

Reg No.: \_\_\_\_\_

Name: \_\_\_\_\_

**APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY**  
**FOURTH SEMESTER B.TECH DEGREE EXAMINATION, DECEMBER 2018**

**Course Code: ME206**

**Course Name: FLUID MACHINERY (ME)**

Max. Marks: 100

Duration: 3 Hours

**PART A**

*Answer any three questions. Each question carries 10 marks.*

- 1 a) In a Pelton wheel turbine, the runner of the turbine is provided with double hemi- 4  
spherical cup shaped buckets instead of single curved blade. why?
- b) A jet of 7.5cm diameter strikes a flat plate, normal of which is inclined at  $45^0$  to 6  
the axis of the jet with a velocity of 25m/s. Find the normal force exerted on the  
plate i) When the plate is stationary ii) When the plate is moving with a velocity  
of 15m/s in the direction of jet and away from the jet.
- 2 a) Explain advantages and disadvantages of a Pelton turbine? 3
- b) Prove that the hydraulic efficiency of a Pelton wheel turbine is maximum when 7  
the jet velocity striking the runner is twice the tangential velocity of the runner?
- 3 a) What is meant by specific speed of a turbine? What is its significance? 4
- b) With neat sketches, explain the working servo motor mechanism of governing of a 6  
pelton turbine.
- 4 a) Explain the theory of draft tube in reaction turbine. How is the turbine 5  
performance affected in the absence of draft tube?
- b) A Kaplan turbine is designed to develop 9MW power while operating under a net 5  
head of 7m. The speed ratio based on outer diameter and flow ratios are to be 2.09  
and 0.68 respectively and the ratio of outer to hub diameter is 3. Assuming an  
overall efficiency of 85%, find the speed and specific speed of the turbine.

**PART B**

*Answer any three questions. Each question carries 10 marks*

- 5 a) Reciprocating pumps are called positive displacement pump why? 3
- b) A centrifugal pump lifts  $2.5\text{m}^3/\text{min}$  of water to a height of 20m through a pipe line 7  
of 10cm diameter. The total length of the pipe line is 11 0m. Assuming an overall  
efficiency of 75% and an inlet loss of 0.3m, find the power required to drive the  
pump. Take coefficient of friction  $f = 0.012$

- 6 a) What is meant by cavitation in centrifugal pump? What are the effects of cavitation? How it can be eliminated 5
- b) Show that the saving in work done against friction in a double acting reciprocating pump fitted with air vessel is 39.2% 5
- 7 a) Define minimum starting speed of a centrifugal pump. Write down the equation for the same with notations. 4
- b) With the help of necessary sketch, explain the working of a jet pump? Where are they used? 6
- 8 a) What is meant by manometric head of a centrifugal pump? What are the different ways of finding it? 4
- b) The bore and stroke of a double acting reciprocating pump are 15cm and 30cm respectively. The suction and delivery heads are 3m and 30m and the pump delivers  $0.62\text{m}^3/\text{min}$  when running at 60rpm. Find the percentage slip and power required to run the pump if mechanical efficiency is 80%. 6

### PART C

*Answer any four questions. Each question carries 10 marks.*

- 9 a) Deduce an equation for the work done on a reciprocating compressor in terms of pressure ratio using P-v diagram. Assume the process of compression follows polytropic according to  $p v^n = \text{a constant}$ . 5
- b) A single stage single acting reciprocating air compressor is used to compress  $7 \times 10^{-3} \text{ m}^3/\text{min}$  of air from a pressure of 1.013 bar to 14 bar. The index of polytropic compression is 1.3 and mechanical efficiency is 82%. Determine the volumetric efficiency and power required to drive the compressor if the clearance is 3% of the swept volume. 5
- 10 a) Define the following with reference to reciprocating compressors 3
- i) Isothermal efficiency ii) Adiabatic efficiency iii) Volumetric efficiency
- b) Obtain the expressions for volumetric efficiency of an air Compressor in terms of clearance ratio, index of compression and pressure ratio. 7
- 11 a) What are the advantages and disadvantages of multistage compression? 4
- b) Prove that for a multi stage compressor with perfect intercooling between stages, the work done is minimum when the intermediate pressure is the geometric mean of the suction and delivery pressure between successive stages. 6
- 12 a) Define slip factor and pressure coefficient in centrifugal compressors 4

- b) An axial flow compressor draws in air at  $20^{\circ}\text{C}$  and delivers it at  $50^{\circ}\text{C}$ . Assuming 50% degree of reaction, calculate the velocity of flow and number of stages if blade velocity is  $100\text{m/s}$ , work factor as  $0.85$ . Assume the blades are symmetrical and air inlet and exit angle  $\alpha = 10^{\circ}$ ,  $\beta = 40^{\circ}$  6
- 13 A centrifugal compressor has a compression ratio of 4:1 with an isentropic efficiency 88% when running at 14000 rpm and including air at  $25^{\circ}\text{C}$ . Curved vanes at inlet gives the air a pre-whirl of  $18^{\circ}$  to axial direction at all radii and the mean diameter of eye is 245mm. Absolute air velocity at inlet is  $120\text{m/s}$ . Impeller tip diameter is 580mm. Calculate the slip factor. 10
- 14 a) Explain the working of axial flow compressor and obtain the expression for the work done. 5
- b) Explain surging and choking in centrifugal compressors. 5

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