Answer the following questions

Question 1 (20 marks)

(a) Define: N.P.S.H available and required –Specific speed.

(b) What do you understand by cavitation? What are its causes and how it can be prevented?

(c) Explain how can reciprocating pump be classified. Explain the main important functions of an air vessel.

(d) A single acting reciprocating pump running at 60 r.p.m has a plunger diameter of 25.4 cm and a stroke of 45.72 cm. The delivery pipe is 11.43 cm diameter and 48.77 m long. If the motion of the pump is simple harmonic, find the H.P. required overcoming friction of the delivery pipe when (a) no air vessel is fitted on it and (b) a large air vessel is fitted on the centre line of the pump. Assume $f = 0.01$.

Question 2 (20 marks)

(a) What is meant by priming? Explain some of the important methods of priming.

(b) What are the possible troubles causes in centrifugal pump, if (i) Water is not delivered, (ii) Pump stops after working short duration, (iii) Pump runs noisy, (v) Bearing get heated up.

(c) How will you classify centrifugal pumps?

(d) Water is lifted from a tank to a total lift of 15 m with the help of a centrifugal pump. The pump is situated 2m above the water surface of water. The radial velocity of flow through the wheel is 4 m/s. Vane at exit makes an angle of 120^0 with the direction of motion. The velocity of water at delivery pipe is 2 m/s. Determine (i) Peripheral velocity at exit, (ii) velocity head at exit, and (iii) Pressure head at exit.

Question 3 (20 marks)

(a) Draw an illustrative diagram of a centrifugal compressor stage indicating the names of its principal parts. Explain briefly the purpose of the inlet guide vanes and inducer blades.

(b) Draw sketches of the three types of impellers and the velocity triangles at their entries and exits.

(c) A centrifugal compressor is required to deliver 8 kg/s of air with a stagnation pressure ratio of rotating at 15,000 rpm. The air enters the compressor at 25^OC and 1 bar. Assume that the air enters axially with velocity of 145 m/s and the slip factor is 0.89. If the compressor isentropic efficiency is 0.89, find the rise in stagnation temperature, impeller tip speed, diameter, work input, and area at the impeller eye.

Question 4 (20 marks)

(a) What are the various losses occurring in centrifugal compressor stage. With the aid of sketch show the effect of losses on the performance characteristics.

(b) For centrifugal compressor with the aid of sketch draw the variation of degree of reaction with flow coefficient for various values of impeller exit air angle. Also draw the variation of pressure coefficient with degree of reaction.

(c) For centrifugal compressor define the degree of reaction and prove that: $R = 1/2 + 1/2\ \phi_2 \cot \beta_2$

(d) The tangential velocity component of air at the volute base circle (r=25cm) is 177.5 m/s. Determine its shape and throat-to-diameter ratio for a constant width of 12 cm and discharge 5.4 m^3/s assuming free vortex flow.

Question 5 (20 marks)

(a) With sketch show the important applications of fans and blowers in industries.

(b) What are the types of axial fan stages? With sketch draw two types and its velocity triangles.

(c) Draw the performance characteristics for axial flow fans. Show how can surging be reduced or wholly overcome for axial fans.

(d) An axial fan stage consisting of a rotor and downstream guide vanes has the following data:

Rotor blade air angle at exit.	10^0 C	Tip diameter	60 cm
Hub diameter	30 cm	Speed	960 rpm
Power required	1 kW	Flow coefficient	0.245

Inlet flow conditions (p_1 = 1.02 bar, T_1 = 316 K) Determine:

1- The rotor blade angle at the entry, 2- The flow rate, 3- The stage pressure rise, 4- Overall efficiency, 5- Degree of reaction, 6- Specific speed, and 7- Gide vane air angle at the entry.

With our best wishes