

No. of Printed Pages : 07

Roll No.

C43

B. Tech. EXAMINATION, 2020

(Third Semester)

(B Scheme) (Re-appear Only)

(CHE)

CHE203B

FLUID FLOW

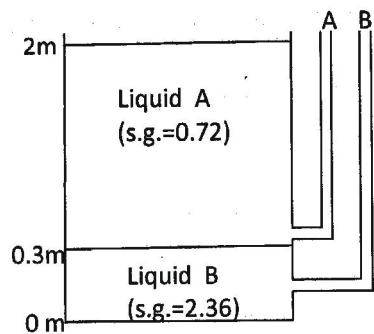
Time : 2½ Hours]

[Maximum Marks : 75

Before answering the question-paper candidates should ensure that they have been supplied to correct and complete question-paper. No complaint, in this regard, will be entertained after the examination.

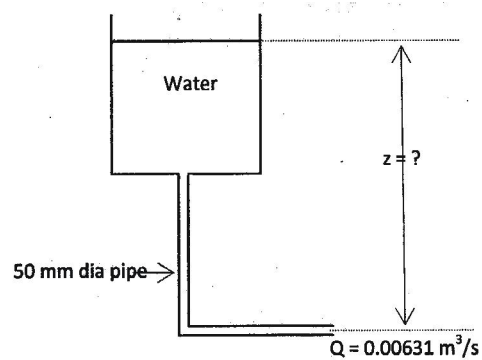
Note : Attempt *Four* questions in all. All questions carry equal marks. Assume missing data, if any, with justification.

1. (a) What are the different types of fluids ?
Explain their properties.
- (b) For the open tank with piezometers attached on the side, containing two different immiscible liquids, as shown in the figure, find :
- (i) elevation of liquid surface in piezometer A
 - (ii) elevation of liquid surface in piezometer B
 - (iii) total pressure at the bottom of the tank.



2. (a) Show that the center of pressure of a plane vertical surface immersed under liquid is always below its centroid.
- (b) A flow field is represented by the stream function $\Psi = x^2 - y^2$. Find the corresponding velocity field. Show that this flow field is irrotational.
3. For a fully developed laminar flow in a pipe, show that :
 - (a) Pressure drop is given by the Hagen-Poiseuille's equation
 - (b) $U/U_{\max} = 0.5$, where U is average velocity and U_{\max} is the velocity at $r = 0$
 - (c) Kinetic energy correction factor $\alpha = 2.0$.
4. (a) The drag force on a smooth sphere depends on the relative velocity V , sphere diameter D , fluid density ρ , fluid viscosity μ . Using Buckingham Pi theorem of dimensional analysis, determine the dimensionless group that can be used to correlate the data.

- (b) Water is to be delivered from a reservoir through a pipe to a lower level and discharged into the air as shown in the figure. If head loss in the entire system is 11.58 m, determine the vertical distance between the point of water discharge and the water surface in the reservoir.



5. Water is pumped at the rate of 1 kg/s from a storage tank through a 100 m of a pipe with dia. 30 mm. The pipeline has two fully open globe valves and three 90° elbows. Water is discharged into an overhead tank through a spray nozzle. The discharge is at a height of

20 m above the level of water in the storage tank. The required pressure at the nozzle entrance is 300 kPa gauge.

Estimate the theoretical horsepower required for the pump. Equivalent length in terms of pipe diameter d ,

for fully open globe valve = 300 d

for 90° elbow = 30 d

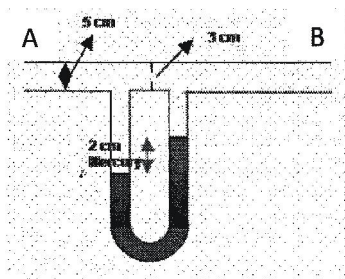
Friction factor for turbulent flow may be calculated by : $f = 0.079 \text{ Re}^{-0.25}$.

6. (a) Water flows in a rectangular, concrete, open channel that is 12 m wide at a depth of 2.5 m. The channel slope is 0.0028 and $n = 0.013$. Find the water velocity and the flow rate.
- (b) Two reservoirs are connected by three pipes in series constituting a siphon operating at a head differential of 10 m.

	Length (m)	Dia. (cm)
First pipe	5	20
Second pipe	20	10
Third pipe	10	10

Calculate the discharge, neglecting minor losses. (Take $f = 0.02$ for each pipe).

7. (a) Flow rate of water flowing through a pipe of diameter 5 cm is being measured by an orifice meter as shown in the following figure :



- (i) What is the direction of flow in the pipe ?
 - (ii) Derive an expression for velocity through the orifice. Determine the flow rate for an orifice coefficient of 0.8.
- (b) What is a supersonic flow ?

An airplane flies at 370 m/s through air at -10°C and 40 kPa. Describe the flow type of airplane.

8. (a) Explain the construction and working of centrifugal pump with a neat sketch. Draw and discuss its characteristic curves.
- (b) Explain the term NPSH in connection with hydrodynamic pumps.