B.Tech Sem – VI (2007 Course) (Mechanical Engg.) : SUMMER - 2019

SUBJECT: FLUID MACHINERY

Day : Wednesday
Date : 29/05/2019

S-2019-3135

Time : 02.30 PM TO 05.30 PM
Max. Marks: 80

N. B. :

1) **Q. No.1 and Q. No.5 are COMPULSORY.** Out of the remaining attempt **ANY TWO** questions from each section.
2) Figures to the right indicate **FULL** marks.
3) Answer to both the sections should be written in **SAME** Answer book.
4) Assume suitable data, if necessary.
5) Draw neat and labeled diagrams **WHEREVER** necessary.

SECTION-I

Q.1 **a)** Derive an expression for the force exerted by a jet of water on a fixed vertical plate in the direction of the jet. **(05)**

b) How are hydraulic turbines classified? **(05)**

c) What is the difference between propeller turbine and a Kaplan turbine? **(04)**

Q.2 **a)** Derive an expression for force exerted on a stationary symmetrical curved vane when the jet strikes at one end tangentially. **(05)**

b) A 75 mm diameter water jet having a velocity of 12 m/s impinges on a plane, smooth plate at an angle of 60° to the normal to the plate. What will be the impact when, i) the plate is stationary and ii) the plate is moving in the direction of the jet at 6 m/s? **(08)**
Estimate the work done per unit time by the jet on the plate in each case. Take the density of water as 998 kg/m^3.

Q.3 **a)** With the help of a neat sketch explain inlet and outlet velocity triangles of a Pelton turbine. Also define each symbol. **(05)**

b) A single jet Pelton turbine runs at 300 rpm under a head of 510 m. The jet diameter is 200 mm, its deflection inside the bucket is 165° and its relative velocity is reduced by 15% due to friction. **(08)**
Determine:
i) Water power ii) Resultant force on the bucket
iii) Overall efficiency
Take: mechanical losses = 3%, coefficient of velocity = 0.98 and speed ratio = 0.46.

Q.4 A Francis turbine has to be designed to develop 367.5 kW under a head of H = 70 m while running at N = 750 rpm. Ratio of width of runner to diameter of runner, n = 0.1. Inner diameter is half the outer diameter. Flow ratio = 0.15, hydraulic efficiency = 0.95, mechanical efficiency = 0.84. **(13)**
4% of circumferential area of runner to be occupied by the thickness of vanes, velocity of flow is constant and the discharge is radial at exit.
Calculate:
i) The diameter of the wheel
ii) The quantity of water supplied
iii) The guide vane angle at inlet
iv) Runner vane angles at inlet and exit

P.T.O.

SECTION-II

Q.5 **a)** Define: specific speed and runaway speed of turbines. **(05)**

b) Define: static head, manometric head and total head. **(05)**

c) With the help of a neat sketch explain an operation of torque converter. **(04)**

Q.6 **a)** With the help of a neat sketch explain governing mechanism of reaction turbines. **(05)**

b) A turbine is to operate under a head of 25 m at 200 rpm. The discharge is 9 m^3/s. If the efficiency is 90%, determine the performance of the turbine under the head of 20 m. **(08)**

Q.7 A three stage centrifugal pump has impeller 400 mm in diameter and 20 mm wide. The vane angle at outlet is 45° and the area occupied by the thickness of the vanes may be assumed 8% of the total area. If the pump delivers 3.6 m^3 of water per minute when running at 920 rpm, **(13)**

Determine:

i) Power of the pump ii) Manometric head

iii) Specific speed

Assume mechanical efficiency as 88% and manometric efficiency as 77%.

Q.8 **a)** With the help of a neat sketch, explain the construction and working of fluid coupling. Also explain its efficiency versus speed ratio curve. **(07)**

b) What is purpose of air vessels? Explain operation of reciprocating pump with air vessels with the help of a neat sketch. **(06)**

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