

## CSE - 2018

S) For an incompressible fluid,  $u = n^2 + 2y^2 + 3z^2$   $v = x^2y - y^2z + xz$ Determine w so they satisfy the efn of continuity. Also find the z component of acceleration.

It is a continuity equation in cartisian co-ordinals:

 $\frac{\partial y}{\partial x} + \frac{\partial y}{\partial y} + \frac{\partial w}{\partial z} = 0$   $\frac{\partial}{\partial x} + \frac{\partial}{\partial y} + \frac{\partial}{\partial z} = 0$   $\frac{\partial}{\partial x} + \frac{\partial}{\partial x} + \frac{\partial}{\partial z} = 0$ 

7 0w = 2yz - 2x - x2

Intigrating wr. t ?:

The z-component of acceleration.  

$$a_{\pm} = (q \cdot \nabla) w + \partial w$$

 $= \frac{u \partial w}{\partial x} + \frac{v \partial w}{\partial y} + \frac{v \partial w}{\partial z}$   $= \frac{(z^2 + z^2 + z^2 + z^2 + z^2)}{(z^2 + z^2 + z^2 + z^2 + z^2)}$ 

 $= (x^{2} + 2y^{2} + 3z^{2}) (2f(x, y))$ 

 $a = (x^2 + 2y^2 + 3z^2) \left( \frac{\partial f}{\partial x} - 2z - 2xz \right)$ 

 $+ (x^{2}y - y^{2}z + xz)(2f + z^{2})$   $+ (yz^{2} - 2xz - x^{2}z + f(x, y))(2yz - 2z - x^{2})$ 

g) for a 20 flow:  $\phi = x^2y - xy^2 + 1(x^3 - y^3)$ Determine relocity components along the dir x & y. Also determine y and check of is a possible flow or orst. Soln: Let q = uê + vj  $\frac{1}{2} u = - \left( \frac{2xy - y^2 + x^2}{2xy} \right)$  $V = -\frac{\partial \phi}{\partial y}$   $\frac{\partial \phi}{\partial y}$   $\frac{\partial \phi}{\partial y} = -\left(\frac{x^{2} - 2xy - y^{2}}{x^{2} + 2xy}\right)$   $\frac{\partial \phi}{\partial y} = \frac{y^{2} - x^{2} + 2xy}{y^{2} + 2xy}$ We know that \$+ i4 is an analytic function and satisfies Cauchy Riemann equations.

So, 
$$-\frac{\partial V}{\partial y} = u$$
 and  $\frac{\partial V}{\partial x} = V$ 
 $\frac{\partial V}{\partial x} = y^2 - x^2 + 2xy$ 

Integrating  $N \ Y \cdot L \ x :$ 
 $\psi = xy^2 - x^3 + x^2y + f(y)$ 

Now,  $\frac{\partial V}{\partial y} = 2xy + x^2 + f'(y)$ 

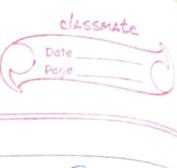
and  $\frac{\partial V}{\partial y} = -u$ 
 $\frac{\partial V}{\partial y} = -u$ 
 $\frac{\partial V}{\partial y} = -y^2$ 
 $\frac{\partial V}{\partial y} =$ 

 $2 = \frac{1 + 2bxy + cy^2}{2}$   $\frac{1 + 2bxy + cy^2}{2}$ ; a, b, C, m, 14 are constants and  $5^2 \neq ae$ . write down Lagrangian equations of motion and identify the system. Idn: Lagrange's x equation:

