %, ≈4]

Problem (5.3) The outlet angles of the nozzle and blades of a two-row impulse turbine are in succession 16°, 18°, 20° and 30° and the corresponding nozzle and blade velocity coefficients are 0.92, 0.72, 0.78 and 0.84. The flow through the nozzle is at the rate of 4 kg/s, and the supply is at 1.2 MPa and 50°C superheat. The chamber pressure is 0.5 MPa and the blade speed is 1/5 that of the jet speed leaving the nozzle. Determine the work done and the blade efficiency.

Ans. [391.67 kW, 61.13 %]

Problem (5.4) A nozzle in an impulse turbine delivers 1 kg/s steam to a set of blades moving at 200 m/s. The nozzles are inclined at an angle of 16° to the plane of the wheel. The blade velocity coefficient is 0.72, calculate the blade efficiency, work done and also estimate the energy lost in the blades as; $m_o(V_{r1}^2 - V_{r2}^2)$ .Take the blade angles at inlet and outlet =25°.

Ans. [76%,105 kW, 27.072 kW