INDIAN MARITIME UNIVERSITY

(A central University, Government of India)

May/June 2018-END SEMESTER EXAMINATION

B. Tech (Marine Engineering)

Semester: I

Fluid Mechanics II (UG11T2504/1504)

Date: 09-07-2018 **Maximum Marks: 100**

Time: 3 hrs **Pass Marks : 50**

Part-A (**10 x 3 = 30)**

(All Questions are compulsory)

1.

a) Show that the equation force=mass x acceleration is dimensionally homogeneous.

b) Define geometric similarity, kinematic similarity and dynamic similarity.

c) Define indicator diagram. Draw a well labeled ideal indicator diagram.

d) Give three uses of air vessel.

e) Define hydraulic efficiency, mechanical efficiency and overall efficiency of a turbine.

f) Give any three advantages of centrifugal pump over reciprocating pump.

g) Define static head, manometric head and gross head of a centrifugal pump.

h) Give three differences between Impulse and Reaction turbine.

i) Define draft tube. Give two functions of draft tube.

j) Define cavitation. Give two disadvantages of cavitation.

PART B **(5 x 14 = 70)**

(Answer any 5 of the following 7 questions)

2. Shaft power of a pelton wheel is 9560 kW. The turbine is operating at a speed of 750 r.p.m under a net head of 350 m. If overall efficiency of the turbine is 85% and jet diameter is 1/6th of the runner diameter find (i) runner diameter (ii) jet diameter and (iii) number of jets required. Take coefficient of velocity as 0.985 and speed ratio as 0.45 **[14]**

3. A Francis turbine with an overall efficiency of 76 percent is required to produce 150 kW. It is working under a head (H) of 8 m. The runner velocity at inlet is $0.25\sqrt{2gH}$ and the radial velocity of flow at inlet is $0.95\sqrt{2gH}$. The wheel runs at 150 r.p.m. and hydraulic efficiency is 80%. Assuming radial discharge determine (i) guide blade angle at inlet (ii) the wheel vane angle at inlet (iii) diameter of wheel at inlet (iv) width of wheel at inlet. **[14]**

4. The impeller of a centrifugal pump has an external diameter of 400 mm and internal diameter of 180 mm and it runs at 1440 r.p.m. Assuming a constant radial flow through the impeller at 2.5 m/s and the vanes at the exit are set back at an angle of 25 degree, determine (i) inlet vane angle (ii) outlet blade angle (iii) Euler (theorotical) head (iv) draw inlet and outlet velocity triangles **[14]**

5. A single acting reciprocating pump has a piston diameter of 150 mm and stroke length 350 mm. The centre of the pump is 3 m above the water surface in the sump and 20 m below the delivery water level. Both suction and delivery pipe have same diameter of 100 mm and are 5 m and 30 m long respectively. If the pump is working at 35 r.p.m. determine pressure head in the cylinder at the start, middle at end of both suction and delivery strokes. **[14]**

6. Using Buckingham's pi theorem show that the discharge Q of a centrifugal pump depends on mass density of fluid ρ, speed of the pump N, diameter of the impeller D, manometric head H, viscosity of fluid μ and gravitational acceleration g. Show that

$$Q = ND^3\varphi\left(\frac{gH}{N^2D^2}, \frac{\mu}{\rho ND^2}\right)$$

[14]

7.

a. A centrifugal pump is discharging 0.025 m^3/s of water against a total head of 18 m. The diameter of the impeller is 0.4 m and it is rotating with 1400 r.p.m. Calculate the head, discharge and ratio of powers of a geometrically similar pump of diameter 0.25 m when it is running at 2800 r.p.m. **[9]**

b. A single acting reciprocating pump running at 60 r.p.m. delivers 0.53 m3 of water per minute. The diameter of the pump is 200 mm and stroke length 300 mm. The suction and delivery heads are 4 m and 12 m respectively. Determine theoretical discharge, coefficient of discharge and slip of the pump. **[5]**

8. The plunger diameter and stroke length of a single acting reciprocating pump are 300 mm and 500 mm respectively. The speed of the pump is 60 r.p.m. The diameter and length of delivery pipe are 150 mm and 60 m respectively. If the pump is equipped with an air vessel on delivery side, find power saved in overcoming friction in delivery pipe. Take coefficient of friction f=0.01. **[14]**