BE/Sem VII/CBSGS/MECH/MVS/5-12-2017

QP CODE : 27421

(3 Hours) (Maximum 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. State advantages of multistage reciprocating compressor.
b. Describe the function of air vessel in reciprocating pump with the help of neat sketch.
c. Differentiate centrifugal pump and reciprocating pump.
d. What is the basic criteria in selecting the piping network in compressed air system?
e. Why axial flow compressors are used for jet aircraft applications?

Q.2 a) Derive an expression for volumetric efficiency of single stage single acting reciprocating air compressor with clearance and discuss atleast four factors which affect volumetric efficiency. (12)

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 45^0 respectively. If air enters impeller at 15 m/s. Find speed of impeller in r.p.m. and work done per kg of air. (08)

Q.3 a) A single acting reciprocating pump having 12 cm diameter and 25 cm stroke takes liquid from sump at 2 m below the center of pump and delivers to tank at 10 m above the center of pump. The diameter of suction and delivery pipes is 8 cm each and length of suction pipe is 3 m and delivery pipe is 12 m. Only one air vessel is placed to the delivery pipe very near to the pump axis. The separation pressure is 88 KN/m^2 below atmospheric pressure. Taking density of liquid as 1200 kg/m^3 and f = 0.01, find maximum speed of the pump without separation and power required to run the pump. (12)

b) Define NPSH, Thoma's cavitation factor and suction specific speed of pump. Explain NPSHA and NPSHR w.r.t. cavitation in pumps using neat sketch. (08)

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Q.4 a) Draw an indicator diagram, considering the effect of acceleration and friction in suction and delivery pipes. Derive an expression for the work done per second in case of a single-acting reciprocating pump. (10)

b) 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 are 0.1 MPa and 16^0C. The air is compressed to 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 and determine (10)

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

Q.5 a) Explain construction and working of centrifugal compressor with the help of neat sketch. (08)

b) A centrifugal pump runs at 1440 r.p.m. The impeller is 40 cm in diameter and 2.5 cm wide at outlet. The pump lifts water through height of 30 m of which suction lift is 2.5m. The suction and delivery pipes are 30 cm in diameter. The losses due to friction in suction and delivery pipes are 1.5 m and 5.5 m respectively. The exit blade angle is 2.5^0. Assume the flow to be radial at inlet and monomeric efficiency is 84%. Calculate quantity of water flowing through the pump and pressure at suction and delivery end of pump if atmospheric pressure is 10.35 m of water. (12)

Q.6 Solve any four (20)

a. Why capacity control of compressors is essential? State the methods of capacity control in compressor.
b. Explain chocking, surging and stalling in axial flow compressor with the help of neat sketch.
c. Define coefficient of discharge, volumetric efficiency and slip in reciprocating pump. Describe negative slip with proper reason.
d. Describe the methods of speed reduction to meet variable flow reduction in pumping system.
e. Draw and comment on performance characteristics of reciprocating pump.
