B. M. E. (Evening) 2nd Year 1st Semester Supplementary Examination 2017

EX/ME/5/T/213/2017(S)

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 and narrate why the "Specific Speed" is important in connection with the shape, size and performance of a Turbo-machine rotor. (8+12=20)

2. List the variable associated with the performance of an incompressible-flow turbo machine and obtain appropriate functional relationship between these variables by using Dimensional analysis. (20)

3. a) Define the terms 'Flow Co-efficient', 'Head Co-efficient' and 'Power Co-efficient'. (8)

   b) A Pelton wheel is rotating at a speed of 1000 r. p .m. and develops 10000 MW, working under a head of 400 m with an overall efficiency of 85 %. Determine "Unit Speed", "Unit Discharge" and "Unit Power" of the Turbine. Also Calculate its "Specific Speed". (12)

4. The experimental datas 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.)	1520	1530	1540	1545	1550	1560
Discharge (Lit./min.)	540	565	550	495	350	0
Suction Gauge Reading (in m of water)	3.0	2.7	2.4	2.1	0.60	0.2
Delivery Gauge Reading (in m of water)	19.0	22.5	23	24	25	27
Power input to the pump (in KW)	4.0	4.5	3.9	2.7	2.5	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 1550 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)

5. a) Show that the ideal head (H_i) developed by a radial-flow pump impeller varies linearly with the volume flow rate (Q) of the pump. Explain why the actual head (H) Vs. discharge rate (Q) curve differs from the ideal one. (10)

   b) An eight bladed Centrifugal pump has an outlet diameter of 225 mm and the width of the impeller at the inlet is 18 mm. The blades are curved backward

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making an angle of 45° with the tangential direction and the impeller rotates at a speed of 2980 r.p.m. Neglecting blockage effects and all losses, find the relationship between the ideal head (H_i) in m and volume of flow rate (Q) in m^3/s through the impeller. (10)

6. a) Explain the system curve, design point and operating point in connection with a centrifugal pump and pipeline assembly. (8)
b) A 1400 m long pipeline having a diameter of 175 mm is used to pump water from a reservoir to storage tank, where the water levels stands at a height of 60 m above the water level in the reservoir. The Darcy's friction factor for the pipeline is 0.03. The pump connected to this pipeline has the Head-Discharge characteristics as tabulated below:

Total Head (H) in meter	45	65	75	95
Discharge (Q) in lit/min	2500	2000	1600	1000

Plot the Head Vs. Discharge Curve for this pump as well as the System Head curve for the pipeline system and thus obtain the point of operation. (12)

7. a) Distinguish between the 'available NPSH' and required 'NPSH' of a turbo pump. (6)
b) A centrifugal pump having a dimensional specific speed of 40 (r.p.m., m^3/s, m) delivers 0.08 m^3/s of water at maximum efficiency while running at 1600 r.p.m. This pump is going to be used at a location where the static suction lift is 6.5 m and local barometric pressure is 750 mm of Mercury. The temperature of water at this site is 28° C and estimated head loss in the suction pipe is 0.5 m of water. If the critical value of the Thomas cavitation factor (σ_c) for the pump is 0.23, determine whether cavitation will occur when pump is operating at its maximum efficiency. Saturation vapour pressure of water at 28° C is 26.3 mm of Mercury. (14)

8. a) explain the function of wicket gates and draft tube in a reaction type hydro turbine. (8)
b) A vertical shaft Francis turbine has an overall efficiency of 80 % and runs at12 revolutions per second with a water discharge of 16 m^3/s. The velocity at the inlet of the spiral casing is 10.0 m/s and pressure head at this point is 250 m, the centerline of the casing inlet being 3.5 m above the tailrace level. The diameter of the runner at inlet is 3.0 m and width at inlet is 350 mm. The hydraulic efficiency 90%, determine:
i) Output power II) The dimensionless specific speed III) The guide vane angle iv) The runner blade angle at inlet. (12)

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

a) Non-dimensional specific speed of pumps and turbines, b) Priming of a Centrifugal Pump c) Cavitation d) Characteristics of a Centrifugal pumps.
e) Run away Speed of a Hydro-Turbine