

KATHMANDU UNIVERSITY
End Semester Examination
February/March, 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 **FEB. 24 2019**

SECTION "A"

[8 Q. × 1= 8 marks]

Choose the most appropriate answer/s.

1. Which fluid does not experience shearing stress during flow?
 Pseudoplastic Dilatant Newtonian Inviscid
2. Which of the following statement is wrong?
 A flow whose streamline is represented by a curve, is called two dimensional flow
 The total energy of a liquid particle is the sum of potential energy, kinetic energy and pressure energy
 The length of divergent portion in a venturimeter is equal to the convergent portion
 A pitot tube is used to measure the velocity of flow at the required point in a pipe
3. The location of the centre of pressure over a surface immersed in a liquid is
 always above the centroid
 will be at the centroid
 will be below the centroid
 for higher densities it will be above the centroid and for lower densities it will be below the centroid
4. Metacentric height is given as the distance between
 the center of gravity of the body and the meta center
 the center of gravity of the body and the center of buoyancy
 the center of gravity of the body and the center of pressure
 center of buoyancy and metacenter
5. The fluid forces considered in the Navier-Stokes equation are
 gravity, pressure and viscous gravity, pressure and turbulent
 pressure, viscous and turbulent gravity, viscous and turbulent
6. If viscosity of fluid is more, the thickness of boundary layer is
 more less
 not affected by change in viscosity zero
7. 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
8. Flow of exhaust gas in a large chimney is measured by
 orifice plate venturimeter Rotameter Pitot tube

SECTION "B"
[12 Q.× 1= 12 marks]

Fill in the blanks.

9. Pressure inside a bubble is _____ than atmospheric pressure.
10. _____ is also called form drag because of its strong dependence on the form or shape of the body.
11. Discharge coefficient of a venturimeter is approximately _____.
12. The critical Reynolds number for a flow over flat plate is _____.
13. In a fully rough turbulent regime over a flat plate the friction coefficient is a function of _____ alone and is independent of _____.
14. Orifice and venturi meter fall under the category of _____ flowmeter.
15. Toothpaste is an example of which non-Newtonian fluid? _____.
16. The layer immediate to the surface in turbulent flow regime is called _____.
17. Navier-Stokes equation in its shortest form is _____.
18. Trailing edge vortices is a kind of _____ drag.
19. Minor losses are usually expressed in terms of the **loss coefficient** $K_L =$ _____.
20. The following equation was developed by _____.

$$\frac{1}{\sqrt{f}} \cong -1.8 \log \left[\frac{6.9}{\text{Re}} + \left(\frac{\epsilon/D}{3.7} \right)^{1.11} \right]$$

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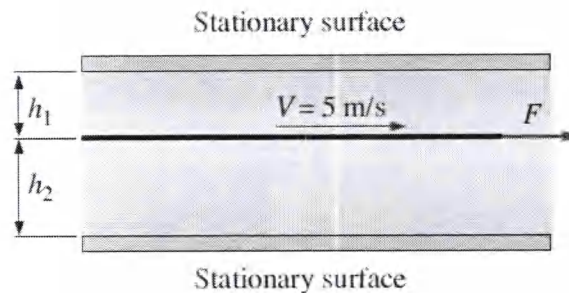
Level : B.E.
Year : III
Time : 2 hrs. 30 mins.

Course : MEEG 301
Semester: I
F.M. : 55

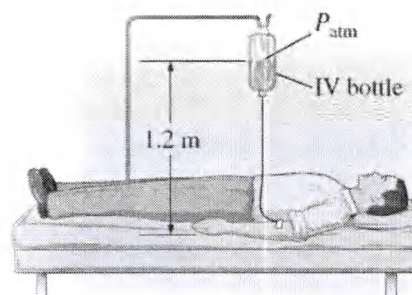
SECTION "C"
[5Q × 11 = 55 marks]

Answer *ALL* the questions.

