

B.E Mechanical 3rd Year 1st Semester Supplementary Examination 2017Subject: **Fluid Machinery - II**

Time: Three hours

Full Marks: 100

Answer any five questions.

Use suitable data and condition, if necessary.

1. (a) Define flow coefficient, head coefficient and power coefficient in reference to a pump for incompressible fluids and obtain the expression for specific speed for the pump.

(b) A multistage centrifugal pump is to be installed to lift water through a head of 80 m at the rate of $0.1 \text{ m}^3/\text{s}$. The pump is coupled to an electric motor running at 1000 rev/min. Make calculations for the head developed per stage and the required number of stages; the required impeller diameter if the speed ratio based on impeller diameter is 0.9; and the power required. Assume that the overall efficiency is 0.75 and the specific speed of each impeller is 30.

[10+10]

2. (a) What is meant by priming of a pump?

(b) A centrifugal pump running at 1400 rpm has the characteristics as given below:

Discharge , Q lit/s	11.3	16.9	22.6	28.3	34.0	39.6	45.2
Head, H m	25.8	25.0	24.1	23.1	21.4	18.9	15.8
Overall Efficiency (%), η_o	65.0	70.0	73.0	74.0	72.0	69.0	62.0

Draw the operating characteristics of the pump (use graph paper) and determine its specific speed.

(c) In relation to the data in (b) above, the pump lifts water against a static head of 12 m through a long pipeline in which the loss of head in meters, due to friction is given by the expression, $h_f = 0.012 Q^2$, where Q is the discharge in lit/s. The minor losses in the pipe may be neglected. Determine the head, discharge and power required to drive the pump.

[4+8+8]

3. (a) What is cavitation? What are the factors which limit the suction head of a pump?

(b) With a neat sketch, define NPSH and Thomas Cavitation parameter.

(c) A centrifugal pump with critical cavitation number 0.12 is to be installed at a location where barometric pressure and the vapor pressure are stated to be 95 kPa (abs) and 3 kPa (abs) respectively. If the pump delivers water against a head of 25 m, determine the minimum value of NPSH. Also calculate the maximum allowable elevation above the sump water surface where the pump can be setup. Take intake pipe friction equivalent to 0.25 m.

[4+6+10]

[Turn over

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

(b) With A neat diagram, briefly explain the speed control mechanism of a Pelton turbine.

[12+8]

5. (a) State briefly the functions of the spiral casing, guide vanes and the draft tube of a reaction turbine. With naming, sketch the different types of draft tubes that are commonly used for reaction turbines.

(b) Neatly draw the Main/ Constant head characteristics of a Francis turbine with few comments on the nature of the characteristics curves. What is run-away speed of a turbine?

[12+8]

6. (a) Show that the maximum suction head during suction stroke can be expressed by the following

$$h_s = \frac{l_s A_p}{g A_s} \omega^2 r$$

,where, symbols have their usual meanings. Assume piston follows simple harmonic motion.

(b) A single acting reciprocating pump has a plunger of 7.5 cm. diameter and stroke length of 15 cm. It takes its supply of water from a sump 3 meters below the pump through a pipe 8 meters long and 4 cm. in diameter. If separation occurs at 0.75 kgf/cm^2 below the atmospheric pressure, find the maximum permissible speed at which pump may be operated without separation. Assume plunger follow simple harmonic motion. Assume atmospheric pressure head (abs) as 10.3 m of water column.

[10+10]

7. (a) Briefly explain the functions of air-vessels fitted to the suction and delivery pipes of a reciprocating pump

(b) With neat indicator diagram, work out the power saving in a single-acting reciprocating pump when air vessels of adequate capacity are installed on the suction and delivery pipes. Use suitable notations.

[8+12]

8. Briefly write notes on any two of the following topics.

a) Fluid coupling

b) Hydraulic Ram

c) Torque Converter

[2×10]