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

PAPER ID : 2528 Roll No. | | | | | | | | | | |

B.Tech.

(SEMESTER-VI) THEORY EXAMINATION, 2012-13

FLUID MACHINERY

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

SECTION – A

1. Attempt **all** question parts. **10 × 2 = 20**

(a) Define the term impact of jets.

(b) Define effective head and give its equation.

(c) State the differences between Inward and Outward Radial flow reaction turbine.

(d) Mention the importance of Euler turbine equation.

(e) Define cavitation. What are the effects of cavitation ?

(f) Draw and discuss the operating characteristics of a centrifugal pump.

(g) Define Slip of reciprocating pump. When the negative slip does occur ?

(h) Differentiate between Single acting and Double acting reciprocating pump.

(i) Define capacity of accumulator and give its equation.

(j) State the reason for low efficiency of hydraulic ram.

SECTION – B

2. Attempt any **three** question parts : **3 × 10 = 30**

(a) Draw and discuss the working of multistage pump with

(i) Impeller in parallel

(ii) Impeller in series

(b) Show that the hydraulic efficiency for a Francis turbine having velocity of flow through runner as constant is given by the relation

$$n_h = \frac{1}{1 + \frac{\frac{1}{2}\tan^2 \alpha}{\left\{1 - \frac{\tan \alpha}{\tan \theta}\right\}}}$$

(c) Derive the fundamental energy equation for energy transfer between the fluid and rotor (Euler's Equation).

(d) The bore and stroke of a double acting single cylinder reciprocating pump running at 30 r.p.m. are 200 mm and 400 mm respectively. The pump draws water from a sump 1.2 m below the pump through a suction pipe 100 mm in diameter and 3.0 m long. The water is delivered to a tank 28 m above the pump through a delivery pipe 100 mm in diameter and 38 m long. Assuming the motion of the piston to be simple harmonic determine the net force due to fluid pressure on the piston when it has moved through a distance of 100 mm from Inner dead centre. Take coefficient for both the suction and delivery pipe as 0.006. Neglect the size of the piston rod.

(e) Describe with an aid of neat sketch the working of a hydraulic torque converter.

SECTION – C

Attempt **all** questions. **5 × 10 = 50**

3. Attempt any **two** parts : **2 × 5 = 10**

(a) A single acting reciprocating pump has a bore of 200 mm and a stroke of 350 mm and runs at 45 rpm. The suction head is 8 m and the delivery head is 20 m. Determine the theoretical discharge of waste and power required. If slip is 10%, what is the actual flow rate ?

(b) Describe the principle and working of a Gear Pump.

(c) Draw the indicator diagram for Reciprocating Pump and explain its significance.

4. Attempt any **one** part : **1 × 10 = 10**

(a) A centrifugal pump is running at 1000 r.p.m. The outlet vane angle of the impeller is 45° and velocity of flow at outlet is 2.5 m/s. The discharge through the pump is 200 lit/s when the pump is working against a total head of 20 m. If the manometric efficiency of the pump is 80%. Determine

(i) Diameter of the impeller (outside diameter)

(ii) Width of the impeller at outlet

(b) Show that the pressure rise in the impeller of a centrifugal pump when frictional and other losses in the impeller are neglected is given by

$$\frac{1}{2g}\{V_{f1} + u_2^2 - V_{f2}\ \text{cosec}^2\ Q\}$$

where V_{f1} and V_{f2} are velocity of flow at inlet and outlet, u_2 = tangential velocity of impeller at outlet and Q = vane angle at outlet.

5. Attempt any **one** part : **1 × 10 = 10**

(a) Design a Pelton wheel for a head of 60 m and speed of 200 r.p.m. The Pelton wheel develops 95.6475 kW shaft power. The velocity of bucket = 0.45 times the velocity of the jet. Take coefficient of velocity = 0.98 overall efficiency = 0.85.

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

(i) The angle of jet so that there is no shock at inlet

(ii) The absolute velocity of the jet at exit both in magnitude and direction

(iii) The work done per second per N of water

6. Attempt any **one** part : **1 × 10 = 10**

(a) A Kaplan turbine plant develops 24647.6 kW power at an average head of 39 m. Assuming a speed ratio of 2, flow ratio of 0.6, diameter of boss equal to 0.35 times the diameter of the runner and overall efficiency of 90%. Calculate the diameter, speed and specific speed of turbine.

(b) A Francis turbine working under a head of 30 m has a diameter of 1.2 m at the entrance and 0.6 m at the exit. The vane angle at the entrance is 90° and guide blade angle is 15°. The water at the exit leaves the vanes without any tangential velocity and velocity of flow in the runner is constant. Neglecting the effect of draft tube and losses in the guide and the runner passages, determine the speed of wheel in r.p.m and vane angle at the exit. State whether the speed calculated is synchronous or not. If not, what would you recommend to couple the turbine with an alternator of 50 cycles ?

7. Attempt any **two** parts : **2 × 5 = 10**

(a) What is the difference between hydraulic accumulator and hydraulic intensifier ?

(b) Draw only the diagram of direct acting and suspended hydraulic lift.

(c) Describe Air lift pump with a neat sketch.
