Ex/ME/T/321/2017(Old)

B.E Mechanical Engineering Third Year Second Semester Examination 2017 (Old)
Subject: Performance Analysis and Design of Fluid Machinery

Time: Three hours **Full Marks: 100**

Answer any five questions
Use suitable data and condition, if necessary

1. What is meant by flow coefficient, head coefficient and power coefficient in reference to rotodynamic machines for incompressible fluids. Neatly draw the non-dimensional performance characteristics of a rotodynamic pump with few observations and obtain the expression for specific speed for the pump.

   A single stage centrifugal pump discharges 0.45 m^3 of water per minute producing a head of 15 m. A motor drives the pump and the tachometer registrar a speed of 1250 rpm. At this speed the brake horse power necessary to drive the pump is 6 kW. If the number of revolutions is increased to 1450 rpm, find the new discharge, head and brake power. Also calculate the specific speed if the pump is assumed to run under maximum efficiency. [20]

2. What is meant by priming of a pump?

   The head-discharge characteristics relationship for a centrifugal-pump is given by: $H = 40 - 200.\ Q^2$, where H is the total head generated by the pump in meters and Q is the discharge in m^3/s. The pump lifts water through a pipe of 0.3 m diameter over a distance of 1000 m. The static lift is 25 m. Find the operating/ duty point (Q and H) if the friction coefficient of the pipe 'f' is 0.03. What will be equation for the combined characteristics (head-discharge), if two such identical pumps operate in parallel? [20]

3. With a neat sketch, define NPSH and Thomas Cavitation parameter.

   A centrifugal pump was tested for cavitation initiation. The pump was placed above the sump level and the total head development of the pump was 40 m and the flow rate was 0.06 m^3/s. Cavitation started when the net head available at the suction side (Taking care of suction lift and friction) was 3 m. The atmospheric pressure was 760 mm of Hg and the vapour pressure at this temperature was 2.0 kPa. Calculate the cavitation parameter.

   It was proposed to install the pump where the atmospheric pressure is 700 mm Hg and the vapour pressure at the location Hg is 1.0 kPa. If the pump develops the same total head and flow rate, can the pump be placed at the same height above the sump level as the laboratory setup? [20]

4. What do you mean by unit quantities in reference to hydraulic turbine? Obtain the expression for unit speed, unit discharge and unit power and hence, derive the expression for specific speed of a turbine.

   A turbine is to operate under a head of 25 m at 200 rpm. The discharge is 9 m^3/s. If the turbine efficiency is 90% determine: (i) specific speed of the turbine (ii) rotational speed, discharge and power generated of the turbine under a head of 20 m. Also state the type of turbine. [20]

[Turn over