

III B.Tech I Semester Regular Examinations, November 2006

HYDRAULIC MACHINERY AND SYSTEMS

(Common to Mechanical Engineering and Automobile Engineering)

Time: 3 hours

Max Marks: 80

Answer any FIVE Questions

All Questions carry equal marks

1. (a) Derive an expression for the force exerted by a jet on a stationary curved plate, when the jet strikes the curved plate at one end tangentially when the plate is symmetrical.
(b) A jet of water of diameter 10 cm moving with a velocity of 30 m/s strikes a curved fixed symmetrical plate at the center. Find the force exerted by the jet of water in the direction of the jet if the jet is deflected through an angle of 120° at the outlet of the curved plate. [6+10]
2. (a) What are guide vanes?
(b) Define flow ratio and speed ratio?
(c) What are the disadvantages of an outward flow turbine? [4+6+6]
3. (a) One Pelton wheel develops 15MW power under a head of 360m at 450 rpm. What is its specific speed? What would be its normal speed and output under a head of 145m .
(b) Explain what do you understand by unit speed, unit power and unit discharge of turbine. [10+6]
4. (a) Derive an expression for the discharge of water into and from air vessel fitted to the delivery pipe of a single acting reciprocating pump.
(b) A double acting reciprocating pump, running at 60 r.p.m has a plunger diameter of 250 mm and a stroke of 500mm. The delivery pipe is 100mm diameter and 50 m long. If the motion of the pump is simple harmonic, find the power required to overcome friction of the delivery pipe when no air vessel is fitted. Assume $f = 0.01$ [8+8]
5. (a) What is the basic principle applied to find the work done on water in centrifugal pump? Explain in detail.
(b) A centrifugal pump delivers water against a net head of 10 m at a speed of 1000 rpm. The vanes are curved backward and make an angle of 30 degrees. The impeller outside diameter is 30 cm and has a width of 5 cm at the outlet. Determine the discharge if manometric efficiency is 95%. [8+8]
6. (a) What do you understand by multistage pump? When do you use them?
(b) What do you understand by pumps in parallel? When do you connect the pumps in parallel ? [8+8]

7. (a) Describe with neat sketch the working of a hydraulic press.
- (b) A hydraulic press has diameter of ram 200 mm and of plunger 40 mm. It is provided with a lever for applying force to the plunger. If the ratio of leverage is 10, determine the weight lifted by the press, when the force applied to the level is 100 N. [8+8]
8. (a) Describe the construction and working of a gear pump.
- (b) What is the effect of change in speed and temperature of liquid in case of a gear pump? [8+8]

III B.Tech I Semester Regular Examinations, November 2006**HYDRAULIC MACHINERY AND SYSTEMS****(Common to Mechanical Engineering and Automobile Engineering)****Time: 3 hours****Max Marks: 80****Answer any FIVE Questions****All Questions carry equal marks**

1. (a) Prove that the moment of the momentum flux across an area about any axis equals the momentum of all the external forces applied at the center of the area about the same axis.
(b) The resistance of a ship is given by $(5.55 U^6 + 978 U^{1.9})$ N at a speed of U m/s. It is driven by a jet propulsion with intakes facing forward, the efficiency of the jet drive being 0.8 and the efficiency of the pumps is 0.72. The vessel is to be driven at 3.4 m/s. Find the mass of water to be pumped per second and the power required to drive the pump. [6+10]
2. A reaction turbine is supplied with 100 m^3 of water per second under an average head of 150 m. The runner diameter is 3.6 m at inlet and 2.4 m at outlet. Its inlet vane angle is 120° . Assuming radial discharge at 15m/s breadth of wheel being constant and hydraulic efficiency of 90%. Find the power produced and the speed of the machine. [16]
3. (a) One Pelton wheel develops 15MW power under a head of 360m at 450 rpm. What is its specific speed? What would be its normal speed and output under a head of 145m .
(b) Explain what do you understand by unit speed, unit power and unit discharge of turbine. [10+6]
4. (a) Derive an expression for the discharge of water when air vessel fitted to the delivery pipe of a double action reciprocating pump
(b) A single acting reciprocating pump running at 60 r.p.m has a plunger diameter of 250 mm and a stroke of 500 mm. The delivery pipe is 100mm diameter and 50m long. If the motion of the pump is simple harmonic, find the power required to overcome friction of delivery pipe when a large air vessel is fitted at the center line of the pump. Assume $f=0.01$. [8+8]
5. (a) Explain how the centrifugal pump is equivalent to the reverse of a reaction turbine.
(b) Differentiate between
 - i. Mechanical efficiency
 - ii. Volumetric efficiency
 - iii. Manometric efficiency. [8+8]
6. (a) Why do we provide kinematic similarity between model and prototype?

