B.Tech Sem – VI (2007 Course) (Mechanical Engg.) : WINTER - 2018

SUBJECT: FLUID MACHINERY

Day : Friday
Date : 16/11/2018

W-2018-2870

Time : 10.00 AM TO 01.00 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 the both sections in **SEPARATE** answer books.
4) Assume suitable data, if necessary.
5) Draw neat and labeled diagrams **WHEREVER** necessary.

SECTION-I

Q.1 **a)** Prove that for a curved radial vane the efficiency is given by: **(05)**

$$\eta = \frac{2(V_{w1}u_1 \pm V_{w2}u_2)}{V_1^2}$$

b) Draw a general layout of hydraulic power plant using an impulse turbine and define the following terms: **(05)**

i) Gross head
ii) Net head
iii) Hydraulic efficiency
iv) Overall efficiency

c) State advantages of Kaplan turbine over Francis turbine. **(04)**

Q.2 **a)** A jet strikes tangentially to a smooth curved vane moving in the same direction as the jet, and the jet gets reversed in the direction. Show that the maximum efficiency is slightly less than 60%. **(05)**

b) A jet of water moving at 12 m/s impinges on a concave shaped smooth vane to deflect the jet through 120° when stationary. The vane is moving at 5 m/s. Find: **(08)**

i) The angle of jet so that there is no shock at inlet.
ii) The absolute velocity of jet at exit, both in magnitude and direction.
iii) The work done per second per Newton of water

Q.3 **a)** Derive an expression for hydraulic efficiency of a Pelton turbine. **(05)**

b) The following data is related to a Pelton turbine: **(08)**

Brake or shaft power = 126.5 kW
Head = 300 m
Speed = 600 rpm
Coefficient of velocity, C_v = 0.98
Speed ratio, K_u = 0.48
Overall efficiency η_o = 0.75

Determine:

i) The discharge
ii) The least jet diameter
iii) Number of buckets

P.T.O.

Q.4 **a)** What is cavitation? How it can be avoided in reaction turbines? **(05)**

b) Design a Francis turbine runner with the following data: **(08)**

Net head = 68 m
Speed of runner = 750 rpm
Output = 330.9 kW
Overall efficiency = 85%
Hydraulic efficiency = 94%
Flow ratio = 0.15
Breadth ratio = 0.1

Inner diameter of the runner = 0.5 × Outer diameter
Also assume 5 % of circumferential area of the runner to be occupied by thickness of the vanes.
Velocity of flow remains constant throughout and the flow is radial at exit.

SECTION-II

Q.5 **a)** With the help of a neat sketch, explain operation of deep well pump. **(05)**

b) What do you mean by Net Positive Suction Head (NPSH)? **(05)**

c) Explain the function of surge tanks in water turbines. **(04)**

Q.6 **a)** What are the factors to be considered for selection of water turbines? **(05)**

b) What is specific speed of a turbine? Derive an expression for specific speed of a water turbine. **(08)**
A turbine is to operate under a head of 25 m at 200 rpm. The discharge is 9 m^3/s. If the overall efficiency is 90%, determine:

i) Power generated
ii) Specific speed of the turbine
iii) State the type of turbine

Q.7 **a)** What are the various operational difficulties in centrifugal pumps? Also discuss their remedies. **(05)**

b) A centrifugal pump running at 800 rpm is working against a total head of 20.2 m. The external diameter of the impeller 480 mm and outlet width 60 mm. If the vanes angle at outlet is 40° and manometric efficiency is 70%, determine: **(08)**

i) Flow velocity at the outlet
ii) Absolute velocity of water leaving the vane
iii) Angle made by the absolute velocity at outlet with direction of motion at outlet
iv) Rate of flow through the pump

Q.8 **a)** With the help of a neat sketch, explain different components of a single acting reciprocating compressor. Also explain its working. **(06)**

b) Explain with a neat sketch, the working of an air lift pump. Mention its disadvantages. **(07)**

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