1. a. Thin plate moves between two parallel, horizontal, stationary flat surfaces at a constant velocity of 5 m/s. The two stationary surfaces are spaced 4 cm apart, and the medium between them is filled with oil whose viscosity is 0.9 N s/m^2 . The part of the plate immersed in oil at any given time is 2-m long and 0.5-m wide. If the plate moves through the mid-plane between the surfaces, determine the force required to maintain this motion. What would your response be if the plate was 1 cm from the bottom surface (h_2) and 3 cm from the top surface (h_1)? [6]



- b. Explain why some people experience nose bleeding and some others experience shortness of breath at high elevations. [2]
- c. Explain how hydrostatic forces as well as location of the line of action of a submerged curved surface is determined. [3]
2. a. Explain various types of non-Newtonian fluids with the use of appropriate diagram and examples. [4]
- b. Intravenous infusions usually are driven by gravity by hanging the fluid bottle at sufficient height to counteract the blood pressure in the vein and to force the fluid into the body. The higher the bottle is raised, the higher the flow rate of the fluid will be. (i) If it is observed that the fluid and the blood pressures balance each other when the bottle is 1.2 m above the arm level, determine the gage pressure of the blood. (ii) If the gage pressure of the fluid at the arm level needs to be 20 kPa for sufficient flow rate, determine how high the bottle must be placed. Take the density of the fluid to be 1020 kg/m^3 . [4]



c. Explain Eulerian and Lagrangian approach in fluid mechanics application. [3]

3. a. Explain both mathematical concept and physical meaning of total acceleration, local acceleration and convective acceleration. Given the Eulerian velocity field,

$$\mathbf{V} = 3t\mathbf{i} + xz\mathbf{j} + ty^2\mathbf{k}$$

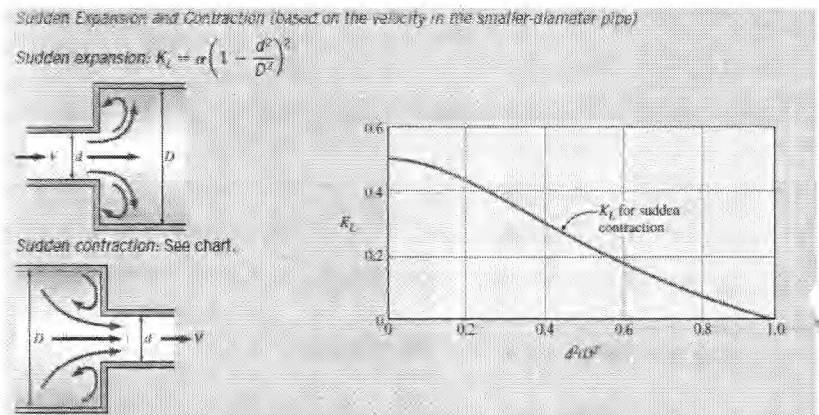
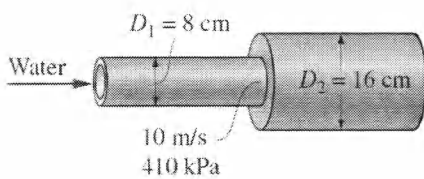
find the total acceleration of the particle. [4.5]

b. What is stagnation pressure? Explain how it can be measured. [1.5]

c. A fan is to be selected to ventilate a bathroom whose dimensions are 2 m x 3 m x 3 m. The air velocity is not to exceed 8 m/s to minimize vibration and noise. The combined efficiency of the fan–motor unit to be used can be taken to be 50 percent. If the fan is to replace the entire volume of air in 10 min, determine (i) the wattage of the fan–motor unit to be purchased, (ii) the diameter of the fan casing, and (iii) the pressure difference across the fan. Take the air density to be 1.25 kg/m³ and disregard the effect of the kinetic energy correction factors. [5]

4. a. Demonstrate mathematically that the velocity profile of fully developed laminar flow in pipe is parabolic. [5]

b. A horizontal pipe has an abrupt expansion from $D_1 = 8$ cm to $D_2 = 16$ cm. The water velocity in the smaller section is 10 m/s and the flow is turbulent. The pressure in the smaller section is $P_1 = 410$ kPa. Taking the kinetic energy correction factor to be 1.06 at both the inlet and the outlet, determine the downstream pressure P_2 , and estimate the error that would have occurred if Bernoulli's equation had been used. [6]



5. a. How does the following equation lead to the design of the modern converging-diverging nozzles? Explain the concept. [4]

$$\frac{dA}{A} = (M^2 - 1) \frac{du}{u}$$

b. How is flow in a pipe measured by the use of venturi or orifice meter? Derive mathematical expression. Why do you need coefficient of discharge in such devices? [4]

c. The drag coefficient of a car at the design conditions of 1 atm, 25°C, and 90 km/h is to be determined experimentally in a large wind tunnel in a full-scale test. The height and width of the car are 1.25 m and 1.65 m, respectively. If the horizontal force acting on the car is measured to be 220 N, determine the total drag coefficient of this car. [3]