Code No: 07A40105 **R07** **Set No. 2**

II B.Tech II Semester Examinations,December 2010
FLUID MECHANICS AND HYDRAULIC MACHINERY
Mechanical Engineering

Time: 3 hours Max Marks: 80

Answer any FIVE Questions
All Questions carry equal marks
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1. (a) What is the difference between single-stage and multistage pumps? Describe multistage pump with
   i. impellers in parallel, and
   ii. impellers in series.

   (b) The diameter of an impeller of a centrifugal pump at inlet and outlet are 30 cm and 60 cm respectively. The velocity of flow at outlet is 2.5 m/s and vanes are set back at an angle of 45^0 at outlet. Determine the minimum starting speed of the pump if the manometric efficiency is 75%. [8+8]

2. (a) What are unit quantities? Define the unit quantities for a turbine. Why are they important?

   (b) A turbine develops 7357.5 kW S.P. when running at 200 r.p.m. The head on the turbine is 40 m. If the head on the turbine is reduced to 25 m, determine the speed and power developed by the turbine. [8+8]

3. (a) Derive the equation for discharge of a flow nozzle. Draw a neat sketch and explain its working.

   (b) A vertical venturimeter of d/D ratio 0.60 is fitted in a 0.1m diameter pipe. The throat is 0.2m above the inlet. The meter has a coefficient of discharge of 0.92. A liquid of specific gravity 0.8 flows through the meter at the rate of 50lit/sec. Determine the pressure difference as recorded by two gauges fitted at the inlet and throat. [8+8]

4. (a) What is forebay and what are different parts of forebay. Explain.

   (b) What is a tunnel. Discuss the classification of tunnels. [8+8]

5. (a) Derive an expression for work done per second per unit weight of water in a reaction turbine.

   (b) Design a Pelton wheel for a head of 80m and speed 300 r.p.m. The Pelton wheel develops 103 kW S.P. Take $C_v = 0.98$, speed ratio = 0.45 and overall efficiency = 0.80 [16]

6. (a) A jet of oil of specific gravity 0.85 strikes a fixed curved symmetrical plate at its center and leaves at the outlet tips. The diameter of the jet is 62 mm and the velocity of the jet is 45 m/sec. If the jet is deflected by 100 degrees, calculate the force exerted on the curved plate.

(b) How do you estimate the impact of a jet striking a moving normal plate in the direction of the jet. [8+8]

7. (a) Derive the equation for the pressure difference for a liquid jet of water and a soap bubble.

   (b) An open tank contains water to a depth of 2.5 m and an oil of relative density 1.25 to a depth of 1.5m. Determine the pressure at

      i. the water surface
      ii. the oil water interface
      iii. a depth of 3.5m below the free surface and
      iv. the bottom of the tank. [8+8]

8. (a) A pipe line carrying oil of specific gravity 0.84 changes in size from 0.20 m at section X to 0.45 m at section Y. section X is 4 m below section Y. The pressures at the two sections are 80KN/m^2 and 60KN/m^2 respectively. The discharge in the pipe is 2000 lit/sec. Determine the head loss between the two sections.

   (b) What do fluid kinematics and fluid dynamics deal with, in fluid mechanics? Explain their features. [10+6]

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Code No: 07A40105 **R07** **Set No. 4**

II B.Tech II Semester Examinations,December 2010
FLUID MECHANICS AND HYDRAULIC MACHINERY
Mechanical Engineering

Time: 3 hours Max Marks: 80

Answer any FIVE Questions
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1. (a) What are penstocks? What is meant by economical diameter of a penstock. How can it be found.
   (b) What are the functions of a surge tank. Describe with neat sketches, the behavior of various types of surge tanks. [8+8]

2. (a) Define the terms: speed ratio, flow ratio and jet ratio
   (b) An inward flow reaction turbine has external and internal diameters as 1.2 m and 0.6 m respectively. The velocity of flow through the runner is constant and is equal to 1.8 m/s. Determine:
      i. Discharge through the runner, and
      ii. Width at outlet if the width at inlet = 20 cm [16]

3. (a) What is cavitation? How can it be avoided in reaction turbine?
   (b) What is governing and how it is accomplished for different types of water turbines?
   [8+8]

4. (a) Differentiate total energy line and hydraulic gradient line. Draw neat sketches and discuss.
   (b) Three pipes A,B and C with the details as given below are connected in series:

Pipe	Diameter(cm)	Length(m)	f
A	12	1000	0.032
B	18	800	0.028
C	10	950	0.030

   Calculate the size of a pipe of length 850m and f = 0.02 equivalent to the compound pipe ABC. [8+8]

5. (a) What are the assumptions made in the derivation of Bernoulli's equation? Write about any two applications of the equation.
   (b) A pipeline has the following data at its two sections A and B:

Item	Section A	Section B
Diameter	30cm	45cm
Elevation	10m	16m
Pressure	40Kpa	30KPa

   Assuming a head loss of 20 timse the velocity head at A, calculate the discharge of water through the pipe line. [8+8]

6. (a) What is priming? Why is it necessary? Explain how it is done.

