

KATHMANDU UNIVERSITY
End Semester Examination [C]
May/June, 2019

Marks scored:

Level : B.E.

Course : MEEG 301

Year : III

Semester: I

Exam. Roll No.:

Time: 30 mins.

F.M. : 20

Registration No.:

Date 06 JUN 2019

SECTION "A"

[12 Q. \times 1 = 12 marks]

Choose and mark [X] the most appropriate answer/s.

- Boundary layer thickness is the distance from the boundary to the point where velocity of the fluid is
 equal to 10% of free stream velocity
 equal to 50% of free stream velocity
 equal to 90% of free stream velocity
 equal to 99% of free stream velocity
- Friction factor for laminar flow is given by
 $(Re / 64)$ $(64 / Re)$ $(Re / 16)$ $(16 / Re)$
- Which acceleration has a nonzero value in uniform flow?
 Local acceleration
 Convective acceleration
 Both local as well as convective acceleration
 Angular acceleration
- The fluid will rise in capillary when the capillary is placed in fluid, if
 the adhesion force between molecules of fluid and tube is less than the cohesion between liquid molecules
 the adhesion force between molecules of fluid and tube is more than the cohesion between liquid molecules
 the adhesion force between molecules of fluid and tube is equal to the cohesion between liquid molecules
 the cohesive force exceeds the viscous force of the liquid.
- Which of the following devices does not use Bernoulli's equation as its working principle?
 Venturimeter Orifice-meter Pitot tube U tube manometer
- Minor losses do not make any serious effect in the total losses in
 short pipes long pipes
 both the short as well as long pipes big diameter pipes
- What is the effect of free stream velocity on thickness of boundary layer?
 Increase in free stream velocity increases the boundary layer thickness
 Increase in free stream velocity decreases the boundary layer thickness
 The boundary layer thickness does not get affected by any change in free stream velocity
 the boundary layer thickness cannot be predicted by free stream velocity

8. A one dimensional flow is one which
 is uniform flow
 steady and uniform flow
 involves zero transverse component of flow
 takes place in a straight line
9. In every types of flow the total energy at any point of the fluid is always constant. This is given by _____ equation
 Euler's equation Navier-Stokes equation
 Reynold's equation Bernoulli's equation
10. The unit of dynamic viscosity in S.I. units is
 N-m/s² N-s/m² Poise Stoke
11. The actual path followed by a fluid particle as it moves during a period of time, is called as
 timeline pathline streamline streakline
12. The wall shear stress _____ in the flow direction within the entrance region (before the fully developed region starts)
 remains constant increases decreases will be zero

SECTION "B"

[8 Q. × 1 = 8 marks]

Fill in the blanks.

13. _____ is also called form drag because of its strong dependence on the form or shape of the body.
14. The region in the turbulent boundary layer zone, adjacent to the solid surface of the plate is called as _____.
15. The head loss through fluid flowing pipe due to friction is _____ loss.
16. Reynolds number signifies the ratio of _____ forces to _____ forces.
17. Dynamic viscosity of most of the gases _____ with rise in temperature.
18. The flow in a pipe is neither laminar nor turbulent when Reynold number is from _____ to _____.
19. Venturimeter is used to measure the _____ of flowing fluid.
20. The vacuum pressure is equal to the difference between _____.

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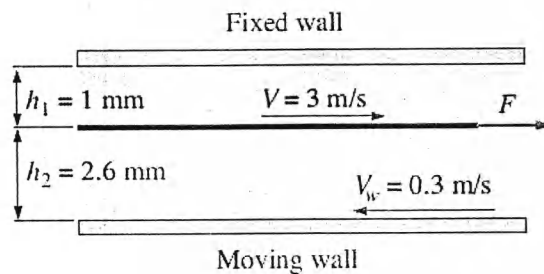
Level : B.E.
Year : III
Time : 2 hrs. 30 mins.

SECTION "C"
[5Q × 11 = 55 marks]

Answer ALL the questions.

1.

- Even though steel is about 7 to 8 times denser than water, a steel paper clip or razor blade can be made to float on water! Explain and discuss. Predict what would happen if you mix some soap with the water. [3]
- Write a short note on 'Modeling in Fluid Mechanics'. [4]
- Nutrients dissolved in water are carried to upper parts of plants by tiny tubes partly because of the capillary effect. Determine how high the water solution will rise in a tree in a 0.0026-mm-diameter tube as a result of the capillary effect. Treat the solution as water at 20°C with a contact angle of 15°. [4]



2.

