BACHELOR OF ENGINEERING (MECHANICAL ENGINEERING) SECOND YEAR FIRST SEMESTER EXAM 2019

FLUID MACHINERY- II

Time:-Three Hours Full Marks:-100

Answer any **five** Questions

Assume any data relevant to the questions if not provided

1. a) Explain the "Specific Speed" of an incompressible-flow Turbo-machine. Give the expressions of dimensional and non-dimensional specific speed for the pump and the turbine respectively. Also explain the importance of the "Specific Speed". (12)

   b) What is the Affinity Law? Explain unit quantities. (8)

2. By using Dimensional analysis obtain non-dimensional functional relationship between the variables of an incompressible turbo-machinery. (20)

3. a) Explain the terms 'Flow Co-efficient', 'Head Co-efficient' and 'Power Co-efficient'. Why they are important? (8)

   b) A hydraulic turbine is rotating at a speed of 1200 r. p .m. and develops 5000KW, working under a head of 250 m with an overall efficiency of 70 %. Determine "Unit Speed", "Unit Discharge" and "Unit Power" of the Turbine. (12)

4. Explain thoroughly with a neat diagram the testing of a centrifugal pump. How you get the input power of a centrifugal pump? Draw the characteristic curves of a centrifugal pump. (20)

5. The experimental data for the performance test of a double entry Centrifugal Pump are as given below:

Run No.	1	2	3	4	5	6
Test Speed (in r.p.m.)	1500	1520	1540	1560	1580	1600
Discharge (Lit./min.)	730	760	740	680	545	0
Suction Gauge Reading (in m of water)	4.9	4.8	4.4	4.3	0.90	0.6
Delivery Gauge Reading (in m of water)	26.0	21.0	19	17	25	27.0
Power input to the pump (in KW)	5.8	5.6	4.8	3.9	3.7	3.0

The suction and delivery pipes attached to the pump are of same diameter and the centers of the suction and delivery gauges are located on the same horizontal plane. Plot the following curves using the above test-data at a rated speed of 1650 r.p.m.

i) Total Head (H) Vs. Discharge (Q)
ii) Pump input Power (P) Vs. Discharge (Q)

iii) Overall Efficiency (η_o) Vs. Discharge (Q).

Find from these curves the rated head, rated discharge and rated power input of the pump. (20)

6. Two centrifugal pumps P and Q are available for use in a pipe flow system and their characteristics are as follows:

Pump P		Pump Q	
Discharge Q, m^3/s	Head H, m	Discharge Q, m^3/s	Head H, m
0	45	0	50
0.15	38	0.16	45
0.25	33	0.28	40
0.33	28	0.35	35
0.4	23	0.43	30

Determine the head vs. capacity curves for these pumps when both pumps are connected in:

1. Series
2. Parallel (20)

7. a) Explain the system curve, design point and operating point in connection with a centrifugal pump and pipeline assembly. (8)

b) A single stage centrifugal pump runs at 600 r.p.m. and delivers 360 m^3/min of water against a head of 144 m. The pump impeller is 2.4 m in diameter and it has a positive suction lift (including the velocity head and friction) of 3.6 m. Laboratory tests are to be conducted on a model with 0.54 m diameter impeller and on a reduced head of 114 m. Calculate the speed, discharge and suction lift for the laboratory tests. Assuming atmospheric head = 10.18 m of water and vapour head=0.32 m of water. (12)

8. a) Distinguish between the 'available NPSH' and required 'NPSH' of a turbo pump. (6)

b) A Centrifugal pump running at 250 r.p.m. has an outlet vane angle of 65°. The velocity of flow through the impeller is constant at 2.75 m/s. The manometric head is 24 m and the manometric efficiency is 80 %. The outer diameter is twice the inlet diameter. Assuming that the water enters without whirl, find (i) the inlet and outlet diameter of the impeller (ii) Inlet vane angle. (14)

9. Write short notes on any two of the followings: (10 X 2 =20)

a) Cavitation) b) Characteristics of a Centrifugal pump c) Priming of a Centrifugal Pump d) Draft tube e) Multistaging of Centrifugal pumps.