INDIAN MARITIME UNIVERSITY

(A Central University, Government of India)

End Semester Examination December 2017

Programme: B.Tech (Marine Engineering) **Semester:** V

Subject Name: FLUID MECHANICS-II **Subject Code:** UG11T2504/1504

Date: 11.12.2017 **Maximum Marks:** 100

Time: 3 Hours **Pass Marks:** 50

PART - A

Question No. 1 is compulsory (3 X 10=30 Marks)

1.

a. How do you select repeating variables in case of Buckingham's pi method?

b. Explain the terms –Geometric, Kinematic and Dynamic similarities?

c. What do you mean by Operating Point and Design Point of a Centrifugal pump?

d. Centrifugal pump is running but unable to deliver water in spite of fulfilling installation and priming criteria. Explain with justification.

e. Explain the terms of centrifugal pump- Hydraulic efficiency, Manometric efficiency and Overall efficiency.

f. Why is the higher speed of Reciprocating pump restricted to a certain limit?

g. What are the difference between Centrifugal pump and Reciprocating pump?

h. Why can the suction lift of Centrifugal pump not exceed a certain limit?

i. Differentiate between Pelton wheel and Francis turbines.

j. Define the terms unit power, unit speed and unit discharge with reference to hydraulic turbine.

PART-B

Answer any five of the following questions

(14x5=70 Marks)

2. A centrifugal pump with 1.2 m diameter runs at 200 rpm and pumps 1880 litres per sec, the average lift being 6 m. The angle which the vanes make at exit with tangent to the impeller is 26 degree and the radial velocity of flow is 2.5 m/sec. Determine the manometric efficiency and the least speed to start pumping against a head of 6 m, the inner diameter of the impeller being 0.6 m. (14 Marks)

3. Show that the pressure rise in the impeller of a centrifugal pump when frictional and other losses in the impeller are neglected is given by

$$\frac{1}{2g}\left[V_{f1}^{\ 2} + u_2^{\ 2} - V_{f2}^{\ 2}\cos ec^2\phi\right]$$

Where V_{f1} and V_{f2} are velocity of flow at inlet and outlet, u_2 is tangential velocity of impeller at outlet and ϕ is vane angle at outlet.

(14 Marks)

4. The following data is given for a Francis Turbine. Net head H is 60 m; speed N is 700 rpm; shaft power 294.3 kw; overall efficiency is 84%; hydraulic efficiency 93%; flow ratio is 0.20; breadth ratio (B1/D1) is 0.1; outer diameter of runner is two times greater than inner diameter of runner. The thickness of vanes occupancy 5% of the circumferential area of the runner, velocity of flow is constant at inlet and outlet and discharge is radial at outlet. Determine:

i) Guide blade angle

ii)Runner vane angles at inlet and outlet

iii)Diameter of runner at inlet and outlet

iv)Width of wheel at inlet (14 Marks)

5. The three jet Pelton wheel turbine are working under the net head of 450 m at the nozzle and required to produce 12000 kw. The blade angle is 170 degree and the reduction in relative velocity while passing through the bucket 6%. Assuming that the total efficiency of the wheel is 75 %, coefficient of the nozzle velocity is given as 0.98 and the speed ratio is 0.45. Calculate the following

i) Diameter of the jet

ii) Total flow in cubic meter per second

iii) Force exerted by a jet on the buckets

If the jet ratio is not to be less than 10 m, determine (iv) the speed of the wheel for a frequency (f) of 55 Hz and (v) the corresponding wheel diameter (Assume synchronous speed of generator is N= 60f /p. where p is number of pair of poles)

(14 Marks)

6. a) Explain the disadvantages if Air Vessels are not attached to Reciprocating Pump.

b) Derive the expression of Rate of Flow of liquid into and from Air Vessel for both Single and Double acting pumps and also find out their crank angles at which there is no flow of liquid into or from the Air Vessel. (6+8 Marks)

. A single acting reciprocating pump has a piston diameter 0.15 m and stroke length 0.30 m. The centre of the pump is 5 m above the level of water in sump and 33 m below delivery water level. The length of suction and delivery pipes are 6.5 m and 39 m respectively and both the pipes have the same diameter of 75 mm. If the pump is working at 30 rpm find the pressure head on the piston at the beginning, middle and end of both suction and delivery strokes and find the power required to drive the pump. Take atmospheric pressure as 10.3 m of water and Darcy's friction factor for both the pipes as 0.04. (14 Marks)

8. A pump running at 1450 rpm with impeller diameter of 20cm is geometrically similar to a pump with 30 cm impeller diameter running at 950 rpm. The discharge of the large pump at the maximum efficiency was 200 litres/sec at a total head of 25 m. Determine the discharge and the head of the smaller pump at the maximum efficiency conditions. Also determine the ratio of power required. (14 Marks)

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