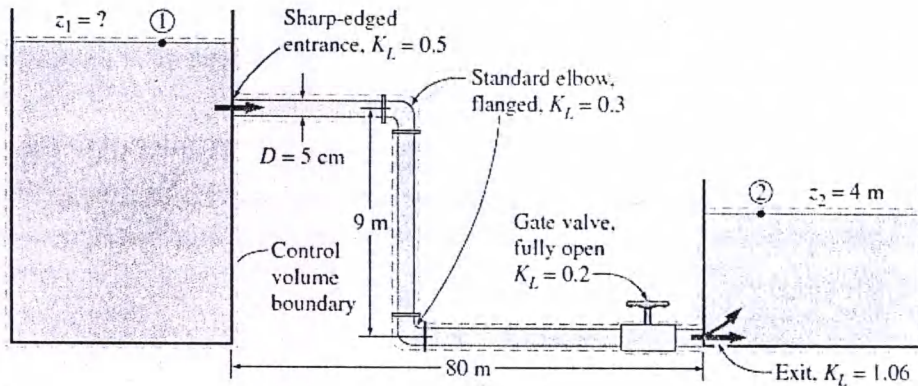
- A thin 30-cm x 30-cm flat plate is pulled at 3 m/s horizontally through a 3.6-mm-thick oil layer sandwiched between two plates, one stationary and the other moving at a constant velocity of 0.3 m/s, as shown in the above right figure. The dynamic viscosity of the oil is 0.027 Pa. s. Assuming the velocity in each oil layer to vary linearly, (a) plot the velocity profile and find the location where the oil velocity is zero and (b) determine the force that needs to be applied on the plate to maintain this motion [5]
- Discuss about buoyancy and stability of an object in a fluid. [3]
- Explain Eulerian and Lagrangian approach in fluid mechanics, with relevant examples and applications. [3]

3.

- What are hydraulic grade line (HGL) and energy grade line (EGL)? Explain the various things that can be noted from those lines. [4]
- Explain various flow visualization techniques. [3]
- Water enters a hydraulic turbine through a 30-cm diameter pipe at a rate of 0.6 m³/s and exits through a 25-cm diameter pipe. The pressure drop in the turbine is measured by a mercury manometer to be 1.2 m. For a combined turbine-generator efficiency of 83 percent, determine the net electric power output. Disregard the effect of the kinetic energy correction factors. [4]

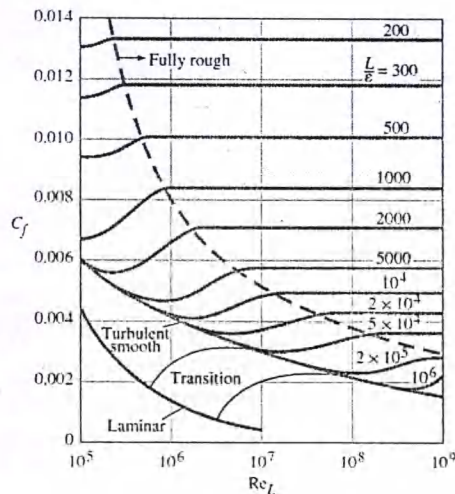
4.

- Explain the Moody chart? What important points on pipe flows can be observed from the Moody chart? [4]
- Why is the Colebrook equation of friction factor difficult to apply? What is the best way to use it? [2]
- Water at 10°C flows from a large reservoir to a smaller one through a 5-cm diameter cast iron piping system, as shown the following figure. Determine the elevation z_1 for a flow rate of 6 L/s. The density and dynamic viscosity of water at 10°C are $\rho = 999.7 \text{ kg/m}^3$ and $\mu = 1.307 \times 10^{-3} \text{ kg/m} \cdot \text{s}$. The roughness of cast iron pipe is $\epsilon = 0.00026 \text{ m}$. [5]



5.

- Explain the following figure for parallel flow over smooth and rough flat plates. [3.5]



- How is trailing edge vortex formed by an aircraft wings in the flight? Why is it necessary to minimize it? How is it minimized in modern aircrafts? [3]
- Two common methods of improving fuel efficiency of a vehicle are to reduce the drag coefficient and the frontal area of the vehicle. Consider a car whose width (W) and height (H) are 1.85 m and 1.70 m, respectively, with a drag coefficient of 0.30. Determine the amount of fuel and money saved per year as a result of reducing the car height to 1.55 m while keeping its width the same. Assume the car is driven 18,000 km a year at an average speed of 95 km/h. Take the density and price of gasoline to be 0.74 kg/L and \$0.95/L, respectively. Also take the density of air to be 1.20 kg/m^3 , the heating value of gasoline to be 44,000 kJ/kg, and the overall efficiency of the car's drive train to be 30 percent. [4.5]