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

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

B.Tech.

(SEM VI) EVEN SEMESTER THEORY EXAMINATION, 2009-2010

FLUID MACHINERY

Time : 3 Hours   *Total Marks : 100*

Note : *(i)   Attempt **ALL** questions.*

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

(iii)   Assume missing data, suitably, if any.

1.   Attempt **any two** parts of the following :   2x10=20
      (a)   Determine the force exerted and work done
              by a water jet when it strikes :
              (i)   A stationary flat plate held normal to
                      it ;
              (ii)   A flat plate moving at one third the
                      velocity of the jet, in the direction of
                      jet;
      (b)   Derive Euler's momentum equation.
      (c)   A Pelton wheel has following specifications :
              Shaft Power   = 12,000 kW ;
              Head   = 400 meters,
              Speed   = 750 RPM;
              Overall efficiency = 0.85
              and the ratio of jet diameter to the wheel
              diameter is $\frac{1}{6}$. Determine :

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(i) The wheel diameter

(ii) Diameter of the jet and number of jet required. Take coefficient of velocity = 0.98 and speed ratio = 0.45.

2. Attempt **any two** parts of the following : 2x10=20

(a) What is specific speed of a turbine ? Derive expression for specific speed. How are turbines classified according to specific speed ?

(b) What are functions of a draft tube ? Explain the theory behind the working of draft tube. How is efficiency of a draft defined ?

(c) The hub diameter of a Kaplan turbine, working under a head of 12 m is 0.35 times the diameter of the runner. The turbine is running at 100 RPM. If the vane angle of the runner at the outlet is 15° and flow ratio is 0.6, find :

(i) Diameter of the runner

(ii) Diameter of the boss, and

(iii) Discharge through the runner. The whirl component of velocity at the outlet is zero.

3. Attempt **any two** parts of the following : 2x10=20

(a) (i) How does a centrifugal pump imparts pressure energy to the fluid ? Explain the mechanism involved.

(ii) What is priming of a centrifugal pump ? Explain why priming is essential before starting a centrifugal pump ?

(b) Discuss the main and operating characteristics of a centrifugal pump. Explain the importance of constant efficiency curves.

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(c) A centrifugal pump with 1.2 m diameter runs at 200 RPM and discharges 1900 litres water per second, the average lift being 6m. The angle which the Vanes make at exit with the tangent to the impeller is 26° and the radial velocity of flow is 2.5 m/s. The inner diameter of the impeller is 0.6 m. Determine :

(i) the power required to drive the pump,

(ii) the manometric efficiency and

(iii) the minimum RPM to start pumping against a head of 6m.

4. Attempt **any two** parts of the following : 2x10=20

(a) Sketch and explain theoretical pressure–volume diagram for the cylinder of a reciprocating pump, which has no air vessel connected to it show clearly the effects of acceleration and friction in both the suction and delivery pipes and explain.

(b) A single acting reciprocating pump has its piston executing a simple harmonic motion. Show that the ratio of the work done against friction with air vessels fitted to that without air vessels is $\dfrac{3}{2\pi^2}$

(c) A double acting reciprocating pump has a simple harmonic motion and runs at 25 RPM. It has a bore of 25 cm and a stroke of 40 cm. The pump lifts water from a sump 4 m below and delivers it to a tank placed 70 m above the cylinder axis. The suction and delivery pipes are of length 6m and 160 m respectively and the diameter of delivery pipe is 10 cm. If an air vessel of adequate capacity has been fitted on the discharge side, determine :

(i) Minimum diameter of suction pipe to prevent cavitation, assuming minimum head of 2.5 m is needed to prevent cavitation .

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(ii) The maximum gross head against which the pump has to work, and

(iii) Discharge through the pump

5. Attempt **any two** parts of the following :   2x10=20

   (a) Explain the working of following with neat sketches :

       (i) hydraulic coupling

       (ii) hydraulic torque converter

   (b) Explain the construction and working of a hydraulic press with a neat sketch. What is mechanical advantage, leverage and velocity ratio in a hydraulic press ?

   (c) Explain the working principle of a hydraulic ram. What are its advantages over conventional pumps ?

       In a hydraulic ram ; supply head = 2.5 m; delivery head = 15 m ; water supply rate is 1 m^3/min. and waste water flow rate is 10m^3/min. Calculate D'Auburisson's and Rankins efficiencies of the ram.

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(ii)   The maximum gross head against which the pump has to work, and

(iii) Discharge through the pump

5.   Attempt **any two** parts of the following :   2x10=20

(a) Explain the working of following with neat sketches :

(i)   hydraulic coupling

(ii)   hydraulic torque converter

(b) Explain the construction and working of a hydraulic press with a neat sketch. What is mechanical advantage, leverage and velocity ratio in a hydraulic press ?

(c) Explain the working principle of a hydraulic ram. What are its advantages over conventional pumps ?

In a hydraulic ram ; supply head = 2.5 m; delivery head = 15 m ; water supply rate is 1 m^3 /min. and waste water flow rate is 10m^3/min. Calculate D'Auburisson's and Rankins efficiencies of the ram.

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