

JK LAKSHMIPAT UNIVERSITY, JAIPUR

INSTITUTE OF ENGINEERING AND TECHNOLOGY

End Term Examination November 2018

B. Tech in Civil/Mechanical Engineering, Semester III

Roll No.....

CE306/ME 308 : Fluid Mechanics/ Fluid Mechanics & Machines

Time: 3 hours

Max. Marks: 80

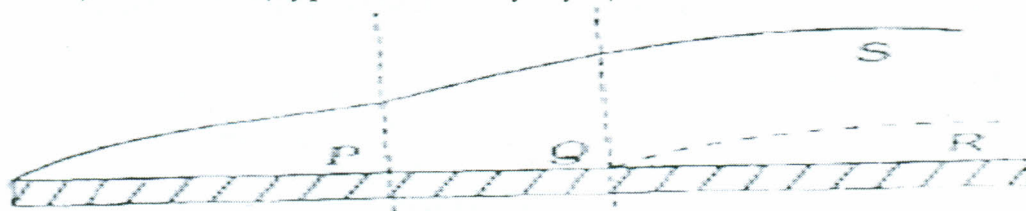
Instructions to students:

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. The diameter of a circular pipe suddenly increase by two times. The ratio of loss of energy to the velocity head before expansion is
(a) $\frac{1}{2}$ (b) $\frac{1}{4}$ (c) $\frac{9}{16}$ (d) $\frac{16}{9}$
- ii. 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

List-II

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

Codes: A B C D

(a) 3 1 2 4

(c) 4 2 1 3

A B C D

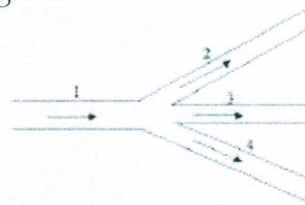
(b) 3 2 1 4

(d) 4 1 2 3

- iii. Boundary layer thickness is the distance from the boundary to the point where velocity of the fluid is
(a) equal to 10% of free stream velocity (b) equal to 50% of free stream velocity
(c) equal to 90% of free stream velocity (d) equal to 99% of free stream velocity
- iv. Which of the following devices does not use Bernoulli's equation as its working principle?
(a) Venturimeter (b) Orifice-meter
(c) Pitot tube (d) None of the above
- v. For the stability of a floating body, under the influence of gravity alone, which of the following is TRUE?

- (a) Metacentre should be below centre of gravity.
 (b) Metacentre should be above centre of gravity.
 (c) Metacentre and the centre of gravity must lie on the same horizontal line.
 (d) Metacentre and centre of gravity must lie on the same vertical line.
- vi. 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



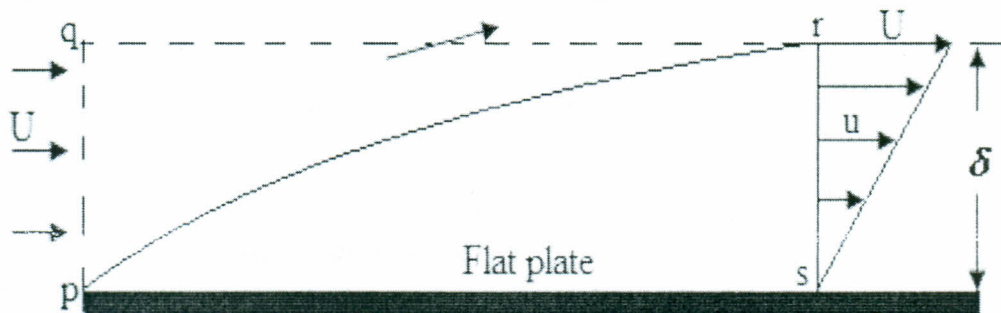
The value of V_2 in cm per second will be

- (a) 15 (b) 20 (c) 30 (d) 35
- vii. Navier Stroke's equation represents the conservation of
 (a) Energy (b) Mass (c) Pressure (d) Momentum
- viii. Which of the following number is applicable in open hydraulic structure such as spillways, where gravitational force is predominant?
 (a) Reynold's Number (b) Froude's Number
 (c) Weber's Number (d) Euler's Number
- ix. The dimensions of volume modulus of elasticity K are :
 (a) $FL^{-1}T^{-2}$ (b) $FL^{-2}T$ (c) FL^{-2} (d) $FL^{-4}T^{-2}$
- x. In an experiment, the following shear stress - time rate of shear strain values are obtained for a fluid:
- | | | | | |
|----------------------------------|---|-----|-----|---|
| Time rate of shear strain (1/s): | 0 | 2 | 3 | 4 |
| Shear stress (kPa): | 0 | 1.4 | 2.6 | 4 |
- (a) Newtonian fluid (b) Bingham plastic
 (c) Pseudo plastic (d) Dilatant

