B.E. (Sem VII) (CBSGS) (Mechanical Engg.)
Mechanical Utility Systems

25th May 2016
11.00 am to 2.00 pm

QP Code : 31325

(3 Hours) **[Total Marks : 80**

Note:

1. Question No.1 is compulsory.
2. Attempt any three questions from remaining five questions.
3. Assume suitable data if required.

Q.1 Solve any four (20)

a. Enumerate the various use of air compressor.
b. Explain the working of an axial flow compressor.
c. Explain the working of vane pump.
d. Enumerate the losses which occur when a centrifugal pump operates.
e. What are the methods of energy conservation in compressed air system?

Q.2 a) Why inter cooling is used in multistage compressor? Derive an expression for intermediate pressure in a two stage compressor when inter cooling is not perfect. (10)

b) A rotary air compressor working between 1 bar and 2.5 bar has internal and external diameters of impeller as 300 mm and 600 mm respectively. The vane angle at inlet and outlet are 30^0 and 40^0 respectively. If air enters impeller at 15 m/s. Find the speed of an impeller in r.p.m. and work done by the compressor per kg of air. (10)

Q.3 a) The diameter and stroke of a single acting reciprocating pump are 300 mm and 500 mm respectively. The pump takes its supply of water from sump 3.2 m below the pump axis through a pipe 9 m long and 200 mm diameter. If separation occurs 2.4 m of water absolute, Determine: (12)

1. The speed at which separation may takes place at the beginning of suction stroke.
2. The speed of the pump if an air vessel is fitted on the suction side 2.4 m above the sump water level.

Take atmosphere pressure head = 10.3 m of water and friction co-efficient, f = 0.01.

b) Derive an expression for work done by the impeller of a centrifugal pump on liquid per second per unit weight of liquid. (08)

Q.4 a) A two stage single acting reciprocating compressor takes in air at the rate of 0.2 m^3/s. The intake temperature and pressure of air at 0.1 MPa and 16^0C. The air is compressed to a final pressure of 0.7 MPa. The intermediate pressure is ideal and cooling is perfect. The compression index in both the stages is 1.25 and the compressor runs at 600 r.p.m. Neglect clearance. (10)

Determine:

1. intermediate pressure,
2. Total volume of each cylinder,
3. Power required to drive the compressor,
4. Rate of heat rejection in the intercooler

b) Calculate the power required to run the vane compressor and its efficiency, when it handles 6 m^3 of air per minute from 1 bar to 2.2 bar. The pressure rise due to compression in the compressor is limited to 1.6 bar. Take the mechanical efficiency of compressor as 80%. (10)

TURNOVER

Q.5 a) A single acting reciprocating pump, running at 50 r.p.m. delivers 0.00736m^3/s of water. The diameter of piston is 200 mm and stroke length 300 mm. The suction and delivery heads are 3.5 m and 11.5 m respectively. Determine (10)

1. Theoretical Dischrge,
2. Co-efficient of discharge,
3. Percentage slip of the pump and

Power required to run the pump.

b) The impeller of a centrifugal pump having external and internal diameters 500 mm and 250 mm respectively, width at outlet 50 mm and running at 1200 r.p.m. works against a head of 48 m. The velocity of flow through the impeller is constant and equal to 3 m/s. The vans are set back at an angle of 40^0 at outlet. (10)

Determine:

1. inlet vane angle,
2. work done by the impeller on water per second and
3. manometric efficiency.

Q.6 Solve any four (20)

a. What do you mean by net positive suction head and its significance?
b. What is cavitation and how it occurs in reciprocating pump?
c. What is octopus network and its limitations.
d. State few methods of improving efficiency of pumping systems.
e. Draw and comment on performance characteristics of centrifugal pump.

XXX