

JK LAKSHMIPAT UNIVERSITY, JAIPUR

INSTITUTE OF ENGINEERING AND TECHNOLOGY

End Term Examination (Regular/Backlog), Nov. 2016

B. Tech in Civil Engineering, Semester III

Roll No.....

CE306: FLUID MECHANICS -I

Time: 3 hours

Max. Marks: 100

Instructions to students:

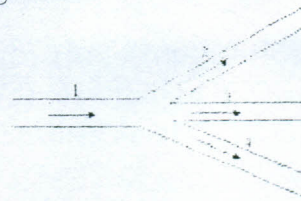
1. Do not write anything other than your roll number on question paper.
2. Assume suitable data wherever required and mention it clearly.
3. Writing appropriate units, nomenclature, and drawing neat sketches/schematics/ flow chart wherever, required are an integral part of the answer.

Q.1A Objective type multiple choice questions (10 questions @ 1 mark)

10

- i. If the dynamic viscosity of a liquid is 0.012 poise and its R.D. is 0.79, then its kinematic viscosity in stoke is
(a) 0.0152 (b) 0.152
(c) 1.52 (d) 15.20
- ii. Pipe '1' branches to three pipes as shown in the given figure. The areas and corresponding velocities are given in the following table.

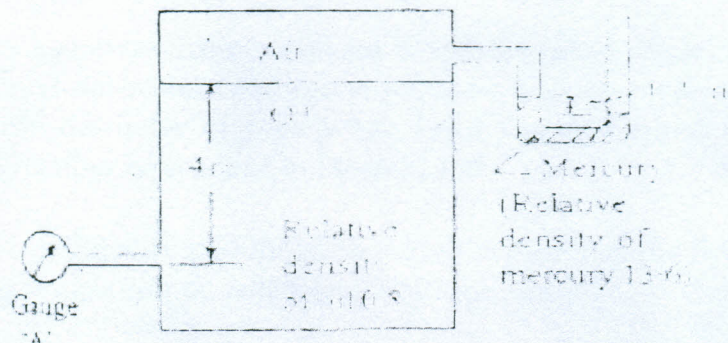
Pipe	Velocity (cm per second)	Area (sq cm)
1.	50	20
2.	V_2	10
3.	30	15
4.	20	10



The value of V_2 in cm per second will be

- (a) 15 (b) 20 (c) 30 (d) 35
- iii. Which one of the following sets of conditions clearly apply to an ideal fluid?
(a) Viscous and compressible (b) Non-viscous and incompressible
(c) Non-viscous and compressible (d) Viscous and incompressible
- iv. At the interface of a liquid and gas at rest, the pressure is:
(a) Higher on the concave side compared to that on the convex side
(b) Higher on the convex side compared to that on the concave side
(c) Equal to both sides
(d) Equal to surface tension divided by radius of curvature on both sides.
- v. In the boundary layer, the flow is:
(a) Viscous and rotational (b) Inviscid and irrotational
(c) Inviscid and rotational (d) Viscous and irrotational

VI. The reading of gauge 'A' shown in the given figure is:



- (a) -31.392 kPa
 (b) -1.962 kPa
 (c) 31.392 kPa
 (d) +19.62 kPa
- vii. X-component of velocity in a 2-D incompressible flow is given by $U=Y^2+4XY$. if Y-component of velocity 'v' equals to zero at $Y=0$, the expression for 'v' is given by
 (a) $4Y$ (b) $2Y^2$ (c) $-2Y^2$ (d) $2XY$
- viii. Fluids that require a gradually increasing shear stress to maintain a constant strain rate are known as
 (a) Rhedoplectic fluids (b) Thixotropic fluids
 (c) Pseudoplastic fluids (d) Newtonian fluids
- ix. An oil of specific gravity 0.9 has viscosity of 0.28 Stokes at 38°C . What will be its viscosity in Ns/m^2 ?
 (a) 0.2520 (b) 0.0311
 (c) 0.0252 (d) 0.0206
- x. Of an iceberg, 15% of the volume projects above the sea surface. If the specific weight of sea water is $10.5\text{kN}/\text{m}^3$, the specific weight of iceberg in kN/m^3
 (a) 12.52 (b) 9.81 (c) 8.93 (d) 7.83

Q.2 Short answer type questions (4 questions @ 2.5 marks)

