## **GUJARAT TECHNOLOGICAL UNIVERSITY** ME - SEMESTER-I(New course)• EXAMINATION – WINTER- 2015

	Subject Code: 2711103Date: 02/01/2Subject Name: Advanced Fluid MechanicsTotal Marks:Time: 2:30 pm to 5:00 pmTotal Marks:Instructions:Total Marks:		
		<ol> <li>Attempt all questions.</li> <li>Make suitable assumptions wherever necessary.</li> <li>Figures to the right indicate full marks.</li> </ol>	
Q.1	(a)	<ul><li>Differentiate between :</li><li>1. Eulerian and Langrangian methods for representing fluid flow.</li><li>2. Pathlines, Streamlines and Streaklines.</li></ul>	07
	(b)	Define: (i) convective and local accelerations. (ii) tangential and normal accelerations (iii) Circulation	02+02 +01=07
Q.2	<b>(a)</b>	If the flow of an incompressible fluid is axially symmetric, develop the continuity equation using cylindrical coordinates.	07
	<b>(b)</b>	In 3-D incompressible fluid flow, the velocity components in $x$ and $y$ directions	07
		are: $2 + 2 + 3 = (- + - + -)$	
		$u = x^2 + y^2 z^3$ ; $v = -(xy + yz + zx)$ Use continuity equation to evaluate an expression for the velocity components w in the z direction	
		expression for the velocity components $w$ in the z-direction. OR	
	<b>(b</b> )	If the velocity field is given by $u = (16y - 8x)$ ; $v = (8y - 7x)$ find the circulation	07
		around the closed curve defined by $x = 4$ , $y = 2$ , $x = 8$ , $y = 8$ .	
Q.3	(a)	Derive Bernoulli's equation for steady flow by integrating Euler's equation of motion.	07
	<b>(b</b> )	In the two-dimensional incompressible flow field the velocity components are $v^3$	07
		$u = 2x - x^2y + \frac{y^3}{3}; v = xy^2 - 2y - \frac{x^3}{3}$	
		expressed as: $3 \qquad 3$ (i) Determine the velocity and acceleration at point L (x = 1 m, y = 3 m).	
		<ul><li>(i) Determine the velocity and determinent if point D (n = 1 m, y = 5 m).</li><li>(ii) Is the flow possible? If so obtain an expression for the stream function.</li></ul>	
		(iii) What is the discharge between streamlines passing through $(1, 3)$ and $(2, 3)$ ?	
		<ul><li>(iv) Is the flow irrotational? If so determine the corresponding velocity potential.</li><li>(v) Show that each of the stream and potential functions satisfy Laplace equation</li></ul>	
		equation. OR	
Q.3	<b>(a)</b>	Derive the Navier-Stokes equation for viscous compressible fluid with constant	07
		viscosity: $\rho \frac{D\overline{q}}{Dt} = \rho \overline{X} - \nabla p + \mu \nabla^2 \overline{q} + \frac{\mu}{3} \nabla (\nabla \overline{q})$	
	$(\mathbf{L})$		07

(b) Discuss Principle of Superposition.

- Q.4 (a) Differentiate between Creeping flows and Nonviscous Flows.
  - (b) For laminar flow over a flat plate, a reasonable assumption for the velocity profile **07** is polynomial in y:  $u = a + by + cy^2$ , Derive the expression for boundary layer thickness,  $\delta$  and skin friction coefficient,  $C_f$  in terms of local Reynolds number.

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		OR	
Q.4	<b>(a)</b>	Write a short note on Prandtl's Mixing Length theory	07
	<b>(b</b> )	Discuss in brief boundary layer stability and transition	07
Q.5	(a)	Describe compressible flow through a convergent-divergent nozzle. How and where does the shock wave occur in the nozzle?	07
	<b>(b)</b>	Define the following terms:	07
		(i) Subsonic flow (ii) Sonic flow (iii) Supersonic flow (iv) Mach cone	
		(v) Stagnation pressure (vi) silence zone (vii) shock strength.	
		OR	
Q.5	<b>(a)</b>	Define maximum velocity and critical velocity of sound. Establish relation between	07
		them.	
	<b>(b)</b>	Define Impulse function and derive its non-dimensional form for isentropic flow.	07
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