(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. Differentiate reciprocating compressors and rotary compressor.

        b. Illustrate the working of air vessel in reciprocating pump.

        c. Describe working of any two type of casings used in centrifugal pump.

        d. Illustrate flow control by throttling method and trimming of impeller method in pumping system.

        e. Find the percentage saving in work input by compressing air in two stages from 1 bar to 7 bar instead of one stage. Assume a compression index of 1.35 in both the cases and complete intercooling in a two stage compressor.

Q.2   a)   Derive an expression for work done by the impeller of a centrifugal pump on liquid   (8)
           per second per unit weight of liquid.

    b)   A centrifugal compressor running at 1440 rpm, handles air at 101 KPa and 20^0C and   (12)
           compresses it to a pressure of 6 bar isentropically. The inner and outer diameters of the impeller are 14 cm and 28 cm respectively. The width of blade at the inlet is 2.5 cm. The blade angles are 16^0 and 40^0 at entry and exit. Calculate mass flow rate of air, degree of reaction, power input and width of blade at outlet.

Q.3   a)   The plunger diameter and stroke length of a single acting reciprocating pump are 300   (10)
           mm and 500 mm respectively. The speed of the pump is 50 r.p.m. The diameter and length of delivery pipe are 150 mm and 55 m respectively. If the pump is equipped with an air vessel on the delivery side at the center line of the pump, find the power saved in overcoming friction in the delivery pipe. Take friction co-efficient, f = 0.01.

    b)   State at least 4 advantages of multistaging in reciprocating compressor. Derive an   (10)
           expression for intermediate pressure in a two stage compressor when inter cooling is imperfect.

Q.4   a)   A single stage, single acting reciprocating air compressor receives air at 1.013 bar,   (08)
           27^0C and delivers it at 9.5 bar. The compressor has a bore = 250 mm, stroke = 300mm and it runs at 200 rpm. The mass flow rate of air is 200 kg/h. Calculate the volumetric efficiency of the compressor.

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b) Derive an expression for the work done in case of a single-acting reciprocating pump (12) considering the effect of acceleration and friction in suction pipe only. Start from basic assumptions.

Q.5 a) Draw a neat sketch of various components of the centrifugal compressor and show the (10) variation of pressure and velocity of air being compressed.

b) A centrifugal pump has diameter 17.5 cm, width at outlet 5 cm, outlet angle 22^0. Head (10) characteristics are given by $H = 40 - 140Q - 1200Q^2$, where Q is in m^3/s, H in m. pump is used to deliver water through a pipe of diameter 15cm, 75 m long. $H_{static} = 31$ m, N = 2880 rpm, volumetric efficiency = 0.96 and mechanical efficiency = 0.96. Determine input power to pump.

Q.6 Solve any four (20)

    a. Illustrate working of compressed air system?
    b. What is cavitation? How can we avoid it in reciprocating pump?
    c. What is octopus network? And its limitations.
    d. What do you mean by priming? Why is it necessary?
    e. Draw and comment on performance characteristics of pump.

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