

Name:  
Enrolment No:



**UNIVERSITY OF PETROLEUM AND ENERGY STUDIES**  
**End Semester Examination, December 2018**

**Course: Applied Fluid Mechanics**  
**Programme: B. Tech (Automotive Design Engineering)**  
**Time: 03 hrs.**

**Semester: III**  
**Code: MECH2002**  
**Max. Marks: 100**

**Instructions: Attempt all questions, internal choices are given. Section B and Section C, both having ONE INTERNAL choice.**

**No. of pages : 03**

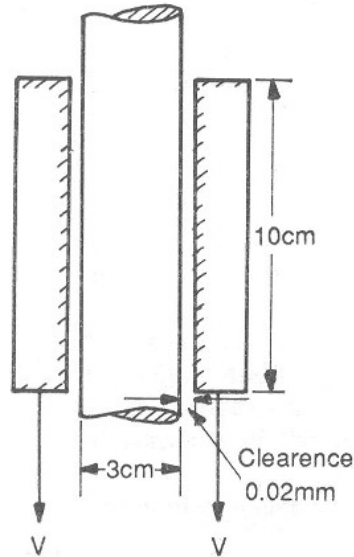
**SECTION A**

| S. No. |  | Marks | CO  |
|--------|--|-------|-----|
| Q 1    | Discuss in brief pitot-static tube. Illustrate your answer with the help of sketch.        | 05    | CO4 |
| Q 2    | Distinguish between:<br>(i) Steady and un-steady flow<br>(ii) Uniform and non-uniform flow | 05    | CO2 |
| Q 3    | Define the following:<br>i) Buoyancy<br>ii) Absolute pressure                              | 05    | CO1 |
| Q 4    | Boundary layer separation and its control  | 05    | CO5 |

**SECTION B**

|     |  |    |     |
|-----|--|----|-----|
| Q 5 | An oil of viscosity $0.1 \text{ NS/m}^2$ and relative density 0.9 is flowing through a circular pipe of diameter 50 mm and of length 300 m. The rate of flow of fluid through the pipe is 3.5 litres/s. Find the pressure drop in a length of 300 m and the shear stress at the pipe wall. The flow of fluid is laminar. | 10 | CO4 |
| Q 6 | Derive continuity equation in three-dimensional cartesian coordinate system. Also, write this equation for (i) steady flow and (ii) steady and incompressible flow.  | 10 | CO3 |
| Q 7 | A sleeve 10 cm long encases a vertical metal rod 3.0 cm in diameter  | 10 | CO1 |

with a radial clearance of 0.02 mm. If when immersed in an oil of viscosity 6.0 poise, the effective weight of the sleeve is 7.5 N, will the sleeve slide down the rod and if so at what velocity?



Q 8 A jet of water of diameter 10 cm strikes a flat plate normally with a velocity of 15 m/s. the plate is moving with a velocity of 6 m/s in the direction of the jet and away from the jet. Find :

- the force exerted by the jet on the plate
- work done by the jet on the plate per second.

**10** **CO4**

**OR**

A jet of water 75 mm in diameter having velocity of 20 m/s strikes a series of the flat plates arranged around the periphery of a wheel such that each plate appears successively before the jet. If the plates are moving at velocity of 5 m/s, compute the force exerted by the jet on the plate, the work done per second on the plate and the efficiency of the jet.

**10** **CO4**

**SECTION-C**

|           |  |    |     |
|-----------|--|----|-----|
| Q 9       | (i) Derive Euler's equation of motion for inviscid flow in Cartesian co-ordinates, subsequently explain how we can obtain Bernoulli's equation from Euler's equation of motion. State all the assumption clearly.  | 10 | CO3 |
|           | (ii) A venturimeter of inlet diameter 300 mm and throat diameter 150 mm is fixed in a vertical pipe line. A liquid of sp. gr. 0.8 is flowing upward through the pipe line. A differential manometer containing mercury gives a reading of 100 mm when connected at inlet and throat. The vertical difference between inlet and throat is 500 mm. If $C_d = 0.98$ , then find; (i) rate of flow of liquid in liter per second and (ii) difference of pressure between inlet and throat in $N/m^2$ . | 10 | CO4 |
| Q 10      | (i) The velocity components in a two-dimensional flow are<br>$u = y^3/3 + 2x - x^2y$ and $v = xy^2 - 2y - x^3/3$<br>Show that these components represent a possible case of an irrotational flow.  | 10 | CO2 |
|           | (ii) Derive the expression for displacement thickness and momentum thickness for boundary layer flow.  | 10 | CO5 |
| <b>OR</b> |  |    |     |
|           | (i) Consider the two-dimensional incompressible velocity potential<br>$\phi = xy + x^2 - y^2$<br>(a) Is it true that $\nabla^2 \phi = 0$ , and, if so, what does this mean? (b) If it exists, find the stream function $\psi(x, y)$ of this flow. (c) Find the equation of the streamline, which passes through $(x, y) = (2, 1)$ .  | 10 | CO2 |
|           | (ii) A flat plate 1.5m x 1.5m moves at 50 km/hr in stationary air density 1.15 $kg/m^3$ . If the coefficient of drag and lift are 0.15 and 0.75 respectively. Determine<br>(a) The lift force (b) The drag force (c) The resultant force (d) The power required to keep the plate in motion.   | 10 | CO5 |