QP CODE : 27420

Time duration: 3 Hours **Marks 80**

Note: 1) Question no. **1** is compulsory.

2) Attempt any **three** questions out of the remaining **five** questions.

3) Clearly mention the assumptions made if any.

Q.1 Solve any four 20

a) Explain with neat labeled diagram vortex casing in case of centrifugal pump.

b) Explain Ideal Indicator diagram in detail.

c) Define following terms for centrifugal compressor,

1) Degree of reaction

2) Slip factor

3) Work factor

4) Pressure coefficient

d) A single-cylinder, double-acting, reciprocating air compressor receives air at 1 bar; 17°C, compresses it to 6 bar according to the law $pV^{1.25}$ = constant. The cylinder diameter is 300mm. The average piston speed is 150 m/min at 100 rpm. Calculate the power required in kW for driving the compressor. Neglect clearance.

e) Write a note on load unload test.

Q.2 a) What are axial thrust in centrifugal pumps? Discuss the methods of balancing the axial thrust 10

b) In an axial flow compressor, having 10 stages works with 50% degree of reaction. It compresses air with a pressure ratio of 5. The inlet conditions of air are 27°C and 100 kpa. The air enters the compressor with a velocity of 110 m/s. The mean speed of the rotor blade is 220 m/s. The isentropic efficiency is 85%. Calculate work input per kg and blade angle. 10

Q.3 a) A single-stage centrifugal pump with impeller diameter of 30 cm rotates at 2000 rpm and lifts 3 m^3 of water per second to a height of 30 m with an efficiency of 75%. Find the number of stages and diameter of each impeller of a similar multistage pump to lift 5 m^3 of water per second to a height of 200 m when rotating at 1500 rpm. 8

b) A double-acting reciprocating pump, running at 40 rpm, is discharging 1 m^3 of water per minute. The pump has a stroke of 400 mm. The diameter of piston is 200 mm. The delivery and suction head are 20 m and 5 m respectively. Find the slip of the pump and power required to drive the pump. 6

[TURN OVER

c) Explain methods of improving efficiency in pumping system. 6

Q.4 a) Explain construction and working of double-acting reciprocating pump with neat labeled diagram, and derive the formula for discharge and work done to drive a double-acting pump. 10

b) Calculate the power required to compress 25 m^3/min atmospheric air at 101.3 kpa, 20°C to a pressure ratio of 7 in an LP cylinder. Air is then cooled at constant pressure to 25°C in an intercooler, before entering HP cylinder, where air is again compressed to a pressure ratio of 6. Assume polytropic compression with n= 1.3 and R= 0.287 kJ/kg K. 10

Q.5 a) Explain in detail construction and working of axial compressor with neat labeled diagram, and state losses in axial compressor. 10

b) The outer diameter of an impeller of a centrifugal pump is 400 mm and outlet width is 50mm. The pump is running at 800 rpm. and is working against a total head of 15 m. The vanes angle at outlet is 40° and manometric efficiency is 75%. Determine: 10

(i) velocity of flow at outlet (ii) velocity of water leaving the vane

(iii) angle made by the absolute velocity at outlet with the direction of motion at outlet,

(iv) discharge

Q.6 Write short note on following (any four) 20

a) Limitations of single stage reciprocating compressor

b) Model testing of centrifugal pump.

c) Screw pump.

d) Variable Speed Drive.

e) Applications of compressed air in industry.
