

Code No: 07A52401

**R07****Set No. 2**

**III B.Tech I Semester Examinations, November 2010**  
**FLUID MECHANICS AND HYDRAULIC MACHINERY**  
**Automobile Engineering**

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

**Answer any FIVE Questions**  
**All Questions carry equal marks**

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1. (a) Bring out the differences between impulse and reaction turbines.  
 (b) Explain the working of a Pelton wheel. [8+8]
2. A turbine is to operate under a head of 35m at 250rpm. The discharge is  $9\text{m}^3/\text{s}$ . If the overall efficiency is 80 per cent, determine:  
 (a) Power generated.  
 (b) Specific speed of the turbine.  
 (c) Type of turbine. [16]
3. (a) Define the terms:  
     i. Impact of jets.  
     ii. Jet propulsion.  
 (b) Find the force exerted by a jet of water of diameter 100mm on a stationary flat plate when the jet strikes the plate normally with a velocity of 30m/s. [8+8]
4. (a) Explain with a neat sketch of piezo meter.  
 (b) A differential manometer is connected at two points A and B. At A air pressure is  $100\text{ KN/m}^2$ . Find the absolute pressure at B. [8+8]
5. (a) Derive an expression for the minimum speed for starting a centrifugal pump. Explain briefly the effect of variation of discharge on the efficiency.  
 (b) List the main component parts of centrifugal pump and explain them briefly. [8+8]
6. The following data is available for a hydropower plant: Available head = 130m, catchments area = 220 Sq. km, annual average rainfall = 150 cm, Turbine efficiency = 86%, generator efficiency = 91%, and evaporation losses = 18%. Determine power developed in MW taking load factor as unity. [16]
7. A pipe of diameter 0.4m and of length 2000m is connected to a reservoir at one end. The other end of the pipe is connected to a junction from which two pipes of lengths 1000m and diameter 300mm run in parallel. These parallel are connected to another reservoir, which is having level of water 10m below the water level of the above reservoir. Determine the total discharge if  $f = 0.015$ . [16]

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8. A pipe (1) 450mm in diameter branches into two pipes 2 & 3 of diameters 300mm and 200mm respectively. If the average velocity in 450mm diameter pipe is 3 m/sec, find.
- (a) Discharge through 450mm diameter pipe.
  - (b) Velocity in 200mm diameter pipe if the average velocity in 300mm pipe is 2.5 m/sec.

[16]

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1. (a) Briefly explain about the water hammer in pipes.  
 (b) What is a surge tank. Draw and briefly explain about different types of surge tanks. [8+8]
2. (a) Define the term vapour pressure. How does it vary with temperature?  
 (b) A soap bubble 50mm diameter has an internal pressure in excess of the outside pressure of 25 N/m<sup>2</sup>. Calculate tension in the soap film. [8+8]
3. (a) How is the continuity equation based on the principle of conservation of mass stated. State and explain continuity equation.  
 (b) The diameter of a pipe at the sections 1 and 2 are 10cm and 15cm respectively. Find the discharge through the pipe if the velocity of water flowing through the pipe at section 1 is 5m/sec. Determine also the velocity at section 2. [8+8]
4. (a) Explain the term coefficient of friction. On what factors does this coefficient depend?  
 (b) What is a compound pipe? What will be loss of head when pipes are connected in series? [8+8]
5. From the investigation of hydro site the following data is available. Available head = 50m, catchments area = 50sq.km, rainfall 150 cm/ year, 60% rainfall can be utilized: Turbine efficiency = 80%, generator efficiency = 91%, penstock efficiency = 75%, load factor = 60%, Determine the suitability of capacity of turbo generator. [16]
6. (a) Draw an indicator diagram considering the effect of acceleration and friction in suction and delivery pipes. Find an expression for the work done/second in case of single - acting reciprocating pump.  
 (b) Define Specific speed of a centrifugal pump. Derive an expression for the specific speed. How does the specific speed of a centrifugal pump differ from that of a turbine? [8+8]
7. A jet of water having a velocity of 35m/s impinges on a series of vanes moving with a velocity of 20m/s. The jet makes an angle of 30° to the direction of motion of vanes when entering and leaves at angle of 120°. Draw the triangles of velocities at inlet and out let and find:

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- (a) The angles of vanes tip so that water enters and leaves without shock.
  - (b) The work done per unit weight of water entering the vanes.
  - (c) Efficiency. [16]
8. (a) Differentiate between:
- i. Inward and outward flow reaction.
  - ii. Turbine and pump.
- (b) Define and explain hydraulic efficiency, mechanical efficiency and overall efficiency of a turbine. [8+8]