- (b) Two homologous pumps A and B will run at same speed of 600 rpm. The discharge and head of pump A are $0.4 \text{ m}^3 / \text{sec}$ and 50 m respectively. Determine the discharge of pump B to lift the discharge by 30 m. [6+10]
7. (a) Differentiate between Hydraulic Accumulator and a Differential accumulator.
- (b) The diameter of the ram of an accumulator is 500mm and the stroke is 759 mm. It is loaded with 1.25 MN of total weight. If the packing friction of the ram is 0.5 percent of the weight on the ram, calculate the power delivered to the mains, if the ram falls steadily at the rate of the stroke in 125 seconds and the pumps are delivering simultaneously at the rate of 2 m^3 per minute.[8+8]
8. (a) Describe the construction and working of a gear pump.
- (b) What is the effect of change in speed and temperature of liquid in case of a gear pump? [8+8]

III B.Tech I Semester Regular Examinations, November 2006**HYDRAULIC MACHINERY AND SYSTEMS****(Common to Mechanical Engineering and Automobile Engineering)****Time: 3 hours****Max Marks: 80****Answer any FIVE Questions****All Questions carry equal marks**

1. (a) Obtain an expression for the force on the inclined plate moving in the direction of the jet . Also get the expression for the work done per second by the jet on the plate.
- (b) A jet of water moving at 12 m/s impinges on a concave shaped vane to deflect the jet through 120° when stationary. If the vane is moving at 5m/s, find the angle of jet so that there is no shock at inlet. Also compute the absolute velocity of jet at exit both in magnitude and direction and the work done per second per N of water. Assume that the vane is smooth. [6+10]
2. Show that the hydraulic efficiency of a Pelton wheel is given by

$$\eta_m = (1 + \cos \phi) \frac{2u(V - u)}{V^2}$$

With the usual notations

V = Velocity of the jet

u = Velocity of the vane at the impact point

 ϕ = outlet vane angle

[16]

3. (a) One Pelton wheel develops 15MW power under a head of 360m at 450 rpm. What is its specific speed? What would be its normal speed and output under a head of 145m .
- (b) Explain what do you understand by unit speed, unit power and unit discharge of turbine. [10+6]
4. (a) Show from first principle, the work saved against friction in the delivery pipe of a double-acting reciprocating pump by fitting air vessel is 39.2%
- (b) A double acting reciprocating pump running at 60 r.p.m has a plunger diameter of 250 mm and a stroke of 500 mm. The delivery pipe is 100mm diameter and 50m long. If the motion of the pump is simple harmonic, find the power required to overcome friction of delivery pipe when a large air vessel is fitted at the center line of the pump. Assume $f=0.01$. [8+8]
5. (a) What are the mechanical losses in the working of a centrifugal pump?
- (b) The impeller of a centrifugal pump has outer diameter of 40 cm and inner diameter of 20 cm. The blade angle at outlet is 30° . The speed of the impeller is 1450 rpm. The velocity of flow at inlet and out let is same at 2.2 m/ sec. Find head developed if manometric efficiency is 75%, absolute velocity at out let and blade angle at inlet. [8+8]

