

JK LAKSHMIPAT UNIVERSITY, JAIPUR

INSTITUTE OF ENGINEERING AND TECHNOLOGY

End Term Examination (Regular/Backlog), Nov.-Dec. 2015

B. Tech in Civil Engineering, Semester III

Roll No.....

CE306: FLUID MECHANICS -I

Time: 3 hours

Max. Marks: 100

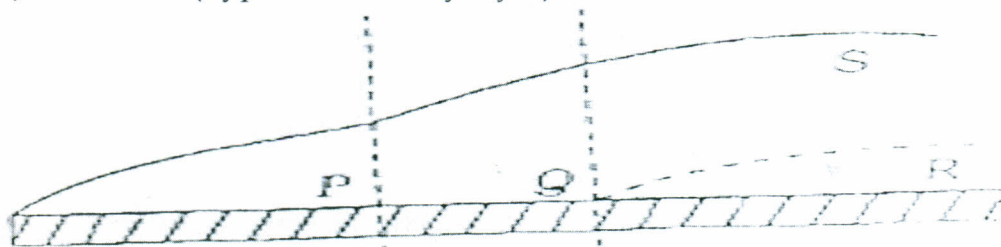
Instructions to students:

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. Which phenomenon will occur when the valve at the discharge end of a pipe connected to a reservoir is suddenly closed?
(a) Cavitation (b) Erosion (c) Hammering (d) Surging
- ii. When a tube of smaller diameter is dipped in water, the water rises in the tube due to viscosity of water.
(a) True (b) False
- iii. The development of boundary layer zones labeled P, Q, R and S over a flat plate is shown in the given figure. Based on this figure, match List-I (Boundary layer zones) with List-II (Type of boundary layer) and select the correct answer:



List-I

- A. P
- B. Q
- C. R
- D. S

Codes: A B C D

(a) 3 1 2 4

(c) 4 2 1 3

List-II

- 1. Transitional
- 2. Laminar viscous sub-layer
- 3. Laminar
- 4. Turbulent

A B C D

(b) 3 2 1 4

(d) 4 1 2 3

- iv. In the boundary layer, the flow is:
(a) Viscous and rotational (b) Inviscid and irrotational
(c) Inviscid and rotational (d) Viscous and irrotational
- v. Which Property of mercury is the main reason for use in barometers?
(a) High Density (b) Negligible Capillary effect
(c) Very Low vapour Pressure (d) Low compressibility

- VI. Newton 'law of viscosity relates
- Intensity of pressure and rate of angular deformation
 - Shear stress and rate of angular deformation
 - Shear stress, viscosity and temperature
 - Viscosity and rate of angular deformation
- vii. The kinematic viscosity is the
- ratio of absolute viscosity to the density of the liquid
 - ratio of density of the liquid to the absolute viscosity
 - product of absolute viscosity and density of the liquid
 - product of absolute viscosity and mass of the liquid
- viii. 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
- $4Y$
 - $2Y^2$
 - $-2Y^2$
 - $2XY$
- ix. Newton 'law of viscosity relates
- Intensity of pressure and rate of angular deformation
 - Shear stress and rate of angular deformation
 - Shear stress, viscosity and temperature
 - Viscosity and rate of angular deformation
- x. For steady incompressible flow, if the u-component of velocity is $u = Ae^x$, then what is the v-component of velocity?
- Ae^y
 - Ae^{xy}
 - $-Ae^{xy}$
 - $-Ae^x$

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

10

- Determine the bulk modulus of elasticity of a liquid, if the pressure of the liquid is Increased from 70 N/m^2 to 130 N/m^2 The volume of the liquid decreases by 0.15per cent.
- 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 irrorational. Then what is difference in pressure P_1 and P_2 at point 1 and 2.
- Determine the shear stress developed in lubricating oil, of viscosity 9.81 poise, filled between two parallel plates 1 cm apart and moving with relative velocity of 2 m/s .
- When the pressure on a given mass of liquid is increased from 3.0 MPa to 3.5 MPa , the density of the liquid increases from 500 kg/m^3 to 501 kg/m^3 .What is the average value of bulk modulus of the liquid over the given pressure range?

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

05

Q.3B What do you mean by gauge pressure, vacuum pressure and absolute pressure? Explain the working principle of U-tube differential manometer with neat sketch.

05

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

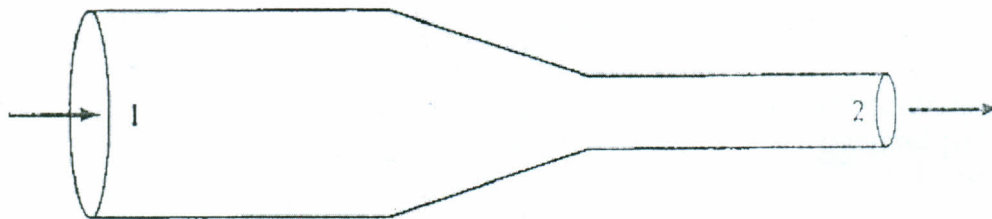
Q.4B A water tank 4 km away from a college hostel. Water supplies 150 lit per day per student. The strength of student in hostel is 1000. The total water required is pumped into the tank in night time for 6 hours. Calculate diameter of pipe when head loss is limited to 25m. Assume $f=0.0018$. 05

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 Define the equation of continuity. Obtain the expression for continuity equation for three dimension flow. 05

Q.6B Draw and explain the rheological diagram. 05
OR

Q.6B Find the head lost due to friction in a pipe of diameter 300mm and length 50 m, through which water is flowing at a velocity of 3 m/s using 05
(i) Darcy formula,
(ii) Chezy's formula for which $C = 60$.
Take ν (viscosity) for water $= 0.01$ stoke .

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 A two dimensional flow is described by the velocity components, $u=5x^3$; $v= -15x^2y$.evaluate the stream function, velocity and acceleration at Point P (1, 2). 05

OR

Q.7B Distinguish between :(any two) 05
(i) steady flow and un-steady flow
(ii) rotational and irrotational flow
(iii) compressible and incompressible

Q.8 The velocity distribution near the solid wall at a section in a laminar flow is given by 07+03

$$u = 5.0 \sin(5\pi y)$$

For $y \leq 0.10\text{m}$. Compute the shear stress at a section at (i) $y=0$, (ii) $y=0.05\text{ m}$ and (iii) $y= 0.10\text{ m}$. the dynamic viscosity of the fluid is 5 poise.

(b) What is difference between dynamic viscosity and kinematic viscosity? State their units of measurements and dimensions.

Q.9A If the velocity profile of a fluid over a plate is parabolic with the vertex 20 cm from the plate, where the velocity is 120 cm/sec. calculate the velocity gradients and shear stresses at a distance of 0, 10 and 20 cm from the plate, if the viscosity of the fluid is 8.5 poise. 10

Q.9B State Bernoulli's theorem for steady flow of an incompressible fluid. Derive an expression for Bernoulli's theorem by first obtaining Euler equation of fluid motion and state the assumptions made for such a derivation. 10

OR

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