Total No. of Questions : 12]

SEAT No. :

P1697

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B.E. (Mechanical)

c - DESIGN OF PUMPS BLOWERS AND COMPRESSORS

(Elective - I) (2008 Course) (Semester - I)

Time : 3 Hours] *[Max. Marks : 100*

Instructions to the candidates:

1) ***Answer any three questions from each section.***

2) ***Answers to the two sections should be written in separate books.***

3) ***Neat diagrams must be drawn wherever necessary.***

4) ***Figures to the right indicate full marks.***

5) ***Use of Logarithmic tables slide rule, Mollier charts, and electronic pocket calculator and steam tables are allowed.***

6) ***Assume suitable data, if necessary.***

SECTION - I

Q1) a) Explain the following terms: **[8]**

i) Flow Machines

ii) Turbines

iii) Pumps

iv) Compressible Flow Machines

b) A turbo blower develops 750 mm W.G. at a speed of 1480 rpm and a flow rate of $38 m^3/s$. It is desired to build a small model which develops the same head at a higher speed (2490 rpm) and low discharge. Determine the specific speed and the flow rate through the model. **[8]**

OR

Q2) a) Explain the performance characteristics of pumps, compressors, fans and blowers. **[10]**

b) Write equations of energy transfer between fluid and rotor. **[6]**

P.T.O.

Q3) a) The impeller of a centrifugal pump has 1.4m outside diameter. It is used to lift 1800 liters of water per second against a head of 10 m. Its Vanes make an angle of 45° with the direction of motion at outlet and runs at 400 rpm. If the radial velocity of flow at outlet is 3.5 m/s, find the manometric efficiency. Also find the power required if the overall efficiency is 82%. **[8]**

b) Explain various efficiencies of centrifugal pump. **[8]**

OR

Q4) a) Explain various types of characteristic curves usually prepared for centrifugal pumps. **[8]**

b) What is NPSH? Derive the expression of the same. Find the height from the water surface at which a centrifugal pump may be installed in the following case to avoid cavitation: Atmospheric pressure = 1.01 bar; vapour pressure = 0.022 bar; losses in suction pipe = 1.42 m; effective head of pump = 49m; and cavitation factor = 0.115. **[8]**

Q5) a) Explain the following terms: **[8]**

i) Static Suction Head

ii) Static Discharge Head

iii) Total Static Head

b) Explain the design procedure of centrifugal pump. **[10]**

OR

Q6) a) Explain various forms of corrosion occurred in hydraulic machines. **[8]**

b) A centrifugal pump running at 1450 rpm has the characteristic as given below: **[10]**

Discharge (Lit/sec)	11.3	16.9	22.6	28.3	34	39.6	45.2
Head (m)	25.8	25	24.1	23.2	21.4	18.9	15.8
Efficiency %	65	70	73	74	72	69	62

Draw the operating characteristic of the pump and determine its specific speed. The pump lifts water against a static head of 12 m through a long pipeline in which the loss of head in meters, due to friction is given by the expression, hf = 0.012 Q2, where Q is the discharge in liters/sec. The minor losses in the pipe may be neglected. Determine the power required to drive the pump.

SECTION - II

Q7) a) Discuss various applications of fan. **[8]**

b) Explain functions of an airfoil and discuss the characteristics curves of airfoils. **[8]**

OR

Q8) a) How does dust erosion of centrifugal pump impeller occurs? What is its effect on the performance? **[8]**

b) Prove the following relations for an axial fan stage with UGV and DGVS: $\rightarrow$

(Δp) st = $2\rho u^2 (\phi \tan\beta_2 - 1)$, $\psi = 4(\phi \tan\beta_2 - 1)$ and R = 1 **[8]**

Q9) a) What are the main causes of noise generation? What are the methods of reducing fan noises? **[8]**

b) What is surging? What are its effects? What is stalling? How it is developed? **[8]**

OR

Q10)a) Explain briefly what is the purpose of inlet guide vanes and inducer blades. Why is the radial tipped impeller mostly used in centrifugal compressor stages? **[8]**

b) Stage design considerations and empirical relations used to determine various fan design parameters. **[8]**

Q11)a) What is the work done factor for an axial compressor stage? How does it vary with the number of stages? **[8]**

b) Prove the following relation for isentropic flow in a radial tipped impeller.

$\psi = 1; P_{r\bar{w}} = 1 + \left(\frac{U_2^2}{Cp.T01}\right) \cdot (y/y - 1)$; with usual notations. **[10]**

OR

Q12)a) Derive the following relations for an axial compressor stage with constant axial velocity. **[12]**

i) $(\tan\alpha_1+\tan\beta_1)=(\tan\alpha_2+\tan\beta_2)=(\mathrm{U/V}x)$

ii) $\psi=\phi(\tan\beta_1-\tan\beta_2)$

iii) $\dfrac{(\Delta p)st}{\rho u^2}=\phi(\tan\alpha_2-\tan\alpha_1)$

iv) $(n_{st})=\left(\dfrac{(\Delta p)st}{\Omega\rho\mathrm{U}\mathrm{V}_x(\tan\alpha_2-\tan\alpha_1)}\right)$; with usual notations.

b) What is "slipfactor"? What is its effect on the flow and the pressure ratio in the stage? **[6]**