10

- a. Absolute pressure at a point is 30 kPa. Convert this pressure in terms of gauge pressure. Also calculate the corresponding height in terms of oil of specific gravity 0.9 for both of the above values. Take atmospheric pressure = 101.39
- b. At two points 1 and 2 in a pipeline the velocities are V and $2V$, respectively. Both the points are at the same elevations. the fluid density is σ . Flow can be assumed to be incompressible, inviscid, steady and irrotational. Then what is difference in pressure P_1 and P_2 at point 1 and 2.
- c. Explain the term TEL and HGL with neat a sketch.
- d. A 15 cm length of steel rod with relatively density of 7.4 is submerged in a two layer fluid. The bottom layer is mercury and the top layer is water. Determine the height of top surface of the rod above the liquid interface in centimeter.

Q.3A Define the terms: Reynolds number, hydraulic mean radius, Specific gravity, vacuum pressure, compressibility of fluid.

05

Q.3B Explain the working principle of U-tube differential manometer with neat

05

sketch. Compare merit and demerits of U-tube differential manometer with pressure gauge.

Q.4A Derive an expression for velocity distribution for viscous flow through a circular pipe. Also sketch the velocity distribution and shear stress distribution across the section of a pipe. 05

Q.4B A water tank 4 km away from a college hostel. Supplies water at 150 lit per day per student. The total water required is pumped into the tank in night time for 6 hours. Calculate diameter of pipe when head loss is limited to 25m. Assume $f=0.0018$ and Number of student in Hostel 1000. 05

Q.5A For the following velocity profile ,determine the whether the flow has separated or the verge of separation or will attach with the surface : 05

$$(i) \frac{u}{U} = 2 \left(\frac{y}{\delta} \right)^2 - \frac{1}{2} \left(\frac{y}{\delta} \right)^3$$

$$(ii) \frac{u}{U} = \frac{3}{2} \left(\frac{y}{\delta} \right) - \frac{1}{2} \left(\frac{y}{\delta} \right)^3$$

Q.5B A horizontal pipe has a diameter of 0.150 m at point 1 and 0.0500 m at point 2, the velocity of water at point 1 is 0.800 m/s and the pressure is $1.01 \times 10^5 \text{ N/m}^2$.determine the (a) volume flow rate (b) velocity of the water at point 2 and (c) pressure at point 2. 05



Q.6A Obtain the expression for continuity equation for three dimension flow. List atleast one practical example in Civil Engineering Discipline. 05

Q.6B State and Explain the Newton's law of viscosity and Draw the rheological diagram. 05

OR

Q.6B Distinguish between (any two): 05
(i) steady flow and un-steady flow (ii) rotational and irrotational flow
(iii) compressible and incompressible

Q.7A Derive the expression for total pressure and center of pressure for a vertical plate submerged in the liquid with usual notations. 05

Q.7B Briefly discuss about drag force and lift force. Explain the types of drag forces acting on a multistory building with neat sketch. 05

OR

Q.7B Find the head lost due to friction in a pipe of diameter 300mm and length 50 m, 05

through which water is flowing at a velocity of 3 m/s using
 (i) Darcy formula, (ii) Chezy's formula for which $C = 60$.
 Take ν (viscosity) for water = 0.01 stoke for calculations.

Q.8 A 2.0 m long conical diffuser 20 cm in diameter at the upstream end and 60 cm diameter at the downstream end. At a certain instant, the discharge through the diffuser is observed to be 200 liter/sec of water and is found to increase uniformly at a rate of 50 liter/sec. estimate the local, convective and total acceleration at a section 1.5 m from the upstream end. 10

Q.9A A pipeline 60 cm in diameter takes off from a reservoir whose free surface elevation is 150 m above datum. The pipe is 5000 m long and is laid completely at the datum level. In the last 1200 m of the pipe, water is withdrawn by a series of pipe at a uniform rate of 0.088 m³/sec per 300 m. find the pressure at the end of the pipeline. Assume $f = 0.02$ and the pipe to have a dead end. 10

Q.9B For a town water supply a main pipe line of diameter 0.4m is required. As pipes more than 0.35 m diameter are not readily available, two parallel pipes of the same diameter were used for water supply. If the total discharge in the parallel pipes is same as in the single main pipe, find the diameter of the parallel pipe. Assume the coefficient of friction same for all pipes. 10

OR

Q.9B Define physically and mathematically the concept of displacement, momentum and energy thickness of a boundary layer. Place the nominal thickness, displacement thickness and momentum thickness in their order of relative magnitude. 10