

5E3180

B.Tech. V Sem.(Main/Back) Exam Dec. 2012

Mechanical Engg.

5ME6 Principles of Turbomachines

Time : 3 Hours

Maximum Marks : 80

Min. Passing Marks : 24

*Instructions to Candidates:*

*Attempt any five questions. selecting one question from each unit .All Question carry equal marks . schematic diagrams must be shown wherever necessary . Any data you feel missing suitably be assumed and stated clearly. Units of quantities used / calculated must be stated clearly.*

Use of following supporting material is permitted during examination.  
(Mentioned in form No. 205)

1. Nil2. Nil**UNIT - I**

Q.1 (a) Define Turbo machines. Classify the turbo machines based on fluid movement through the machine. 6

(b) How does the following laws and governing equations are applied to the turbo machines:-

(i) Steady flow energy equation.

(ii) Second law of thermodynamics.

(iii) Newton's Second law of motion.

(iv) Continuity Equation.

4x2.5=10

**OR**

- Q.1 (a) Drive an expression for specific speed of a hydraulic turbine. Also give the dimensionless specific speed ranges for hydraulic turbines. 8
- (b) Explain the conditions where the complete similarity between the actual hydraulic turbo machines and the model shall exist. 8

## **UNIT - II**

- Q.2 (a) With the help of neat sketches, explain all the components of a centrifugal pump. Also explain NPSH & Priming in a pump. 8
- (b) Draw the velocity triangles at the inlet and outlet tips of the vane fixed to an impeller and drive an expression for minimum starting speed of a centrifugal pump. 8

**OR**

- Q.2 (a) Explain the various Pump losses and efficiencies in a centrifugal pump. 8
- (b) The Outer diameter of an impeller of a centrifugal pump is 40 cm. and outlet width is 5 cm. The pump is running at 800 rpm and working against a head of 16m. The vane angle at outlet is  $40^\circ$ . Assuming the manometric efficiency to be 75%, determine the discharge. 8

## **UNIT - III**

- Q.3 (a) Give the complete description of an Axial Flow Pump and find out an expression for work done on the fluid and energy transfer. 8
- (b) An axial flow pump has an impeller of outlet diameter 1.0m. The diameter of boss is 0.5m. If the specific speed of the pump is 38 and velocity of flow is 2m/s, suggest a suitable speed of pump to give a head of 6m. Also determine vane angle at the entry of the pump if the flow is axial at inlet. 8

**OR**

- (a) Explain the characteristics of an axial flow pump and the phenomenon of cavitation. 8

- (b) An axial flow pump has particulars as its discharge is 180 l/s, head developed 2m, specific speed 250, speed ratio 2.4, flow ratio 0.5.

Calculate:

- (a) Speed of pump.  
(b) Runner dia.  
(c) The boss dia.

8

## UNIT - IV

- Q.4 (a) Define Slip factor for a centrifugal compressor and drive an expression for the same. 8

- (b) Explain the following parameters used to assess the performance of an actual centrifugal compressor.

(i) Power Input Factor.

(ii) Pressure coefficients.

(iii) Compressor efficiency. 8

OR

- Q.4 (a) How is the degree of reaction of a centrifugal compressor stage defined? 8

$$\text{Prove that } R = \frac{1 - \phi_2^2 \operatorname{cosec}^2 \beta_2}{2 (1 - \phi_2 \operatorname{cat} \beta_2)}$$

Where  $\phi_2$  is flow coefficient and  $\beta_2$  is blade outlet angle. 8

- (b) Explain the characteristics of a centrifugal compressor. Also explain the reasons as to why the actual curve is differing from the ideal curve. 8

## UNIT - V

- Q.5 (a) Explain the working principle of an axial flow compressor. Also draw the velocity triangles for the same and calculate the stage work. 8

- (b) An axial blower supplies air to a furnace at the rate of 3kg/s. The atmospheric conditions being 100kPa and 310K. The blower efficiency is 80% and mechanical efficiency is 85%. The power supplied is 30KW. Estimate the overall efficiency and pressure developed in mm W.G. 8

**OR**

- Q.5 (a) The data refers to a test on an axial flow compressor are given as:  
Atmospheric temp. and pressure at inlet are 18°C & 1 bar, Total head temp. in delivery pipe is 165°C. Total head pressure in delivery pipe is 3.5 bar. Static pressure in delivery pipe is 3 bar. Calculate

- (a) Total head isentropic efficiency.
  - (b) Polytropic efficiency.
  - (c) Air velocity in delivery pipe. 8
- (b) How do we calculate.
- (i) Static Pressure rise.
  - (ii) Stage efficiency.
  - (iii) Pressure coefficient in an axial flow compressor. 8

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