BACHELOR OF ENGINEERING (MECHANICAL ENGINEERING)
SECOND YEAR FIRST SEMESTER EXAM 2025
FLUID MACHINERY-II

Time:-Three Hours Full Marks:-100

Answer any **five** Questions

Assume any data relevant to the questions if not provided

1. Explain dimensional analysis in connection with a turbo-machinery and obtain non-dimensional functional relationship between the variables of an incompressible turbo-machinery. (20)

2. a) Define geometrically similar turbo machines. What are the non-dimensional "Specific Speed" and "unit quantities" of an incompressible-flow Turbo-machine? (12)

b) Explain the "Affinity Law" in connection with the performance of a Turbo-Pump. (08)

3. a) Define and find unit quantities in connection with turbo-machinery. Why they are so important? (08)

b) A Pelton wheel is rotating at a speed of 1200 r. p. m. and develops 6000 KW, working under a head of 400 m with an overall efficiency of 83 %. Determine "Unit Speed", "Unit Discharge" and "Unit Power" and the dimensional and non-dimensional specific speed of the Turbine. (12)

4. The experimental data for the performance test of a single-entry Centrifugal Pump is as given below:

Run No.	1	2	3	4	5	6
Test Speed (in r.p.m.)	1400	1420	1440	1460	1480	1500
Discharge (Lit./min.)	3000	2400	1800	1200	600	0
Suction Gauge Reading (in m of water)	3.9	3.7	3.4	3.3	0.65	0.35
Delivery Gauge Reading (in m of water)	8.2	15.0	18.9	21.20	24.85	24.95
Power input to the pump (in KW)	4.5	4.8	3.8	2.9	2.7	2.0

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 1500 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)

4. a) Define Multistaging of Centrifugal pump and with diagrams explain centrifugal pump in:**1) series connection 2) Parallel connection.** (10)

b) Two Centrifugal Pumps A and B are available for use in a pipe flow system having their characteristics as given below:

Pump A		Pump B	
Discharge Q (m^3/s)	Head H (m)	Discharge Q (m^3/s)	Head H (m)
0	40.00	0	45.00
0.12	35.00	0.13	40.00
0.20	30.00	0.22	35.00
0.27	22.00	0.30	28.00
0.30	16.00	0.35	18.00

Determine the head-capacity curves when these pumps are in parallel connection using graph paper.

(10)

6. a) Explain centrifugal pump priming operation. What are forward, backward and radial flow impeller in connection with centrifugal pump? (10)

b) A centrifugal pump running at 1000 r.p.m. is working against a total head of 35 m. The external diameter of the impeller is 480 mm and outlet width is 60 mm. If the vane angle at outlet is 30° and manometric efficiency is 75%, determine:

i) Flow velocity at outlet ii) Absolute velocity of water leaving the vane

ii) Angle made by the absolute velocity at outlet with the direction of motion at Outlet (iii) Rate of flow through the pump. (10)

7. a) Explain 'NPSH' of a turbo pump. (08)

b) A vertical shaft Francis turbine has an overall efficiency of 80 % and runs at 12 revolutions per second with a water discharge of 15 m^3/s. The velocity at the inlet of the spiral casing is 9.0 m/s and pressure head at this point is 320 m, the centerline of the casing inlet being 4.0 m above the tailrace level. The diameter of the runner at inlet is 1.5 m and width at inlet is 300 mm. The hydraulic efficiency 70%, determine:

i) Output power II) The dimensionless specific speed

III) The guide vane angle iv) The runner blade angle at inlet. (12)

8. Write short notes on any five of the followings: (5 X 4 =20)

a) Surge Tank b) Priming of a Centrifugal Pump c) Cavitation d) Specific speed e) Draft tube