Name:

Enrolment No:

UPES
UNIVERSITY WITH A PURPOSE

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

Course: Introduction to Fluid Mechanics **Semester: IV**
Program: B Tech Civil Engineering **Time: 3 Hours**
Course Code: CIVL 2016 **Max. Marks: 100**
Instructions: Attempt all the questions

SECTION A

1. Each Question will carry 5 Marks
2. Instruction: Calculate / Give the correct answer(s)

S. No.		Marks	CO
Q1	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/m3 to 501 kg/m3.What is the average value of bulk modulus of the liquid over the given pressure range?	**5**	**CO1**
Q2	A steady, incompressible flow is given by $u = 2x^2 + y^2$ and $v = -4xy$. What is the convective acceleration along x-direction at point (1, 2)?	**5**	**CO2**
Q3	A venturimeter of 20 mm throat diameter is used to measure the velocity of water in a horizontal pipe of 40 mm diameter. If the pressure difference between the pipe and throat sections is found to be 30 kPa then, neglecting frictional losses, then find the flow velocity.	**5**	**CO3**
Q4	The resisting force R of a supersonic plane during flight can be considered as dependent upon the length of the aircraft l, velocity V, air viscosity μ, air density ρ and bulk Modulas K. Find the value of power (b_3) of the variable resembling flow similarity corresponding to the π term that includes K as a non-repeating variable.	**5**	**CO4**
Q5	The Reynolds number for flow of a certain fluid in a circular tube is specified as 2500. What will be the Reynolds number when the tube diameter is increased by 20% and the fluid velocity is decreased by 40% keeping fluid the same?	**5**	**CO4**
Q6.	Which of the following functions represent the velocity potential in a two-dimensional flow of an ideal fluid? a) $2x + 3y$ b) $4x^2 – 3y^2$ c) $\cos (x – y)$ d) $\tan^{-1} (x/y)$	**5**	**CO2**

SECTION B

1. Each question will carry 10 marks
2. Instruction: Write short / brief notes

Q7	A circular plate 3m diameter is submerged in water with its plane making an angle of 30^0 with the water surface. If the top edge of the plate is 1m below the water surface, find the force on one side of the plate and its location.	**10**	**CO1**
Q8	A square plate of size 1m x 1m and weighing 350 N slides down an inclined plane with a uniform velocity of 1.5 m/s. The inclined plane is laid on a slope of 5V:12 H and has an oil film of 1mm thickness. Calculate the dynamic viscosity of oil.	**10**	**CO1**
Q9	Explain the constructional details of Orificemeter and also derive the equation to calculate the discharge in Venturimeter. Also compare the efficacy of Orificemeter with venturimeter as a flow measuring device.	**8+2**	**CO3**
Q10	In a 2-D incompressible flow, the velocity components are: u= x-4y and v= -y-4x. Show that velocity potential exists and determine its from. Also determine the stream function.	**10**	**CO2**
Q11	A 10 cm diameter orifice discharges water at 45 litres per second under a head of 2.75m. A plate is held normal to the jet just d/s from the vena contracta requiring a force of 310N to resist the impact of the jet. Find the hydraulic coefficients.	**10**	**CO3**
SECTION-C			
1. Each Question carries 20 Marks. **2. Instruction: Write long answer.**			
Q12	The discharge Q through orifice depends upon the diameter D of the orifice, head H over the orifice and density ρ of liquid, viscosity μ of the liquid and acceleration due to gravity g. Using dimensional analysis, find an expression for the discharge. Hence find the dimensionless parameters on which the discharge coefficients of an orifice depend.	**20**	**CO4**
OR			
Q12	In order to estimate the energy loss in a pipeline of 4m diameter through which kerosene of specific gravity 0.6 and dynamic viscosity of 0.1 Poise is to be transported at the rate of 8000 cumecs, model tests were conducted on a 0.25m diameter pipe using water at 20°C. Calculate the discharge required for the model pipe. If the energy head loss in 80m length of the model pipe is measured 15m of water, determine the corresponding head loss in the prototype. Also determine the value of Darcy's friction factor for the prototype pipe. Tae the absolute viscosity of water at 20°C as 2×10^{-2} poise.	**20**	**CO4**