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

10

- i. A smooth flat plate with a sharp leading edge is placed along a gas stream flowing at $U = 10$ m/s. The thickness of the boundary layer at section r-s is 10 mm, the breadth of the plate is 1 m (into the paper) and the density of the gas $\rho = 1.0$ kg/m³. Assume that the boundary layer is thin, two-dimensional, and follows a linear velocity distribution, $u = U(y/\delta)$, at the section r-s, where y is the height from plate. The mass flow rate (in kg/s) across the section q - r is.



- ii Write down the effect of temperature on viscosity of liquids and gases.
- iii In a flow condition where both viscous and gravity forces dominate and both the Froude number and the Reynolds number are the same in model and prototype; and the ratio of kinematic viscosity of model to that of the prototype is 0.0894. What is the model scale?
- iv A velocity field is given by $u = 3xy$ and $v = \frac{3}{2}(x^2 - y^2)$. What is the relevant equation of a streamline?
- Q.3A State the Bernoulli's equation and obtain Bernoulli's equation from Euler's Equation of motion. 05
- Q.3B State and Explain the Newton's law of viscosity and Draw the rheological diagram. 05
- Q.4A A single column vertical manometer is connected to a pipe containing oil of specific gravity 0.9. The area of the reservoir is 100times the area of the manometer tube. The reservoir contains mercury of specific gravity 13.6. The level of mercury in the reservoir is depth of 30 cm below the center of pipe .if the difference of mercury levels in reservoir and the right limb is 50 cm, calculate the pressure in the pipe. 05
- Q.4B Derive an expression for continuity for 3-D flow and reduce it for steady, incompressible 2-D flow in Cartesian coordinate system. 05
- Q.5A A pipe 20 cm in diameter and 45m long conveys water at a velocity of 2.5m/sec. Find the head lost in friction 05
 1) Using the Darcy weisbach formula
 2) Using Chezy's equation
 Take $f = 0.006$ and $C = 57$
- Q.5B 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.6A 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.6B A 1: 15 model of a flying boat is towed through water. The prototype is moving in sea water of density 1024 kg/m^3 at a velocity of 20 m/s. find the corresponding speed of the model. Also determine the resistance due to waves on model if the resistance due to wave of prototype is 600 N. 05
- OR
- Q.6B Derive the expression for total pressure and center of pressure for a vertical plate submerged in the liquid with usual notations. 05

Q.7 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

Q.8 During the early morning hours of August, the winds of hurricane Andrew visited the home of the author of this study guide. It is estimated that wind gusts in excess of 150mph (67m/s) passed over the roof of author house. Calculate the 10

(a) Difference in pressure between the air in the attic and the air passing over the roof and

(b) upward force exerted on the roof if area of the roof is 275 m². Assume that the air inside the attic was not moving and that the thickness of the roof was negligible. Assume that the density of air is 1.29kg/m³.

OR

Q.8 A cylinder 0.16m in diameter is to be mounted in a stream of water in order to estimate the force on a tall chimney of 1m diameter which is subject to wind of 33m/s. Calculate (A) the speed of the stream necessary to give dynamic similarity between the model and chimney, (b) the ratio of forces. 10

Chimney: $\rho = 1.12\text{kg/m}^3$ $\mu = 16 \times 10^{-6} \text{ kg/ms}$

Model: $\rho = 1000\text{kg/m}^3$ $\mu = 8 \times 10^{-4} \text{ kg/ms}$

Draw up the table of values you have for each variable:

Variable	Water	Air
v	V_{water}	33 m/s
F	F_{water}	F_{air}
ρ	1000kg/m ³	1.12kg/m ³
μ	$8 \times 10^{-4} \text{ kg/ms}$	$16 \times 10^{-6} \text{ kg/ms}$
d	0.16m	1m