Exam.Code:0940
Sub. Code: 7051

2071
B.E. (Mechanical Engineering)
Fourth Semester
MEC-406: Fluid Mechanics

Time allowed: 3 Hours Max. Marks: 50

NOTE: *Attempt five questions in all, including Question No. I which is compulsory and selecting two questions from each Part.*

x-x-x

Q. 1 i) The shape of municipal water tank has the same shape as a drop of water resting on a non-absorbent surface, such as a wax paper. Explain why the tank is designed in this manner.
ii) How hand pump works and show calculation that indicates maximum height to which it can lift a column of water.
iii) A baseball is thrown straight up into the air. Will the time travel to its highest point be longer, shorter or same as the time for it to fall to the same height from which it was thrown? Explain.
iv) Define circulation and vorticity and find out their relation with each other.
v) Why is triangular weir more suitable than a rectangular weir for measuring the discharge?
(02x05=10)

Part-A

Q. 2 a) An isosceles triangle of 4 m base and 6 m height is located vertically in the water whose height is parallel to free surface of water and its vertical height from free surface of water is 8 m. Determine the pressure force acting on it and location of centre of pressure both vertically and laterally. **(06)**
b) Determine the difference between the centreline points A and B in the two pipelines. **(Fig. 1)** if the manometer liquid CD is in the position shown. The density of the liquid in AC and DB is 800 kg/m^3 and in CD is 1100 kg/m^3 respectively. **(04)**

Q. 3 a) A flow field is represented by a velocity potential function as given below:

$$\emptyset = C(x^2 - y^2)$$

Verify whether it is a valid function or not.? If valid, then find out the corresponding stream function. **(06)**

b) What do you understand by convective and local accelerations? Find out expressions for total acceleration if the flow is passing through a diffuser. **(04)**

Q. 4 a) A pipe of 30 cm diameter carrying 0.25 m^3/s water. The pipe is bent by 135^0 from the horizontal anticlockwise. The pressure of water flowing through the pipe is 400 kN. Find the magnitude and direction of the resultant force on the bend. **(07)**
b) A model of the car is constructed to a scale of 1/4 and is to be tested at 20 ^{0}C in a water tunnel. Determine the required velocity of the water if the actual car is travelling at 30 m/s in air

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at this same temperature. Take Kinematic viscosity of air and water at given temperature as $15.1x10^{-06}$ and $1x10^{-06}$ respectively. **(03)**

Part-B

Q. 5 Two reservoirs are connected by a horizontal pipe line of 20 cm diameter and 10 m long and then 30 cm diameter for the remaining 20 m long. The water surface in one reservoir is 5 m above the other reservoir. Assuming: f_1=0.005 and f_2=0.01, find out discharge through the pipe and draw TEL and HGL. **(10)**

Q. 6 (a) The velocity profile for a laminar boundary layer developed over the plate of width b and length L is approximated by the parabola $\frac{u}{U} = \left(\frac{y}{\delta}\right)^{\frac{1}{6}}$

Determine: as a function of x, the thickness of the boundary layer, skin friction coefficient and friction drag coefficient. **(07)**

(b) Discuss the various method to avoid boundary layer separation. **(03)**

Q. 7 (a) A converging nozzle has a throat area of 6 cm^2 and stagnation air conditions of 120 kPa and 400 K. Compute the exit pressure and mass flow if the back pressure is **(a)** 90 kPa and **(b)** 45 kPa. Assume gamma=1.4 **(07)**

(b) Derive the Area-velocity relation for compressible flow. **(03)**

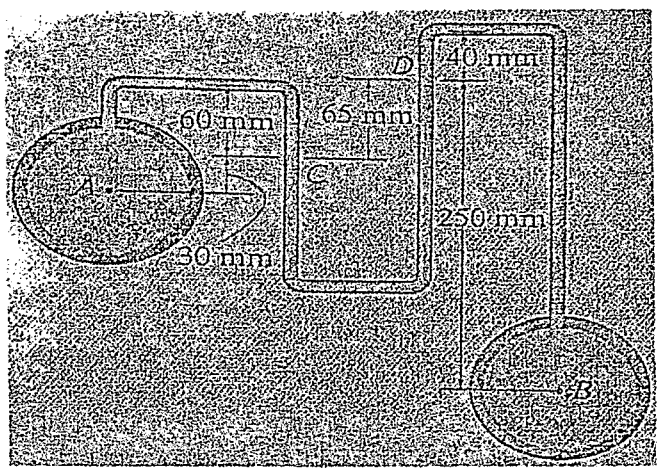

Fig. 1

x-x-x