   (b) Find the number of pumps required to take water from a deep well under a total head of 156 m. Also, the pumps are identical and are running at 1000 r.p.m. The specific speed of each pump is given as 20 while the rated capacity of each pump is 150 lit/s. [8+8]

7. (a) What is the principle of pitot tube? Explain how it works with a neat sketch.

   (b) A U tube differential guage is attached to two sections A and B in a horizontal pipe in which oil of specific gravity 0.8 is flowing. The deflection of the mercury in the guage is 60cm, the level near A being the lower one. Calculate the difference of pressure between the sections A and B. [8+8]

8. (a) A jet of fluid (specific gravity 0.74) 100 mm diameter and having a velocity of 25 m/sec impinges at the centre of a hemispherical vane. The linear velocity of the vane is 10m/sec in the direction of the jet. Find the force exerted on the vane.

   (b) Prove that the force exerted by a jet of water on a moving curved vane when the jet strikes at the centre is F = ρa(V-v)^2 (1+Cosθ) where
   ρ = Mass density of water
   A = Area of cross section of the jet
   V = Velocity of the jet
   v = Velocity of the vane in the direction of the jet
   θ = Angle of the curved plate at the outlet. [8+8]

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Code No: 07A40105 **R07** **Set No. 1**

II B.Tech II Semester Examinations,December 2010
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Mechanical Engineering

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) What are the surface and body forces associated with fluid flow? How are they incorporated in Euler's equation?
   (b) Check whether the following sets of velocity components satisfy the continuity equation of steady incompressible flow:
      i. $u = 4x + 2y - 3$; $v = 2x + 4y + 3$
      ii. $u = 4xy + y^2$; $v = 6xy + 3x + 2$. [8+8]

2. (a) Obtain an expression for unit speed, unit discharge and unit power for a turbine.
   (b) A Pelton wheel is revolving at a speed of 200 r.p.m. and develops 5886 kW S.P when working under a head of 200 m with an overall efficiency of 80%. Determine unit speed, unit discharge and unit power. The speed ratio for the turbine is given as 0.48. Find the speed, discharge and power when this turbine is working under a head of 150 m. [8+8]

3. (a) What are the important fluid properties? Write their units. Derive the equation of hydrostatic pressure variation.
   (b) Find the kinematic viscosity in stokes for a liquid with specific gravity 0.95 and dynamic viscosity 0.011 poise. [10+6]

4. (a) Why are centrifugal pumps used sometimes in series and sometimes in parallel? Draw the following characteristic curves for a centrifugal pump:
   Head, power and efficiency versus discharge with constant speed.
   (b) A double-acting reciprocating pump, running at 50 r.p.m. is discharging 900 litres of water per minute. The pump has a stroke of 40 cm. The diameter of piston is 25 cm. The delivery and suction heads are 25 m and 4 m respectively. Find the slip of the pump and power required to drive the pump. [8+8]

5. (a) What is the necessity of predicting future hydropower load demand.
   (b) The load on a hydel plant varies from a minimum of 10000 KW to a maximum of 35000KW. Two turbo generators of capacities 22000 KW each have been installed. Calculate plant factor, load factor maximum demand and utilization factor. [8+8]

6. (a) A water jet of 40 mm diameter has a velocity of 35 m/sec. It is striking a moving curved plate at the center and gets deflected by 140 degrees at the outer tips of the curved plate. The velocity of the curved plate in the direction of the jet is 10 m/sec. Calculate the force exerted and the work done.

(b) Find out the work done and efficiency when a jet of water strikes a moving flat plate normally. The plate moves in the direction of the jet. [8+8]

7. (a) Describe briefly the functions of various main components of Pelton turbine with neat sketches.

