Total No. of Questions : 10]

SEAT No. :

P2224

[Total No. of Pages : 5

[5254]-557

B.E. (Mechanical Sandwich Engineering) (Semester -II)
DESIGN OF PUMPS, BLOWERS AND COMPRESSORS
(2012 Pattern) (Elective -I)

Time : 2½ Hours] *[Max. Marks : 70*

Instructions to the candidates:

1) *Answer Q.1 or Q.2,Q.3 or Q.4, Q.5 or Q.6, Q.7 or Q.8, Q.9 or Q.10.*
2) *Neat diagram must be drawn wherever necessary.*
3) *Figures to the right indicate full marks.*
4) *Assume suitable data, if necessary.*

Q1) a) Explain the basic equation of Energy Transfer between fluid and rotor. **[6]**

b) Define the following terms- **[4]**

i) Pump

ii) Fan and Blower

iii) Compressor

iv) Turbine

OR

Q2) a) Explain performance characteristics of Pump, fan, blower and compressor. **[6]**

b) A small compressor has the following data: **[4]**

Air flow rate = 1.5778 kg/s Pressure Ratio = 1.6

Rotational Speed = 54,000 rpm Efficiency = 85%

State of air at entry: Po_1 = 1.008 bar, T_{01} = 300 K, C_p = 1.009 kJ/kg K

Calculate the power required to drive the compressor?

P.T.O

Q3) a) What is slip? Explain the negative slip with neat sketch. **[5]**

b) The cylinder bore diameter of a single acting reciprocating pump is 150 mm and its stroke length is 300 mm. The pumps runs at 50 r.p.m. and lifts water through a height of 25m. The delivery pipe is 22m long and 100 mm in diameter. Find the theoretical discharge and the theoretical power required to run the pump. If the actual discharge is 4.2 liters/s. Find the percentage slip. Also determine the acceleration head at the beginning and middle of the delivery stroke. **[5]**

OR

Q4) a) Explain the Air vessel in Reciprocating Pumps? **[5]**

b) A single acting reciprocating pump has piston diameter 12.5 cm and stroke length 30cm. The center of the pump is 4m above the water level in the sump. The diameter and length of suction pipe are 7.5 cm and 7m resp. The separation occurs if the absolute pressure head in the cylinder during suction stroke falls below 2.5 m of water. Calculate the maximum speed at which the pump can run without separation. Take atmospheric pressure head = 10.3 m of water. **[5]**

Q5) a) Explain the different Mechanical losses in fans and blowers? **[8]**

b) A centrifugal fan has the following data: **[8]**

Inner diameter of the impeller	18cm
Outer diameter of the impeller	20cm
Speed	1450 rpm

The relative and absolute velocities respectively are

At entry	20 m/s, 21 m/s
At exit	17 m/s, 25 m/s
Flow rate	0.5 kg/s
Motor efficiency	78%

Determine-

i) Stage Pressure rise

ii) Degree of reaction

iii) The power to drive the fan

Take density of air as 1.25 kg/m^3

OR

Q6) a) Discuss the various applications of fans & blowers **[8]**

b) A centrifugal blower with a radial impeller produces a pressure equivalent to 100 cm column of water. The pressure and temperature at its entry are 0.98 bar and 310 K. The electric motor driving the blower runs at 3000 rpm. The efficiencies of the fan and drive are 82% and 88% respectively. The radial velocity remain constant and has a value of $0.2u_2$. The velocity at the inlet eye as $0.4u_2$. If the blower handles 200 m^3 /min of air at the entry condition determine:- **[8]**

i) Power required by the electric motor

ii) Impeller diameter

iii) Inner diameter of the blade ring

iv) Air angle at entry

Q7) a) Explain design procedure & selection, optimization of blower. **[8]**

b) An axial fan stage consisting of only a rotor has the following data:- **[8]**

Rotor blade air angle at exit	10º
Tip diameter	60 cm
Hub diameter	30 cm

Rotational speed	960 rpm
Power required	1 kW
Flow coefficient	0.245

(Inlet flow conditions P1 = 1.02 bar and T1 = 3.16 K)

Determine the rotor blade angle at the entry, the flow rate, stage pressure rise, overall efficiency, degree of reaction, and specific speed.

OR

Q8) a) What are main cause for noise generation? What are methods for reducing the fan noise? **[8]**

b) The velocities for upstream and downstream of an open propeller fan (d =50 cm) are 5 and 25 m/s respectively. If the ambient conditions are P = 1.02 bar, t = 37ºC determine: **[8]**

i) Flow rate through the fan

ii) Total pressure developed by the fan and

iii) The power required to drive the fan assuming the overall efficiency of the fan as 40%

Q9) a) Explain performance characteristics curves of an Axial flow compressor? **[8]**

b) An Axial compressor stage has the following data **[10]**

i)	Temperature and Pressure at Entry	300 K, 1.0 bar
ii)	Degree of Reaction	50%
iii)	Mean Blade ring diameter	36cm
iv)	Rotational Speed	18000 rpm

v)	Blade Height at entry	6 cm
vi)	Air angles at rotor and stator exit	25º
vii)	Axial velocity	180 m/s
viii)	Work done factor	0.88
ix)	Stage Efficiency	85%
x)	Mechanical Efficiency	96.7%

Determine:-

i) Air angles at the stator and rotor entry

ii) The mass flow rate of air

iii) The power required to drive the compressor

iv) The loading coefficient

v) The pressure ratio developed by the stage

vi) Mach number at the rotor entry

OR

Q10) a) Explain performance characteristics curves of a Centrifugal flow compressor? **[8]**

b) Air enters the inducer of centrifugal compressor at Po1= 1.02 bar, To1=335 K. The hub and tip diameters of the impeller eye are 10 and 25 cm respectively. If the compressor runs at 7200 rpm and delivers 5.0 kg/s of air. Determine the air angle at the inducer blade entry and the relative mach number. If IGVs are used to obtain a straight inducer section, determine the air angle at IGVs exit and the new value of the relative Mach number.**[10]**