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Printed Pages : 4 TME – 604

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

PAPER ID : 4096 Roll No. | | | | | | | | | | |

B. Tech.

(SEM. VI) EXAMINATION, 2006-07

FLUID MACHINERY

Time : 3 Hours] *[Total Marks : 100*

Note : *(1) Answer all questions.*

*(2) All questions carry **equal** marks.*

(3) Assume suitable data wherever not provided.

(4) Give precise answer to the question.

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

a) Derive Euler's momentum equation for hydrodynamic machines.

b) Show that when a jet of water strikes on a series of curved vanes maximum efficiency is obtained when the vane is semi-circular in section and the velocity of the vane is half that of the jet.

c) A Pelton turbine is required to produce **6 MW** power when working under a head of **300 m**. The turbine **RPM** is **550** and the over all efficiency is **0.85.** The turbine works with **3** jets. Determine:

(i) the diameter of the runner

(ii) discharge per second

(iii) diameter of the jet and

(iv) number of buckets.

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

a) What are the main components of a reaction turbine? Describe their functions. Compare a Francis turbine with Kaplan turbine.

b) Show that in a given turbine :

$$u \propto \sqrt{H},\ Q \propto \sqrt{H} \text{ and } P \propto H^{3/2}$$

where u is peripheral speed, Q is discharge rate, P is power and H is the available head.

c) Following data pertain to a Francis Turbine : Net head = **60m, RPM=650**
Brake power – **275 kW**, Ratio of wheel width to wheel diameter = **0.1**, Ratio of outer diameter to inner diameter = **2**. Flow ratio k_f **= 0.17.**

$\eta_{hydraulic}$ **= 0.95** and $\eta_{overall}$ **= 0.85.**

The flow velocity remains constant and the discharge is radial. Find out wheel width, diameter and blade angles at inlet and outlet.

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

a) i) Explain why priming is essential before starting a centrifugal pump.

ii) Explain why the suction lift of a pump can not exceed a certain limit.

b) Discuss the main and operating characteristics of a centrifugal pump. What is the importance of a constant efficiency curve?

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c) Following data refer to a centrifugal pump : Impeller internal and external diameters = **20 cm** and **40 cm** respectively; suction and delivery heads = **5 m** and **25 m** respectively; diameters of suction and delivery pipes = **12 cm** and **8 cm** respectively; discharge rate = **0.035 m^3/ sec.** and **RPM =950**. If the vane outlet angle is **45^o**, flow velocity is constant and is equal to **1.8 m/sec** and the power required to run the pump is **15 kW**. Determine :

i) the vane angle of impeller at inlet

ii) the overall manometric efficiency of the pump.

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

a) Give a sketch of the theoretical pressure- volume diagram for the cylinder of a reciprocating pump, which is not fitted with air vessels. Show clearly the effects of acceleration and friction in both the suction and delivery pipes.

b) Show that the work saved in overcoming friction in the pipelines by fitting air vessels is **84.8%** for a single acting reciprocating pump.

c) In a reciprocating pump executing simple harmonic motion, the velocity of water in the suction pipe varies between zero and V_{max} during suction stroke. Show that mean friction head during the stroke is given by.

$$(h_f)_{mean} = \frac{4}{3}\frac{fl\,V_{max}^2}{g.d.}$$

where ***l, d*** and ***f*** are the length, diameter and friction coefficient respectively for the suction pipe.

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

a) Describe with sketch the working of : (i) Hydraulic Press (ii) Hydraulic Accumulator

b) Explain the working of a hydraulic ram with the help of a neat sketch.

The water is supplied at a rate of **0.02** $\mathbf{m^3}$ per second from a height of **3** meter to a hydraulic ram. The ram raises **0.002** $\mathbf{m^3/sec}$ water to a height of **20** meter. Determine D'Aubuisson's and Rankine's efficiencies of the hydraulic ram.

c) A hydraulic intensifier has a ram of **100 mm** diameter and a sliding piston of **100 cm** diameter. The high pressure water is carried from intensifier to a press. The ram of hydraulic press is **300 mm** in diameter. Intensifier is supplied water from a tank though a **50 mm** diameter pipe, which is **100** meter long. The tank is placed **15** meter above the intensifier. If the coefficient of friction for pipe is **0.01** and the press exerts a force of **500 kN**, determine the speed with which the ram of the press advances to exert the force.
