6 a) What is meant by cavitation in centrifugal pump? What are the effects of   5
        cavitation? How it can be eliminated

   b) Show that the saving in work done against friction in a double acting reciprocating   5
        pump fitted with air vessel is 39.2%

7 a) Define minimum starting speed of a centrifugal pump. Write down the equation   4
        for the same with notations.

   b) With the help of necessary sketch, explain the working of a jet pump? Where are   6
        they used?

8 a) What is meant by manometric head of a centrifugal pump? What are the different   4
        ways of finding it?

   b) The bore and stroke of a double acting reciprocating pump are 15cm and 30cm   6
        respectively. The suction and delivery heads are 3m and 30m and the pump
        delivers $0.62 m^3/min$ when running at 60rpm. Find the percentage slip and power
        required to run the pump if mechanical efficiency is 80%.

PART C
Answer any four questions. Each question carries 10 marks.

9 a) Deduce an equation for the work done on a reciprocating compressor in terms of   5
        pressure ratio using P-v diagram. Assume the process of compression fallows
        polytropic according to $pv^n = a$ constant.

   b) A single stage single acting reciprocating air compressor is used to compress   5
        7×10^{-3} m^3/min of air from a pressure of 1.013 bar to 14 bar. The index of
        polytropic compression is 1.3 and mechanical efficiency is 82%. Determine the
        volumetric efficiency and power required to drive the compressor if the clearance
        is 3% of the swept volume.

10 a) Define the following with reference to reciprocating compressors   3
           i) Isothermal efficiency ii) Adiabatic efficiency iii) Volumetric efficiency

   b) Obtain the expressions for volumetric efficiency of an air Compressor in terms of   7
        clearance ratio, index of compression and pressure ratio.

11 a) What are the advantages and disadvantages of multistage compression?   4

   b) Prove that for a multi stage compressor with perfect intercooling between stages,   6
        the work done is minimum when the intermediate pressure is the geometric mean
        of the suction and delivery pressure between successive stages.

12 a)   Define slip factor and pressure coefficient in centrifugal compressors   4

b) An axial flow compressor draws in air at 20^0C and delivers it at 50^0C. Assuming 50% degree of reaction, calculate the velocity of flow and number of stages if blade velocity is 100m/s, work factor as 0.85. Assume the blades are symmetrical and air inlet and exit angle $\alpha = 10^0$, $\beta = 40^0$ 6

13   A centrifugal compressor has a compression ratio of 4:1 with an isentropic efficiency 88% when running at 14000 rpm and including air at 25^0C. Curved vanes at inlet gives the air a pre-whirl of 18^0 to axial direction at all radii and the mean diameter of eye is 245mm. Absolute air velocity at inlet is 120m/s. Impeller tip diameter is 580mm. Calculate the slip factor.   10

14   a) Explain the working of axial flow compressor and obtain the expression for the work done.   5

b) Explain surging and choking in centrifugal compressors.   5

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