Fluid Machinery
(ME-306, Dec-07)

Note: Section A is compulsory. Attempt any four questions from Section B and any two from Section C.

Section-A

1. a) Determine the force exerted by a jet on a stationary plate held normal to the jet.
   b) Give Euler's equation for energy transfer in a turbo-machine.
   c) Draw velocity triangles at inlet and outlet of typical Francis turbine vane.
   d) Sketch a Pelton turbine bucket and show its working proportions.
   e) List functions of surge tanks.
   f) Sketch layout of a centrifugal pump installation and label it.
   g) What is priming?
   h) List unit quantities as applied to turbo-machines.
   i) Sketch theoretical flow-displacement curve for a three throw reciprocating pump without air vessel.
   j) Sketch differential accumulator.

Section-B

2. Show that when a jet of water impinges on a series of curved vanes, maximum efficiency is obtained when the vane is semi-circular in section and the velocity of vane is half that of the jet.
3. Show that in a given turbine: $u \propto H^{1/2}$; $Q \propto H^{1/2}$; and $P \propto H^{3/2}$. When H is the available head, u is the tangential velocity of vane, Q the discharge and P is the power developed by the turbine. Hence discuss how the performance of a turbine may be obtained from that of a geometrically similar turbine.
4. Discuss the theoretical head discharge curve for a centrifugal pump.
5. Give a sketch of the theoretical pressure-volume diagram for the cylinder of a reciprocating pump which is not fitted with air vessels. Show clearly the effects of acceleration and friction in both the suction and delivery pipe.
6. the diameter of two portions of the ram of a differential accumulator are 16 cm and 15 cm respectively; the stroke being 1.2 m. Find load on the arm and the capacity, if the accumulator is supplied with water at a pressure 1250 m of water.

Section-C

7. The following data pertains to an inward flow reaction turbine:
   Net load = 60m; speed = 650 rpm; Brake power = 275 KW. Ratio of wheel width to wheel diameter at inlet is 0.10. Ratio of inner diameter to outer diameter = 0.5. Flow ratio = 0.17; hydraulic efficiency = 0.95 and overall efficiency = 0.85. The flow velocity remains constant and the discharge is radial. Neglecting area blockage by blades, work out the diameters and blade angles of the turbine.
8. A centrifugal pump impeller has diameter of 60 cm and width of 6 cm at the outlet. The pump runs at 1450 rpm and delivers 800 litres/sec against a head of 80 m. The leakage loss after the impeller is 4 percent of discharge, the external mechanical loss is 10 KW and the hydraulic efficiency is 80%. Determine the blade angle at outlet, the power required and the overall efficiency of the pump.
9. (a) Draw a neat sketch of a hydraulic ram installation and explain its working.
   (b) With the help of a neat sketch explain the working of a torque converter.