6. (a) What is the phenomenon of cavitation ? Where will it occur in centrifugal pump?
(b) When will the kinematic similarity exist between model and prototype? [8+8]
7. The diameter of ram of a hydraulic crane is 200 mm. The velocity ratio is 6. The intensity of pressure of water supplied to the crane is 8 Mpa. The efficiency of the crane is 60%. Determine
(a) load lifted by the crane
(b) volume of water required to lift the load through 10 m. [16]
8. Classify different types of valves and explain the working of any one with a neat sketch. [16]

III B.Tech I Semester Regular Examinations, November 2006**HYDRAULIC MACHINERY AND SYSTEMS****(Common to Mechanical Engineering and Automobile Engineering)****Time: 3 hours****Max Marks: 80****Answer any FIVE Questions****All Questions carry equal marks**

1. (a) Find an expression for the water propelling force and the work done per second on a tank which is provided with an orifice through which jet of water is coming out and the tank is free to move.
(b) A jet of water 7.5 cm in diameter having velocity of 20 m/s strikes a series of the flat plates arranged around the periphery of a wheel such that each plate appears successively before the jet. If the plates are moving at a velocity of 5 m/s, compute the force exerted by the jet on the plate, the work done per second on the plate and the efficiency of the jet. [6+10]
2. A Francis turbine works a head of 150 m while running at 750 rpm. The outer and inner diameter of the runner is 1.4 m and 0.85 m. The water enters the runner with a velocity of 30 m/s. the outer angle of the guide blades is 10° . Estimate the runner blade angles at inlet and outlet, if the discharge is radial and velocity of flow is constant through the runner. Also calculate the hydraulic efficiency. [16]
3. (a) One Pelton wheel develops 15MW power under a head of 360m at 450 rpm. What is its specific speed? What would be its normal speed and output under a head of 145m .
(b) Explain what do you understand by unit speed, unit power and unit discharge of turbine. [10+6]
4. (a) Define separation in a reciprocating pump and explain how it can be avoided?
(b) A single acting reciprocating pump has a plunger 100 mm diameter and a stroke length of 200mm. The center of the pump is 4m above water level in the sump and 14m below the of water in a tank to which water is to be delivered by the pump. The diameter and length of suction pipe are 40mm and 6m while those of the delivery pipe are 30 mm and 18 m respectively. Determine the maximum speed at which the pump may be run without separation, if separation occurs at 80kn/m^2 below the atmospheric pressure. Take atmospheric pressure head = 10.3 m of water. [6+10]
5. (a) What are the mechanical losses in the working of a centrifugal pump?
(b) The impeller of a centrifugal pump has outer diameter of 40 cm and inner diameter of 20 cm. The blade angle at outlet is 30° . The speed of the impeller is 1450 rpm. The velocity of flow at inlet and out let is same at 2.2 m/ sec. Find head developed if manometric efficiency is 75%, absolute velocity at out let and blade angle at inlet. [8+8]

6. A centrifugal pump runs at 800 rpm and delivers $5 \text{ m}^3/\text{sec}$ against a head of 7 m. The impeller has an outer diameter of 25 cm and width of 5 cm at out let. If the vane angle at out let is 50° , determine the manometric efficiency. Find the specific speed. [16]
7. (a) Differentiate between a Hydraulic ram and a centrifugal pump.
(b) A hydraulic ram is used to lift 4 lps of water to a height of 25m using 72 lps of water from a supply tank 3.1m above the ram. If the delivery pipe is 63.5 mm in diameter and 155m long, determine the efficiencies of the ram. Take $f = 0.014$ for the pipe. [8+8]
8. (a) What are hydraulic systems? Describe briefly a hydrostatic and hydro-kinetic system and cite examples.
(b) Describe the principle of working of a vane pump with a neat sketch. [8+8]
