(Following Paper ID and Roll No. to be filled in your Answer Book)

PAPER ID : 140651 Roll No. | | | | | | | | | | |

B.Tech.

(SEM. VI) THEORY EXAMINATION 2013-14

FLUID MACHINERY

Time : 3 Hours *Total Marks : 100*

Note : (1) Attempt **all** questions.

(2) Marks are indicated against each question.

(3) Assume missing data if any.

1. Attempt any **two** parts of the following : **(10×2=20)**

(a) (i) Show that in case of jet striking the series of flat plates mounted on wheel periphery, the efficiency will be maximum when tangential velocity of wheel is half of the jet.

(ii) Establish the ratio of forces executed by a water jet when it is made to strike :

(a) A stationary flat plate held normal to it

(b) A flat plate moving in the direction of jet at one third the velocity of jet

(c) A series of flat plates mounted on a wheel and moving at one third the velocity of jet.

(b) Obtain an expression for the work done per kg of flow by a Pelton wheel in terms of bucket speed u jet velocity V_1 and outlet blade angle β_2. Neglect all friction losses.

If loss due to bucket friction and shock can be expressed by $k_1\frac{(v_1-u)^2}{2g}$ and that loss due to bearing friction by $k_2\frac{u^2}{2g}$ where K_1 and K_2 are constants, show that maximum efficiency based on energy of jet occurs when $\frac{u}{v_1}=\frac{1+\cos\beta_2+k_1}{2(1+\cos\beta_2)+k_1+k_2}$

(c) A single jet pelton wheel runs at 300 rpm under a head of 510 m. The jet diameter is 200 m, its deflection inside the bucket is 165° and its relative velocity is reduced by 15 % due to friction. Find :

(i) Water horse power.

(ii) Resultant force on the bucket.

(iii) Brake power if mechanical losses are 3 % of power supplied

(iv) Overall efficiency

Assume velocity coefficient = 0.98, speed ratio = 0.46

2. Attempt any **two** parts of the following : **(10×2=20)**

(a) Differentiate between Francis and Kaplan turbine. Show that in a turbine, with radial vanes at inlet and outlet, the hydraulic efficiency is given by $\eta_h=\frac{2}{2+\tan^2\alpha_1}$ where α_1 is the guide blade angle. Assume flow velocity to remain constant.

(b) What is the purpose of draft tube in reaction turbines ? A hydraulic turbine is to develop 845 kW when running at 100 rpm under a net head of 10 m work out the maximum flow rate and specific speed for the turbine if the overall efficiency at the best operating point is 0.92. In order to predict, its performance, a 1:10 scale model is tested under a head of 6 m. What would be the Speed, Power Output and Water Consumptions of the model if it runs under the conditions similar to the prototype ?

(c) For a Kaplan turbine with runner diameter 4 m, the discharge is 60 m^3/s and the hydraulic and mechanical efficiencies are 90 % and 94 % respectively. The diameter of boss is 0.3 times the runner diameter and the speed ratio is 2. Assuming that discharge is free and there and is no whirl at outlet. Calculate the net available head on the turbine, the power developed and specific speed.

3. Attempt any **two** parts of the following : **(10×2=20)**

(a) (i) Compare centrifugal pump and reciprocating pump.

(ii) Discuss the characteristics curves for the centrifugal pump.

(b) A centrifugal pump impeller has diameter of 60 cm and width of 6 cm at outlet. The pump runs at 1450 rpm and delivers 0.8 m^3/s against a head of 80 m.

The leakage loss after the impeller is 4 % of the discharge, external mechanical loss is 10 kW hydraulic efficiency is 80 %. Determine the blade angle at outlet, the power required and overall efficiency of the pump.

(c) Prove that manometric head of a centrifugal pump may be written in the form : $H_m=AN^2+BNQ+CQ^2$
where N represents speed and Q represents discharge A, B and C are constants. Indicate the assumptions made.

4. Attempt any **two** parts of the following : **(10×2=20)**

(a) (i) What is air vessel ? Describe the function of air vessel with the help of neat sketch.

(ii) Explain the term negative slip as used in reciprocating pump; why and when negative slip occurs.

A single acting reciprocating pump has the plunger diameter of 20 cm and stroke of 30 cm. The pump discharges 0.53 m^3 of water per minute at 60 rpm. Find the theoretical discharge, coefficient of discharge and percentage slip of pump.

(b) Draw the indicator diagram for reciprocating pump considering acceleration and friction head in suction and delivery pipes and find expression for the work done for a single pump.

(c) A single acting reciprocating pump of 12 cm diameter and 24 cm stroke is delivering water to the tank which is 10 m above the centre of pump. The pump is located 5 m above the centre of sump. The diameter and the length of the suction pipe are 5 cm and 5 m respectively, and diameter and length of delivery pipe are 4 cm and 20 m respectively. Find the maximum speed of the pump to avoid separation either in suction pipe or delivery pipe. Take atmospheric pressure head 10.33 m of water and separation occurs at 80 kN/m^2 below atmospheric pressure.

5. Attempt any **two** parts of the following : **(10×2=20)**

(a) Differentiate between fluid coupling and fluid torque converter and explain their working with the help of neat sketches.

(b) Describe the working of a differential type of accumulator with the help of neat sketches.

A hydraulic ram delivers water at the rate of 5 litres/sec to a tank at 40 m from the ram. The water is supplied to the ram from a tank at 5 m height from ram at a rate of 50 litres/sec.The length and diameter of the delivery pipe are 60 m and 6 cm respectively. Find the d'Aubuisson and Rankine efficiencies of the Ram.

(c) A hydraulic lift is designed to lift a load of 10 kN through a height of 10 m in 100 seconds. The speed of the lift is limited to 1 m/s. When the lift is ascending, the water from the pump and accumulator is supplied to the lift at 50 bar. Assuming pump efficiency is 85 % and lift efficiency is 80 %. Find the power required to drive the pump and minimum capacity of the accumulator. Neglect friction losses.