



FACULTY: ENGINEERING
DEPARTMENT: CIVIL ENGINEERING
SEMESTER I EXAMINATIONS (MARCH 2017)
2016/2017 ACADEMIC SESSION

COURSE CODE: CVE 309, MEE 307

COURSE TITLE: FLUID MECHANICS II, APPLIED FLUID MECHANICS

DURATION: (2 Hours)

HOD'S SIGNATURE

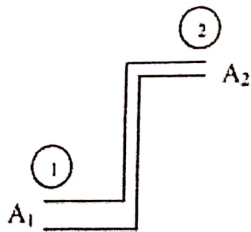
INSTRUCTIONS:

- 1. ANSWER FOUR QUESTIONS**
- 2. SEVERE PENALTIES APPLY FOR MISCONDUCT, CHEATING, POSSESSION OF UNAUTHORIZED MATERIALS DURING EXAM**

(1a) Water enters a house through a pipe 2.0cm internal diameter at an absolute pressure of $4 \times 10^5 \text{ Pa}$. The pipe leading to the 2nd floor bathroom 5.0m above is 1.0cm in internal diameter. Velocity at the inlet is 4 ms^{-1} . Calculate the velocity v and p in the bathroom

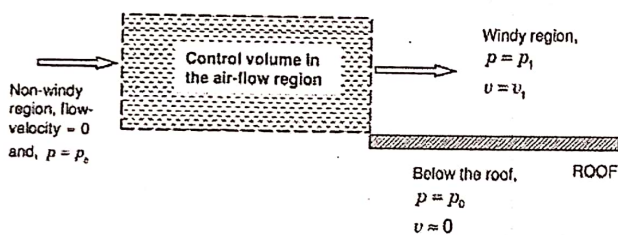
(i) Case 1: water running in the bathroom (static and dynamic pressure) (5 marks)

(ii) Case 2: water is turned off in the bathroom (static pressure only) (5 marks)

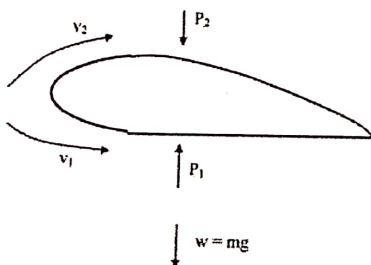


(1b) What is the importance of Reynolds number in the classification of fluid flow? (2 marks)

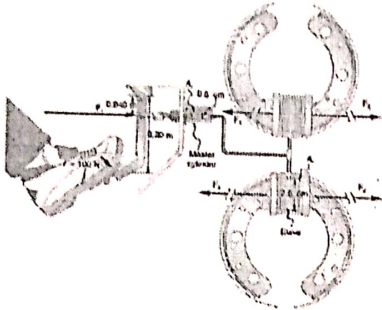
(2) A 40 ms^{-1} wind blows past a roof of dimensions 10m by 15m. Assuming that the air under the roof is at rest, what is the net force on the roof given that the air density is 1.3 kgm^{-3} (12 marks)



(3a) Each wing of an airplane has an area of 25 m^2 . The speed of the air is 50 ms^{-1} over the lower wing surface and 65 ms^{-1} over the upper wing surface. Assume that the airplane is in straight and level at about 300m above the sea level and that all the lift is supplied by the wings. What is the weight of the airplane? (6 marks)



(3b) A force of 100N is applied to the brake pedal shown below, which acts on the cylinder called the master through a lever. A force of 500N is exerted on the master cylinder. Pressure created in the master cylinder is transmitted to four so-called slave cylinders. The master cylinder has a diameter of 0.50cm, and each slave cylinder has a diameter of 2.50cm. Calculate the force F_2 created in each of the slave cylinders (6 marks)



(4) Consider a uniform pipe having a steady flow as shown in the figure below, derive *Darcy-Weisbach* equation for estimating head loss due to friction in pipe flow using *Bernoulli's principle* where,

p_1 = pressure intensity at section 1-1,

V_1 = velocity of flow at section 1-1,

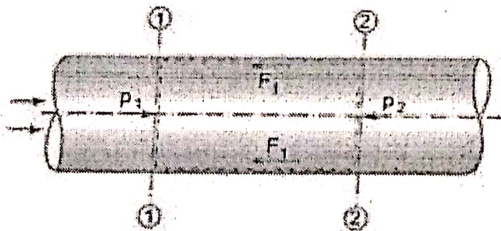
L = Length of pipe between sections 1-1 and 2-2,

f' = Frictional resistance per unit wetted area per unit velocity,

p_2 = pressure intensity at section 2-2,

V_2 = velocity of flow at section 2-2,

z = piezometric or hydraulic head (12marks)



(5a) What is fluid flow visualization in fluid dynamics and what are the main techniques used in fluid flow analysis? (4 marks)

b) What is Computational Fluid Dynamics (CFD)? (2 marks)

c) Mention and explain clearly three main applications of CFD in the academia and industry (6 marks)

(6) The purpose of water tower is to provide storage capacity and to provide sufficient pressure in the pipes that deliver the water to consumers. The drawing below shows a spherical reservoir that contains $5.25 \times 10^5 \text{ kg}$ of water when it is full. The tower is vented to the atmosphere at the top. For a full reservoir, calculate the gauge pressure in house A and B (12 marks)

