1- An inward flow turbine wheel work under a head of 20 m and makes 380 rpm. The diameter of the outlet circumference of the wheel is 60 cm and of the inner circumference 30 cm. the velocity of water entering the wheel is 13 m/s and the angle it makes with the tangent to the wheel is 10^{o}. Assuming the radial velocity of the flow through the wheel to be constant, and that the water leaves the wheel in a radial direction; determine the direction of the tangent to the vane of the wheel at the inlet and outlet. Determine also the hydraulic efficiency of the turbine.

2- An inward flow turbine work under a total head of 30 m. the velocity of wheel periphery at inlet is 15 m/s. the outlet pipe of the turbine is 30 cm in diameter and the turbine supplied with 250 liters of water per second, the radial velocity of the flow through the wheel is the same as the velocity in the outlet pipe. Neglecting friction, determine :

A- The vane angle at inlet.
B- The guide vane angle.
C- HP of the turbine.

3- 233 liters of water per second are supplied to an inward reaction turbine. The head available is 11 m. The wheel vanes are radial at inlet and the inlet diameter is twice the outlet diameter. The velocity of the flow is constant and equal to 1.83 m/s , the wheel makes 370 rpm , find:

A- Guide vane angle.
B- Wheel vane angle at inlet
C- Inlet and outlet diameter of the wheel
D- The width of the wheel at inlet and outlet. Neglecting the thickness of the vanes, assume that the discharge is radial and that there are no losses in the wheel.

4- Two inward flow reaction turbines working under the same head and same hydraulic efficiency having also runners of the same diameters 550 mm and the velocity of the flow for both is 5.5 m/s. one of the runners A has an inlet blade angle of 65^{o} and a speed of 520 rpm, while the other B has an inlet blade angle of 115^{o} .what is the speed of the runner B? State whether the speed calculated is synchronous one or not. If not , what speed would you recommended to couple the turbine with an alternator of 60 cycles/s

5- A- What are the functions of a draft tube? Why a pelton turbine does not processes any draft tube?

B- A Francis turbine has an outer diameter of 1.25 m and an inner diameter of 0.7625 m, the total head above wheel is 186 m, the radial component of the flow velocity of water is 6.23 m/s. the inlet runner blade angle is 90^{o}. Assume that 5% of the total head is lost in friction and eddying in guide apparatus, before the water reaching the wheel, and that 5% is lost in runner itself. The water escapes from the runner into tail-race at atmospheric pressure. Make any reasonable assumptions. What would be the pressure head of the water between the guide blades and the runner blades?

6- A reaction water turbine is equipped with a straight conical draft tube having top and bottom diameters of 0.5 m and 0.75 m respectively, the water velocity at the top is 3 m/s, where the elevation is 5 m above the level of the tail- race water. assuming a loss in draft tube equal to half of the velocity head at exit , compute:

A- The pressure head at the top.
B- The total head at the top with reference to the tail race as a datum
C- The total head at the exit
D- The power in water at the top and at exit
E- The power loss in tube due to friction.
F- The efficiency of the draft tube.

7- A turbine runner has an exit velocity of 10 m/s. the loss of head due to friction and other causes in the draft tube should not exceed 1.5 m. what maximum height of setting will you recommended for the turbine if the cavitation is to be avoided? Assume the velocity of the water at the outlet of the draft tube is 2.5 m/s and the cavitation commences when pressure is 2.5 m of water absolute.