Name:

Enrolment No:

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Semester Examination, December 2021

Course: Applied Fluid Mechanics — **Semester: III**
Program: B. Tech ASE, ASE + AVE — **Time: 03 hrs.**
Course Code: MECH 2002 — **Max. Marks: 100**
Pages: 04
Instructions: Make use of sketch/plots to elaborate your answer. All sections are compulsory

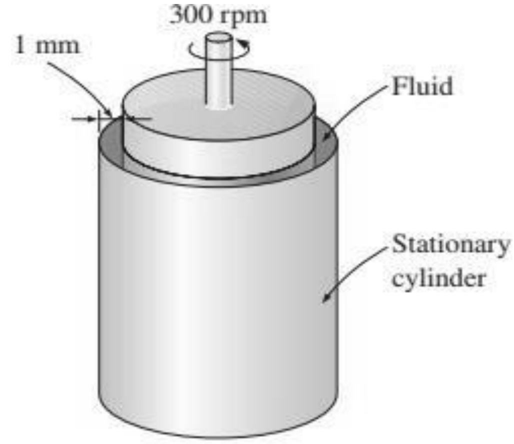
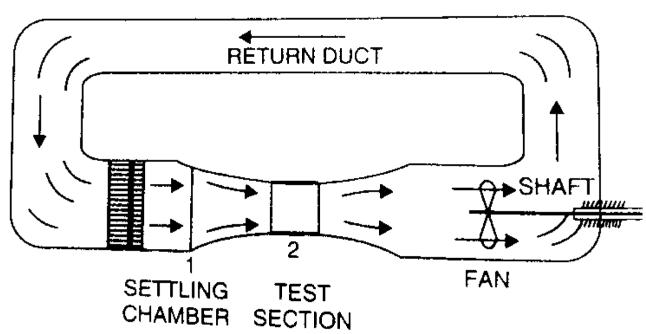
SECTION A (20 marks)

1. Each Question will carry 5 Marks
2. Instruction: Type your answers in the provided space

S. No.		**Marks**	**CO**
Q 1	a) A liquid has a relative density of 0.80 and a kinematic viscosity of 2.3 centistoke. Determine its (i) unit weight (ii) dynamic viscosity in Pa.s (2M) b) The space between two parallel plates kept 3mm apart filled with an oil of dynamic viscosity 0.2 Pa.s. What is shear stress on the lower fixed plate if the upper plate is moved with a velocity of 1.50 m/s? (3M)	**[05]**	**CO1**
Q 2	Find the height through which water rises by capillary action in a glass tube of 2 mm bore if the surface tension at the prevailing temperature is 0.075g/cm	**[05]**	**CO1**
Q 3	A fluid flow is described by the velocity vector $\boldsymbol{U=5x^2i-15x^2yj}$. Test the flow for rationality. Find out the rotation if exists.	**[05]**	**CO1**
Q 4	Mention the conditions of boundary layer separation in terms of shear stress and, pressure gradient. Also, discuss the preventive measure to delay the boundary layer separation.	**[05]**	**CO2**
Q 5	A Pitot-static probe can often be seen protruding from the underside of an airplane. As the airplane flies, the probe measures relative wind speed. Is this a Lagrangian or an Eulerian measurement? Explain.	**[05]**	**CO3**

SECTION B (40 marks)

1. **Each question will carry 10 marks**
2. **Instruction: Write short/brief notes, scan and upload the document**

Q 6	The viscosity of a fluid is to be measured by a viscometer constructed of two 75-*cm*-long concentric cylinders. The outer diameter of the inner cylinder is 15 *cm*, and the gap between the two cylinders is 1 *mm*. The inner cylinder is rotated at 300 *rpm*, and the torque is measured to be 0.8 *N·m*. Determine the viscosity of the fluid.  	**[10]**	**CO2**
Q 7	A subsonic wind tunnel has a test section 0.5m x 0.5m and a settling chamber 1m x 1m. A U-tube manometer installed between the two locations register 0.1 m difference between the vertical columns. The manomeric fluid is alcohol of sp.gr. 0.8. Estimate the test section velocity.  	**[10]**	**CO3**
Q 8	Show that the discharge per unit width between two parallel plates distance b apart, when one plate is moving at velocity V while the other one is held stationary, for the condition of zero shear stress at the fixed plate is : **q= bV/3** .	[10]	CO4

Q 9	Workout the following boundary layer parameters for the velocity distribution given by $$\frac{u}{U_0} = (\frac{y}{\delta})^m$$ a) Displacement thickness b) Momentum Thickness Shape factor	[10]	CO4

SECTION-C (40 marks)
1. Question carries 20 Marks.
2. Instruction: Write long answer, scan and upload the document

Q 10	a) A wing of small airplane is rectangular in planform having a span of 9 m and chord 1.5 m. in a horizontal flight at 250 km/hr., the total aerodynamic force acting on the wing is 20000N. If the lift to drag ratio is 10, make calculations for the lift and drag coefficients, the total weight airplane can carry and the power required for the flight. **[10M]** b) A bus having a projected area of 7 m^2 running at 70km/hr has a total resistance of 2000 N and 20% of this is due to rolling friction and 10% due to surface friction. The rest is due to form drag. Make calculation for the coefficient of form drag. Take density =1.22 kg/ m^3 **[10M]** **OR** Derive the expressions of the following a) Displacement thickness [6M] b) Momentum thickness [7M] **c)** Energy thickness [7M]	**[20]**	**CO5**
Q 11	Derive the equation of ***velocity distribution***, ***shear stress distribution*** and ***pressure drop*** for the laminar flow in the circular pipes. **OR** a) Derive the Darcy equation for head loss due friction in pipes. [10M] b) Calculate the pressure drop and power required to maintain 0.05 m3/s of petrol (sp.gr. 0.7) flow through a steel pipe 0.2 m diameter and 1000 m long. Take coefficient of friction f= 0.0025 in the Darcy relation. [10M]	[20]	CO5