   (b) The following data is given for a Francis turbine: Net head = 70 m, speed = 600 r.p.m., shaft power = 367.875 kW, η_0 = 85%, η_h =95%, flow ratio = 0.25, breadth ratio = 0.1, outer diameter of the runner = 2 X inner diameter of runner. The thickness of vanes occupy 10% of the circumferential area of the runner. Velocity of flow is constant at inlet and outlet and discharge is radial at outlet. Determine:

   i. Guide blade angle,
   ii. Runner vane angles at inlet and outlet,
   iii. Diameters of runner at inlet and outlet, and
   iv. Width of wheel at inlet. [8+8]

8. (a) Define coefficient of discharge. Discuss how it varies for venturi meter, orifice meter and nozzle meter. What factors influence the same?

   (b) A pitot tube is inserted in the middle of a pipe of 30 cm diameter. The static pressure of the tube is 10cm of mercury vacuum. The stagnation pressure at the center of the pipe is 1 N/cm^2. Calculate the rate of flow of water through the pipe. The mean velocity is 0.85 times the maximum velocity in the pipe. Assume coefficient of the pitot tube as 0.98. [8+8]

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Code No: 07A40105 **R07** **Set No. 3**

II B.Tech II Semester Examinations,December 2010
FLUID MECHANICS AND HYDRAULIC MACHINERY
Mechanical Engineering

Time: 3 hours Max Marks: 80

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) A 15 cm diameter jet of water with a velocity of 20 m/sec strikes a plate normally. If the plate is moving with a velocity of 8m/sec in the direction of the jet, calculate the work done per second on the plate and the efficiency of the energy transfer.

   (b) Prove that the force exerted by a jet of water on a fixed hemispherical curved vane when the jet strikes at the centre is F = ρav^2 where
   ρ = Mass density of water
   a = Area of cross section of the jet
   v = Velocity of the jet. [8+8]

2. (a) What is a reciprocating pump? Describe the principle and working of a reciprocating pump with a neat sketch.

   (b) A single-acting reciprocating pump has piston diameter 15 cm and stroke length 30 cm. The centre of the pump is 5 m above the water level in the sump. The diameter and length of the suction pipe are 10 cm and 8 m respectively. The separation occurs if the absolute pressure head in the cylinder during suction stroke falls below 2.5 m of water. Calculate the maximum speed at which the pump can run without separation. Take atmospheric pressure head = 10.3 m of water. [8+8]

3. (a) What are the flow measuring devices? Explain how pressure can be measured in a piezometer using more than one fluid.

   (b) Calculate the specific weight, mass density and specific gravity of a liquid having a volume of 10m^3 and weight of 60KN. [10+6]

4. (a) A pipe line carries carbon Tetrachloride of specific gravity 1.55 at the rate of 2000 lit/sec. The pipe tapers from 20 cm at section X to 40 cm at section Y in a length of 5 m at a slope of 1 in 20. section X is above section Y. The pressures at the two sections are 20 Kpa and 30 Kpa respectively. Determine the direction of flow of the fluid.

   (b) How can you find the force exerted on the pipe bend using momentum equation? Discuss with neat sketches and required equations. [8+8]

5. (a) Give the range of specific speed values of the Kaplan, Francis turbines and Pelton wheels. What factors decide whether Kaplan, Francis, or a Pelton type turbine would be used in a hydroelectric project ?

(b) A Kaplan turbine working under a head of 25 m develops 16000 kW shaft power. The outer diameter of the runner is 4 m and hub diameter is 2 m. The guide blade angle is 35. The hydraulic and overall efficiency are 90% and 85% respectively. If the velocity of whirl is zero at outlet, determine: (i) runner vane angles at inlet and outlet, and speed of turbine. [8+8]

6. (a) Describe the status of hydroelectric power in India.

   (b) Explain how the load factor, capacity factor and utilization factor interrelated. Also explain the significance of diversity factor. [8+8]

7. (a) What do you understand by the characteristic curves of a turbine? Name the important types of characteristic curves.

   (b) An outward flow reaction turbine has internal and external diameters of the runner as 0.5 m and 1.0 m respectively. The guide blade angle is 15^0 and velocity of flow through the runner is constant and equal to 3 m/s. If the speed of the turbine is 150 r.p.m., head on turbine is 10 m and discharge at outlet is radial, determine:

      i. The runner vane angles at inlet and outlet,
      ii. Work done by the water on the runner per unit weight of water striking per second and
      iii. Hydraulic efficiency. [8+8]

8. (a) What are the construction details of a pitot tube and explain how it works?

   (b) An oil of relative density 0.90 flows through a vertical pipe of diameter 20cm. The flow is measured by a 20cm $\times$ 10cm venturimeter. The throat is 30cm above the inlet section. A differential U tube manometer containing mercury is connected to the throat and the inlet. If coefficient of discharge is 0.99 what is the manometer reading for a flow of 50 lit/sec. [6+10]

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