

**GUJARAT TECHNOLOGICAL UNIVERSITY****BE - SEMESTER-V • EXAMINATION – WINTER • 2014****Subject Code: 151903****Date: 03-12-2014****Subject Name: Fluid Power Engineering****Time: 10.30 am - 01.00 pm****Total Marks: 70****Instructions:**

1. Attempt all questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.

- Q.1** (a) What do you understand by minor energy losses in pipe ? Derive expression for the Loss of head due to sudden contraction in the pipe. **07**
- (b) A horizontal pipe, 15cm in diameter is joined by sudden enlargement to a 20cm diameter pipe. Water is flowing through it at the rate of 3 m<sup>3</sup>/s. Find the loss of head due to sudden enlargement and the pressure difference in the two pipes. If the change of section is gradual without any loss what would be the change in pressure? **07**
- Q.2** (a) Explain construction and working of Pelton wheel turbine and derive expression for maximum hydraulic efficiency of Pelton wheel turbine. **07**
- (b) The internal and external diameter of the Francis turbine are 1.0m and 0.6m respectively. Hydraulic efficiency is 90%. Net head is 36m and velocity of flow at outlet is 2.5m/s and discharge is radial at outlet. If guide vane angle at outlet is 15° and width of wheel is 10cm at inlet and outlet. Find **07**
- (i) Speed of the turbine
  - (ii) Guide blade vane angle
  - (iii) Vane angle of runner at inlet
  - (iv) Volume flow rate of turbine
  - (v) Power developed.
- OR**
- (b) A Kaplan turbine runner is to be designed to develop 9100kw. The net available head is 5.6m. If the speed ratio is 2.09, flow ratio is 0.68 overall efficiency is 86% and the diameter of boss is 1/3 times the diameter of runner. Find the diameter of the runner, its speed and Specific speed of the turbine. **07**
- Q.3** (a) Give classification of Centrifugal pump and derive expression for the minimum starting speed of the centrifugal pump. **07**
- (b) A centrifugal pump impeller has internal and external diameter 480mm and 240mm respectively. It is running at 1000 rpm. The rate of flow through the pump is 0.0576 m<sup>3</sup>/s and velocity of flow is constant and is equal to 2.4 m/s. The diameter of suction and delivery pipes are 180mm and 120mm respectively and suction and delivery heads are 6.2m(abs) and 30.2m of water respectively. If the power required to drive the pump is 23.3 KW and the outlet vane angle is 45°. Find **07**
- (i) Inlet vane angle
  - (ii) Overall efficiency
  - (iii) Manometric efficiency
- OR**
- Q.3** (a) Compare Reciprocating pump with Centrifugal pump. Draw theoretical indicator diagram of reciprocating pump and explain function of air vessel. **07**

- (b) A double acting reciprocating pump running at 50rpm, delivers 40 litres per seconds has following specifications: **07**  
Piston diameter=300mm, Poston rod diameter = 50mm, Storke= 400mm,  
Suction head= 4m, Delivery head= 8m. Calculate  
(i) Slip  
(ii) Force required to operate the pump during forward and reverse stroke of piston.  
(iii) Power required to drive the pump.
- Q.4 (a)** With neat sketch explain construction and working of hydraulic Ram. **07**
- (b) A jet of water having velocity of 15 m/s strikes a curved vane which moving with a velocity of 5 m/s in same direction as that of jet inlet. The vane is so shaped that the jet is deflected through  $135^\circ$ . The diameter of jet is 10cm. Assuming the vane to be smooth, find **07**  
(i) Force exerted by jet on the vane in the direction of motion.  
(ii) Power exerted on the vane, and  
(iii) Efficiency of the vane.
- OR**
- Q.4 (a)** With the help of velocity triangles and head-capacity curves, discuss salient features of radial, backward and forward curved vanes in a centrifugal compressor. **07**
- (b) A centrifugal air compressor draws in air at temperature of  $27^\circ\text{C}$  running at 18000 rpm. The outer diameter of blade tip is 550mm, slip factor is 0.82, Isentropic total head efficiency is 0.76. Calculate **07**  
(i) The temperature rise of air passing through the compressor.  
(ii) The static pressure ratio.  
Assume the velocities of air at inlet and outlet are same. Take  $C_p=1.005$  KJ/kg K
- Q.5 (a)** With usual notations derive an expression for indicated work of reciprocating air compressor by considering clearance. **07**
- (b) Atmospheric air at 1 bar and  $20^\circ\text{C}$  is taken into a simple compressor having zero clearance. It is compressed according to law  $PV^{1.2}=\text{constant}$  to the constant discharge pressure of 4 bar. The discharge is taken through a regulating valve into a closed vessel of  $3\text{m}^3$  capacity. Here the initial conditions were 1 bar and  $20^\circ\text{C}$  and after charging for 4.2 minutes were 3.5bar and  $25^\circ\text{C}$ . Calculate neglecting clearance of compressor **07**  
(i) The volume of air taken per minute if measured at atmospheric conditions.  
(ii) The indicated power required to drive the machine.
- OR**
- Q.5 (a)** With suitable sketch explain the working principle of an axial flow compressor. Draw the stage velocity triangles. **07**
- (b) Explain Root blower with the neat sketch and derive expression for the Roots efficiency. **07**

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