DEPARTMENT OF APPLIED MECHANICS

END-SEMESTER EXAMINATION (ODD SEMESTER) 2018-19

B.Tech. 1st Semester (Chemical Engineering)

Fluid flow Operation and Hydraulic Machine (AM13107)

Time: 3 hrs. **Max. Marks: 60**

Note: Attempt all the Questions. Assume data if necessary with proper justifications.

1. Answer in brief: **(10×1=10)**
   a) What is the physical significance of Weber and Euler number ?
   b) Define capillarity ? What is angle of contact for mercury and water ?
   c) Define momentum thickness and shape factor ?
   d) Explain Mach cone with sketch.
   e) Explain the nozzle and diffuser for supersonic flow ?
   f) Define Cavitation and NPSH ?
   g) How fully developed flow achieve in pipe flow ? Define entrance length?
   h) What are the methods to overcome the flow separation?
   i) What is Magnus effect ?
   j) What is the difference between Pitot tube and Pitot static tube ?

2. Given velocity distribution $u = U_0[2\left(\frac{Y}{\delta}\right) - \left(\frac{Y}{\delta}\right)^2]$. Find the ratio of mass flow rate M_{bd} leaving through horizontal section bd to that entering through the vertical section ab is M_{ab} (ref.: *Figure 1*). **(10)**

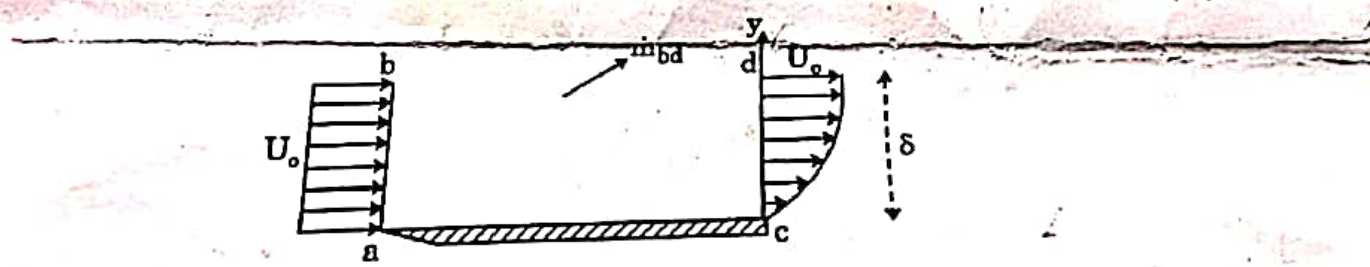

Figure 1

3. The rectangular gate *CD* of *Figure 2* is given *1.8 m* wide and *2 m* long. Assuming the material of the gate is homogeneous and neglecting friction at the hinge *C*. Determine the weight of the gate necessary to keep it shut until the water level rises to *2.0 m* above the hinges. **(10)**

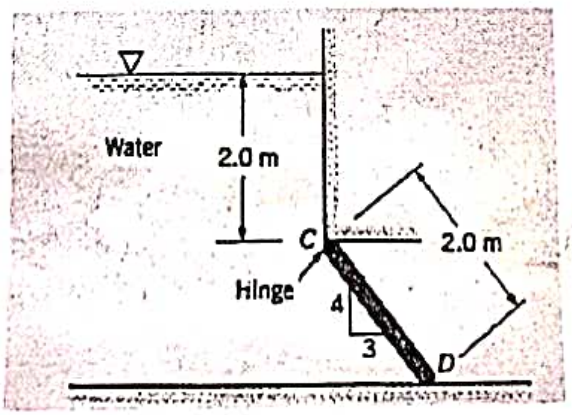

Figure 2

(P.T.O.)

4. What is the function of Rotameter ? Describe its principle, construction and derive the flow rate. Also write down the advantages and disadvantages of Rotameter. **(10)**

5. A centrifugal pump has an impeller *0.5 m* outer diameter and when running at *600 rpm* discharge water at the rate of *8000 litres/ minutes* against a head of *8.5m* . The water enters the impeller without whirl and shock. The inner diameter is *0.25 m*, and the vanes are set back at outlet at an angle of *45°* and the area of flow which is constant from inlet to outlet of the impeller is *0.06 m^2*.
Determine: *(a)* The manometric efficiency of the pump *(b)* The vane angle at inlet *(c)* The least speed at which the pump commences to work.
(10)

6.(a) The velocity component in the x and y direction are given by:

$$u = \lambda x y^3 - x^2 y\,, \quad v = xy^2 - \frac{3}{4}y^4\,.$$

find the value of λ for a possible flow field involving a incompressible fluid. **(5)**

6.(b) An *inverted U-Tube* manometer is used to measure the pressure difference between two pipes *A* and *B*, as shown in *Figure 3*. Pipe *A* is carrying oil (*specific gravity=0.8*) and pipe *B* is carrying water. The densities of air and water are *1.16 kg/m^3* and *1000 kg/m^3*, respectively. Find the pressure difference between pipes *A* and *B* in *kpa*.
(5)

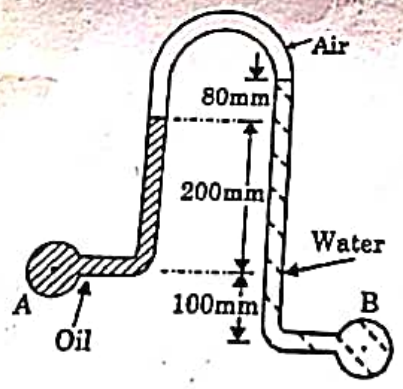

Figure 3