Assignment unit - I

Fluid Machinery, ME 3rd year

(1). A jet of water 10 cm diameter strikes a stationary flat plate which is inclined at an angle of 45° with the axis of the stream. If the jet exerts a force of 2450 N in the direction of flow on the plate, find (a). velocity of jet
(b). Force normal to plate
(c) mass flow rate

Ans :- (a). 24.98 m/s, (b). 3464.82 N
(c). 196.09 kg/s

(2). A jet of water of 75 mm diameter strikes a curved vane at its centre with a velocity of 20 m/s and is deflected through an angle of 140°. If the vane moves with a velocity of 5 m/s in the direction of jet. find
(a). component of force on the plate in the direction of motion (b). Power of jet (c). efficiency of jet

Ans :- (a). 1756.33 N (b). 8781.65 W.
(c). 49.67 %

(3) A jet of water 10cm diam^{r} and having a velocity of 20m/sec. enters tangentially a curved vane, which is moving with a velocity of 5 m/sec. in direction of jet. The jet is deflected through an angle of 135°. find the magnitude and direction of resultant force on the vane. Also find the power developed by the jet.
(Ans: 3.26 kN, 22.5°, 15.07 kW)

(4) A jet of water having a velocity of 25 m/sec. impinges on a curved vane which is moving in the same direction as that of jet with a velocity of 8 m/sec. The jet makes an angle of 20° with the direⁿ of motion of vane at entry and leaves the vane at an angle of 120°. If the water enters and leaves the vane without shock, find vane angles at inlet and outlet. Also find the work done per second per unit weight of water striking vane. Neglect friction.

(Ans. 28.9°, 36.67°, 24.2 N.m/N)

(5) A jet of water having a velocity of 20 m/sec. impings on a curved vane which is moving in same direction as that of jet with a velocity of 5 m/sec. The jet makes an angle of 30° with the direⁿ of motion of vane at entry and leaves the vane at angle of 90° to the direction of motion of vane at outlet. If the water enters and leaves vane without shock, find vane angles at inlet and outlet. Also find work done per second per unit weight of water striking the vane.

(Ans 39.06°, 71.64°, 8.83 N.m/N)

(6) A 45mm diameter water jet having a velocity of 30 m/sec impinges on a curved vane which is moving in same direⁿ as that of jet with a velocity of 10 m/sec. The jet leaves vane at angle of 135° with the direⁿ of motion of vane. Find neglecting friction

(a) The force exerted by the jet in the direⁿ of motion of vane,
(b) The power developed by jet. and
(c) The efficiency of vane.

[Ans (a) 2731.2 N (b) 27312 N-M, (c) 50.58%]

(7) A pelton wheel having diamᵛ of 1m rotates at 500 rpm. Water is supplied at rate of 0.5 m³/sec under a head of 400m. If the buckets deflect the jet through an angle 165°. Find power developed & hydraulic efficiency of Turbine. Assume co-efficient of velocity as 0.8 & Neglect frictional losses in bucket.

(Ans. 1560.46 kw, 88.81%)

(8) A pelton wheel has a mean bucket speed of 35 m/sec with a jet of water flowing at rate of 0.4 m^3/sec under head of 350 cm. The buckets deflect jet through an angle of 165°. If co-efficient of velocity is 0.97, Determine power delivered the runner and hydraulic efficiency of Turbine. Neglect friction loss in bucket.

(Ans: 1317.54 kW, 95.93%)

(9) A two jet pelton turbine is required to generate 6000 kW under a head of 350 m. The buckets deflect the jet through an angle of 160°. The decrease in relative velocity while passing over the blade is 5%. The overall efficiency of turbine is 85%. Determine the diam^{n} of jet and force exerted by a jet on buckets. Assume co-efficient of velocity as ~~0.98~~ 0.97 and speed ratio as 0.46.

[Ans: 128 mm, 82.23 kN]

(10) A pelton wheel develops 9000 kW under a head of ~~350~~ 400 m at a speed of 400 rpm. The wheel diam^{n} is 10 times jet diam^{n}. The overall efficiency of turbine is 82%. Determine required flow rate, wheel diam^{n}, diam^{n} of each jet, and number of jets required, Assume co-efficient of velocity as 0.97 and speed ratio as (0.46)

[Ans: 2.797 m^3/sec, 1.946 m, 194.6 mm, 2]

(11) A pelton wheel is required to develop 8000 kW, when working under a head of 400 m at a speed of 600 rpm. If overall efficiency of 85% find (a) Quantity of water required.

(b) Diam^{r} of Wheel.

(c) Number of jets, and

(d) Number and Size of bucket on the runner.

Assume a jet ratio of 8, co-efficient of velocity as 0.98 and Speed ratio of 0.46.

[Ans:- (a) 2.398 m^3/sec (b) 1.297 m (c) 2 (d) 19, width = 0.81 m, depth = 0.1944 m]

(12) A pelton wheel with single jet rotates at 600 rpm. The pitch circle diam^{r} of wheel 1.2m and buckets deflects the jet through an angle of 165°. The net head on wheel is 400m and discharge through Nozzle is 0.4 m^3/sec. Determine power available at the nozzle, and hydraulic efficiency of the turbine. Take Co-efficient of velocity as 0.97.

[Ans :- 1569.6 KW, 96.82%]