Name:

Enrolment No:

UPES

End Semester Examination, December 2023

Course: Hydraulic Engineering **Semester: V**
Program: B Tech Civil Engineering **Time: 03 hrs.**
Course Code: CIVL 3060 **Max. Marks: 100**

Instructions: Attempt all the questions;

SECTION A
(5Qx4M=20Marks)

S. No.		Marks	CO
Q1	The equation of the velocity distribution over a plate is given by: $$\mathbf{u = 2y - y^2}$$ where u is the velocity in m/s at a point y meter from the plate measured perpendicularly. Assuming μ = 8.60 poise, calculate the shear stress at a point 15 cm from the boundary.	**4**	**CO1**
Q2	For a turbulent flow in pipes, show that: $$\frac{V_{max}}{V_*} = 1.33 f^{1.33} + 1$$	**4**	**CO1**
Q3	What is the necessary and sufficient condition for the separation of flow?	**4**	**CO2**
Q4	For the following profile sate whether the flow is separated or not. $$\frac{u}{U} = -3\left(\frac{y}{\delta}\right) + \left(\frac{y}{\delta}\right)^2$$	**4**	**CO2**
Q5	A rectangular channel is to carry a certain discharge at critical depth. If the section is to have a minimum perimeter, show that: $$y_c = \frac{3B}{4}$$	**4**	**CO3**

SECTION B
(4Qx10M= 40 Marks)

Q6	Rough, turbulent flow occurs in a pipe 0.2 m diameter conveying water. If at y = 20mm, u = 2 m/s and $\frac{\partial v}{\partial y}$ = 10.5 m/s, determine k_0, τ_0, f and U (average velocity). Assume density of water to be 1000 Kg/m^3.	**10**	**CO1**

OR			
Q6	Derive the velocity distribution for **rough** pipes. How are the smooth pipes different from rough pipes in terms of ageing factor?	**8+2**	**CO1**
Q7	If the vertical component of the landing velocity of a parachute is equal to that acquired during a free fall of 2m, find the diameter of the open parachute (hollow hemisphere) if the total weight of parachute and the person is 950N. Assume for air at ambient conditions, Density = 1.2 kg/m^3 and Cd = 1.35	**10**	**CO2**
Q8	An airplane weighing 65 kN, has a wing area of 27.5 m^2 and a drag coefficient (based on wing area) $$\mathbf{C_d = 0.02 + 0.061 \times C_L^2.}$$ Assume for air at ambient conditions, Density = 0.96 kg/m^3. Determine the following when the craft is cruising at 700 km/h: 1. Lift coefficient 2. Drag coefficient, and 3. Power to propel the craft	**10**	**CO2**
Q9	Draw H_2 and A_3 profiles. Define control section and its location for upstream and downstream section.	**4+4+2**	**CO3**
SECTION-C **(2Qx20M=40 Marks)**			
Q10	a) A slightly rough brick-lined (n = 0.017) trapezoidal channel carrying a discharge of 25.0 m^3/s is to have a longitudinal slope of 0.0004. Analyse the proportions of an efficient trapezoidal channel section having a side slope of 1.5 horizontal: 1 vertical. b) Derive the dimensions of most efficient trapezoidal channel section.	**20**	**CO3**
OR			
Q10	A rectangular brick-lined channel (n = 0.016) of 4.0-m width is laid on a bottom slope of 0.0009. It carries a discharge of 15 m^3/s and the flow is non-uniform. If the depth at a Section A is 2.6 m, calculate the depth at section B, 500 m downstream of A, by using: (a) Two steps and (b) Four steps.	**20**	**CO3**
Q11	Show that the max. wall shear stress for the laminar flow through a given pipe of diameter D and with fluid parameters μ and ρ is: $$\boldsymbol{\tau_o = 1600 \frac{\mu^2}{\rho D^2}}$$ b) Show that the momentum energy correction factor for laminar flow through a circular pipe is 1.33.	**10+10**	**CO1**