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1. (a) Define the following terms.
  - i. Static head.
  - ii. Manometric head.
  - iii. Total head.
- (b) A centrifugal pump delivers water against a net head of 14.5 m and a design speed of 1000rpm. The vanes are curved back to an angle of  $30^\circ$  with the periphery. The impeller diameter is 300mm and outlet width 50mm. Determine the discharge of the pump if manometer efficiency is 95%. . [8+8]
2. (a) What are the objectives of the combined hydro and steam power plants?
- (b) What are the safety measures need to be taken for hydro electric power plants? [8+8]
3. (a) Explain briefly:
  - i. Potential head,
  - ii. Velocity head,
  - iii. Pressure head.
- (b) State and derive Bernoulli's equation for ideal incompressible fluid flow. [8+8]
4. (a) Explain the difference between Kaplan turbine and Propeller turbine?
- (b) Draw a neat sketch of a Francis turbine and explain its working? [8+8]
5. Distinguish between:
  - (a) Standard and local atmospheric pressures.
  - (b) Barometric pressure and absolute pressure.
  - (c) Absolute pressure and gauge pressure.
6. A Pelton wheel develops 5520kw under a head of 240m at an overall efficiency of 80% when revolving at a speed of 200rpm. Find the unit discharge, unit power and unit speed. Assume peripheral coefficient = 0.46. If the head on the same turbine falls during the summer season to 150m, find the discharge, power and speed for this head. [16]
7. Two pipes 1 and 2, each of 12cm diameter branch off from a point A in a pipe line and rejoin at B. Pipe 1 is 480m long and pipe 2 is 120m long. Total head at A is 36m. A short pipe 10cm diameter is fitted at B and the flow is discharged into atmosphere through it. Assuming  $f = 0.018$  for both the pipes, calculate:

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- (a) Total discharge,  
(b) Distribution of discharge in pipes 1 and 2. [16]
8. (a) A stationary vane having an inlet angle of zero degree and an outlet angle of  $25^\circ$  receives water at a velocity of 50m/s. Determine the components of force acting on it in the direction of the jet velocity and normal to it. Also find the resultant force in magnitude and direction per unit weight of flow.
- (b) Derive an expression for the normal force and work done by jet impinging on an inclined fixed plate. [8+8]

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1. (a) Obtain an expression for the force exerted by a jet of water on a fixed vertical plate in the direction of the jet with a neat sketch.  
 (b) A jet of water 75mm in diameter issues with a velocity of 30m/s and impinges on a stationary flat plate which destroys its forward motion. Find the force exerted by the jet on the plate and work done. [8+8]
2. (a) Define an Orifice meter. Derive the expression for the discharge through the Orifice-meter.  
 (b) What is a pitot tube? How will you determine the velocity at any point with the help of pitot-tube? [8+8]
3. (a) Define Steady, Un-Steady, Uniform and Non-Uniform flows.  
 (b) The diameter of a pipe at the section 1 and 2 are 15cm and 20cm respectively. Find the discharge through the pipe if velocity of water at section 1 is 4m/sec. Determine also the velocity at section 2. [8+8]
4. A Francis turbine working under a head of 5m at a speed of 210rpm develops 75kw when the rate of flow of water is  $1.8\text{m}^3/\text{s}$ . The runner diameter is 1m. If the head on this turbine is increased to 16m, determine its new speed, discharge and power. [16]
5. (a) Make a neat sketch of a hydro power plant and show clearly the various elements.  
 (b) what is flow duration curve. Explain the use of it with a neat sketch. [8+8]
6. (a) Two jets strike the buckets of a pelton wheel, which is having shaft power as 15450KW. The diameter of each jet is given as 200mm. If the net head on the turbine is 400m find the overall efficiency of the turbine. Take  $CV = 1.0$   
 (b) Write a short note on the special features of a Pelton bucket. How do you find the number of buckets? [8+8]
7. (a) Why are centrifugal pumps used sometimes in series and some times in parallel?  
 (b) Draw and explain the following characteristic curves for a centrifugal pump: head, power and efficiency versus discharge with constant speed. [8+8]
8. (a) Define Surface tension. Discuss the factors affecting surface tension.

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- (b) A piston 9.95 cm diameter works in a cylinder 10 cm diameter, 12cm long. The space between the two is filled with a lubricating oil of viscosity 0.65 poise. Calculate the speed of the piston through the cylinder under the action of an axial force of 5.0 N. [8+8]

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