Calculate the isentropic pressure rise and work done by a cascade of axial flow compressor for the following data :

$u = 200$ m/s, $\alpha_1 = 45°$, axial component of absolute velocity $C_a = 186$ m/s, $\alpha_2 = 14°$, $\rho = 1$ kg/m^3

5. a) Define the following :
   i) Torque ratio and
   ii) Speed ratio
   b) Differentiate between Simple and Differential accumulator.
   c) Draw the neat schematic sketch of reciprocating pump and discuss its functions.
   d) Explain the principle and working of Fluid coupling and its characteristics with the help of neat diagram.

OR

A hydraulic intensifier has a ram of diameter 0.2 m and sliding cylinder of diameter 1 m. Calculate the pressure of water on low pressure side if the pressure of water on high pressure side is to be 24,500 kN/m^2. The loss due to friction at each of the packing of the intensifier is 5% of total pressure on each piston.

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Total No. of Questions : 5] *[Total No. of Printed Pages : 4*

Roll No ....

ME-502

B.E. V Semester

Examination, December 2016

Turbo Machinery

Time : Three Hours

Maximum Marks : 70

Note: i) Answer five questions. In each question part A, B, C is compulsory and D part has internal choice.
ii) All parts of each question are to be attempted at one place.
iii) All questions carry equal marks, out of which part A and B (Max. 50 words) carry 2 marks, part C (Max. 100 words) carry 3 marks, part D (Max. 400 words) carry 7 marks.
iv) Except numericals, Derivation, Design and Drawing etc.
v) Assume suitable data if required. Use of Steam Table/ Mollier diagram is permitted.

1. a) Discuss various devices that come under the family of Turbo Machines.
   b) Define degree of reaction and discuss its value that changes from 0 to 1.
   c) Discuss the principle of impulse and reaction stage with the help of pressure and velocity variation diagram.
   d) How the first and second law of thermodynamics applied to understand the basic concepts of Turbo Machines? Apply the steady flow energy equation in compressible and incompressible flow Turbo Machines.

OR

How energy transfer takes place in Turbo Machines? Derive an expression to determine the moment of momentum equation and Euler's Turbine equation.

2. a) Why compounding is necessary in Steam Turbines?
   b) Define (i) Blade efficiency and (ii) Gross stage efficiency in steam turbines.
   c) Discuss the various losses involved in steam turbines.
   d) In a single-stage impulse turbine, the steam velocity at nozzle mouth is 300 m/s, the nozzle angle is 18°, and the mean blade velocity is 144 m/s. Draw to a suitable scale the velocity diagram for the steam assuming that the outlet angle of blades is 3° less than inlet angle and the relative velocity of the steam at outlet from the blade is 0.84 of the relative velocity at entrance. If the power to be developed is 1,000 kW, calculate the mass of steam that pass through the turbine per second while neglecting disc friction and leakage loss.

OR

The outlet angle of the blade of Parson's reaction turbine is 20° and the axial velocity of flow of steam is 0.5 times the mean blade velocity. Draw the velocity diagram for a stage consisting of one fixed and one moving row of blades, given that the mean diameter is 71cm and the speed of rotation is 3,000 r.p.m. Calculate the inlet angle of blades if the steam is to enter the blade channels without shock. If the blade height be 6.4cm, the mean steam pressure 5.5 bar, the steam dry and saturated, find the power developed in the stage.

3. a) Differentiate between different hydraulic turbines in terms of heads and specific speeds.
   b) Define (i) Hydraulic efficiency and (ii) Volumetric efficiency in water turbines.

   c) Discuss classification of Hydraulic Pumps in brief.
   d) A Kaplan Turbine produces 0.6 MW under a net head of 25 m with an overall efficiency of 90%. Taking the value of speed ratio $K_u = 1.6$, flow ratio $\Psi = 0.5$ and the hub diameter as 0.35 times the outer diameter, find the diameter and speed of the turbine.

OR

A centrifugal pump is running at 1000 r.p.m. The outlet vane angle of the impeller is 30° and the velocity of flow at outlet is 3m/s. The pump is working against a total head of 30m and the discharge through the pump is 0.3 m^3/s. If the manometric efficiency of the pump is 75%, determine (i) the diameter of the impeller and (ii) width of the impeller at outlet.

4. a) Differentiate Fan, Blowers and Compressor in terms of pressure rise.
   b) Define the following dimensionless terms applied to centrifugal compressor :
      i) Flow coefficient
      ii) Head coefficient
   c) Discuss surging phenomena with the help of neat diagram.
   d) An axial compressor has a mean diameter of 60cm and runs at 15,000 r.p.m. If the actual temperature rise and pressure ratio developed are 30°C and 1.3 respectively then calculate :
      i) Power required to drive the compressor while delivering 57 kg/s, and
      ii) Stage efficiency.

OR