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11. Stream lines and path lines always coincide in case of
 - a. Steady flow
 - b. Laminar flow
 - c. Uniform flow
 - d. Turbulent flow
12. Equation of continuity is based on the principal of conservation of
 - a. Mass
 - b. Energy
 - c. Momentum
 - d. None
13. The major loss of energy in long pipes is due to
 - a. Sudden enlargement
 - b. Sudden contraction
 - c. 90 degree bend
 - d. Friction
14. In the case of an external parallel flow over a flat plat, which of the following drag can be neglected?
 - a. Pressure drag
 - b. Friction drag
 - c. Total drag
 - d. Both drags are significant
15. With the same cross-sectional area and immersed in same turbulent flow, the largest total drag will be on a
 - a. circular disc of plate held normal to flow
 - b. sphere
 - c. cylinder
 - d. streamlined body
16. For laminar flow in a pipe of circular cross section, the Darcy's friction factor f is
 - a. directly proportional to Reynolds number and independent of pipe wall roughness
 - b. directly proportional to pipe wall roughness and independent of Reynolds number
 - c. inversely proportional to Reynolds number and independent of pipe wall roughness
 - d. inversely proportional to pipe wall roughness and independent of Reynolds number
17. A tank of diameter 2 m consists of a hole at the bottom of diameter 0.1 m. The velocity at which the water exits the hole is 6 m/s. Determine the height of the water in the tank.
 - a. 1.83 m
 - b. 2.22 m
 - c. 3.04 m
 - d. 4.33 m
18. The hydraulic grade line is
 - a. always above the centre line of pipe
 - b. never above the energy grade line
 - c. always sloping downward in the direction of flow
 - d. always above the energy grade line
19. In series-pipe problems
 - a. the head loss is same through each pipe
 - b. the discharge is same through each pipe
 - c. the discharge through each pipe is added to obtain total discharge
 - d. none of the above
20. Water is discharging from a tank of volume V through a hole which is at the bottom, with a volume flow rate of Q . Which of the following expression closely describes the time taken for the tank to become completely empty?
 - a. V/Q
 - b. Less than V/Q
 - c. More than V/Q
 - d. Half of V/Q

KATHMANDU UNIVERSITY
End Semester Examination
January/February 2024

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

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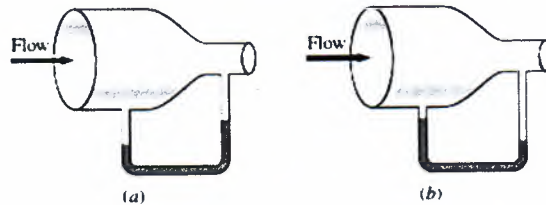
Course : MEEG 301
Semester : I
F. M. : 55

SECTION "B"
[5Q × 11 = 55 marks]

Attempt *ALL* questions. Assume suitable data if any is missing.

1.

- a. Define Steady Flow Field in the Eulerian reference frame. In such a steady flow, is it possible for a fluid particle to experience a nonzero acceleration? [2]
- b. Explain why some people experience nose bleeding and some others experience shortness of breath at high elevations. [2]
- c. A glass manometer with oil as the working fluid is connected to an air duct as shown in Figure below. Will the oil levels in the manometer be as in Figure a) or b)? Explain. What would your response be if the flow direction is reversed? [3]



- d. A steady, incompressible, two-dimensional velocity field is given by the following components in the xy -plane:

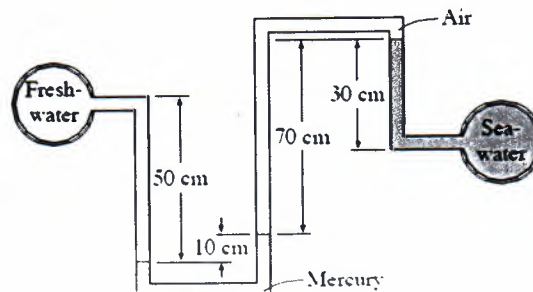
$$u = 0.205 + 0.97x + 0.851y$$

$$v = -0.509 + 0.953x - 0.97y$$

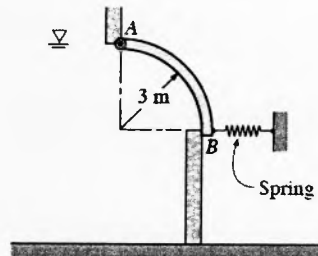
Calculate the acceleration field (find expressions for acceleration components a_x and a_y) and calculate the acceleration at the point $(x,y) = (2,1.5)$ [4]

2.

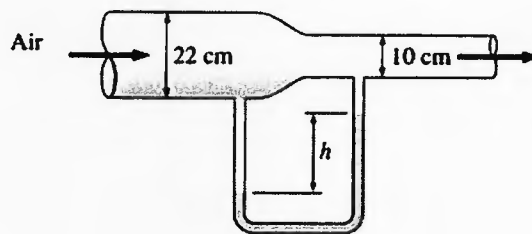
- a. Freshwater and seawater flowing in parallel horizontal pipelines are connected to each other by a double U-tube manometer, as shown in Figure. Determine the pressure difference between the two pipelines. Take the density of seawater at that location to be 1035 kg/m^3 , and the density of mercury is $13,600 \text{ kg/m}^3$. [5]



- b. A 4-m long quarter quarter-circular gate of radius 3 m and of negligible weight is hinged about its upper edge A, as shown in Figure. The gate controls the flow of water over the ledge at B, where the gate is pressed by a spring. Determine the minimum spring force required to keep the gate closed when the water level rises to A at the upper edge of the gate. [6]



- 3.
- Write the mathematical relation for fully developed region in a pipe. [1]
 - A wind tunnel draws atmospheric air at 20 °C and 101.3 kPa by a large fan located near the exit of the tunnel. If the air velocity in the tunnel is 3 m/s, determine the pressure in the tunnel. [5]
 - Air flows through a pipe at a rate of 5 L/s. The pipe consists of two sections of diameters 22 cm and 10 cm with a smooth reducing section that connects them. The pressure difference between the two pipe sections is measured by a water manometer. Neglecting frictional effects determine the differential height of water between the two pipe sections. Take the air density to be 1.20 kg/m³. [5]



- 4.
- What are different techniques for measurement of velocity and flow rate. Explain one of the techniques in detail. [3]
 - Air is flowing past a symmetrical airfoil at zero angle of attack. Is the (a) lift and (b) drag acting on the airfoil zero or nonzero? Explain. [3]
 - The top surface of a car is moving at a velocity of 60 km/hr and is 2 m wide and 4 m long. If the outdoor air is at 1 at and 25°C, determine the drag force acting on the top surface of the car. [5]

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5.

- a. A certain part of cast iron piping of a water distribution system involves a parallel section. Both parallel pipes have a diameter of 30 cm, and the flow is fully turbulent. One of the branches (pipe A) is 1500 m long while the other branch (pipe B) is 2500 m long. If the flow rate through pipe A is $0.4 \text{ m}^3/\text{s}$, determine the flow rate through pipe B. Disregard minor losses and you may assume that the flow is fully turbulent and thus the friction factor is independent of the Reynolds number. [Given data: Density of water 1000 kg/m^3 , Dynamic viscosity $1.138 \times 10^{-3} \text{ kg/m.s}$] [5]
- b. A horizontal pipe has an abrupt expansion from $D_1=8 \text{ cm}$ to $D_2=16 \text{ cm}$. The water velocity in the smaller section is 10 m/s and the flow is turbulent. The pressure in the smaller section is $P_1=410 \text{ kPa}$. 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]

