Name: **Enrolment No:**	UPES UNIVERSITY OF TOMORROW

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Semester Examination, December 2022

Course: Fluid Mechanics and Fluid Machines **Semester : V**
Program: B. Tech Mechatronics **Time : 03 hrs.**
Course Code: MECH3028 **Max. Marks : 100**

Instructions: Assume suitable data if required

SECTION A
(5Qx4M=20Marks)

S. No.		Marks	CO
Q 1	Enunciate Newton's law of viscosity. Explain the importance of viscosity in fluid motion.	**4**	**CO1**
Q 2	Prove that the streamline and equipotential lines are mutually orthogonal.	**4**	**CO1**
Q 3	Define a steady flow field in the Eulerian reference frame. In such a steady flow, is it possible for a fluid particle to experience a nonzero acceleration?	**4**	**CO1**
Q 4	Differentiate between the following heads for a centrifugal pump: Static head, Monomeric head, Net positive suction head, Euler head. Clearly write the expressions for each.	**4**	**CO1**
Q 5	Derive an expression for the force exerted by a jet of water on a fixed vertical plate in the direction of jet.	**4**	**CO1**

SECTION B
(4Qx10M= 40 Marks)

Q6	Two large plane surfaces are 2.4 cm apart. The space between the surface is filled with glycerine. What force is required to drag a very thin plate of surface area 0.5 square meter between the two plane surface at a speed of 0.6 m/s, if the thin plate is at a distance of 0.8 cm from one of the plane surfaces? Take the dynamic viscosity of glycerine = 8.1×10^{-1} N s/m^2.	**10**	**CO3**
Q7	The velocity potential function is given by $\varphi = 5(x^2-y^2)$. Calculate the velocity components at the point (4,5).	**10**	**CO2**
Q8	An oil of viscosity 0.1 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 l/s. Find the pressure drop in a length of 300 m and also the shear stress at the pipe wall.	**10**	**CO2**
Q9	Derive an expression for work done by impeller of a centrifugal pump on water per second per unit weight of water. (OR) Internal and external diameters of the impeller of a centrifugal pump are 300 mm and 600 mm respectively. The pump is running at 1000 r.p.m. The vane angles are at inlet and outlet are 20^o and 30^o respectively. The water enters the impeller	**10**	**CO3**

	radially and velocity of the flow is constant. Determine the work done by the impeller per unit weight of water.		
SECTION-C **(2Qx20M=40 Marks)**			
Q10	A horizontal pipe line 40 m long is connected to a water tank at one end and discharges freely into the atmosphere at the other end. For the first 25 m of its length from the tank, the pipe is 150 mm diameter, and its diameter is suddenly enlarged to 300 mm. The height of water level in the tank is 8 m above the centre of the pipe. Considering all losses of head which occur, determine the rate of flow. Take f=0.01 for both sections of the pipe.	**20**	**CO4**
Q11	A jet of water from a nozzle is deflected through 60^o from its original direction by a curved plate which it enters tangentially with out shock with a velocity of 30 m/s and leaves with a mean velocity of 25 m/s. If the discharge from the nozzle is 0.8 kg/s, calculate the magnitude and direction of the resultant force on the vane, if the vane is stationary. (OR) Explain the working of a Kaplan turbine with sketches. Draw velocity diagrams and derive the equation for hydraulic efficiency.	**20**	**CO4**