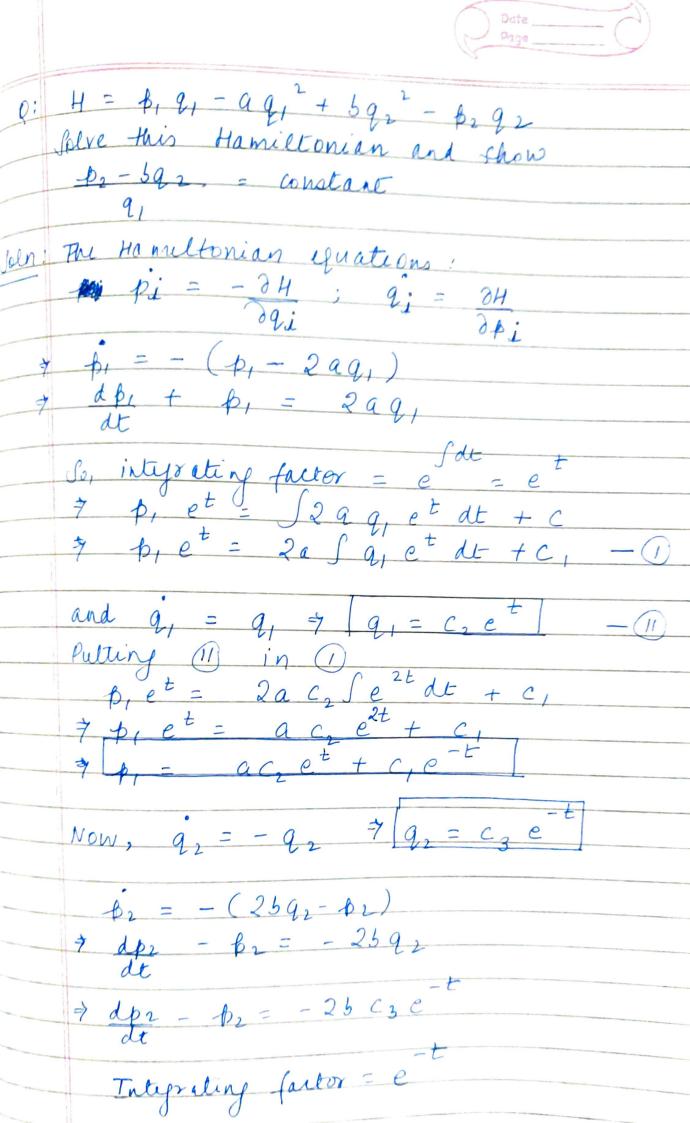
d (3L) - 3L = 0 - (1)

it (vi) vx  $\frac{\partial L}{\partial \dot{x}} = \frac{m}{2} \left( \frac{2a\dot{x} + 25\dot{y}}{2} \right) = m\left( \frac{a\dot{x} + 5\dot{y}}{2} \right)$  $\frac{d}{dt} \left( \frac{\partial L}{\partial \dot{x}} \right) = m \left( a \dot{x} + b \dot{y} \right)$  $\frac{\partial L}{\partial x} = \frac{K}{2} \left( \frac{2ax + 2by}{2by} \right) = K(ax + by)$ So, Eq () gives us:  $m(a\dot{x} + 5\dot{y}) = K(ax + 5y) - A$ Lagrangi's y equation:  $d \left( \frac{\partial L}{\partial y} \right) - \frac{\partial L}{\partial z} = 0 \qquad -11$   $dt \left( \frac{\partial J}{\partial y} \right) \qquad \frac{\partial J}{\partial y} = m \left( \frac{J}{J} + \frac{$ The d ( DL) = m (5i + cy')

By de ( Dy')  $\frac{\partial L}{\partial y} = \frac{K}{2} \left( 25x + 2cy \right) = K(5x + cy)$ Jo, Eq (11) gires m(5 \( \dagger + c \( \dagger \) = us: K(b2+cy) - B)



Now,  $a\ddot{x} + b\ddot{y} = \frac{x}{m} (ax + by)$  $b\ddot{x} + c\ddot{y} = \kappa (bx + cy)$ Axc - Bx 5  $\frac{1}{7} \left(ac - b^2\right) \stackrel{\circ \circ}{x} = k \left(ac - b^2\right) x$  $\frac{1}{x} = \frac{k}{x} \times \frac{1}{m}$ Putting  $\dot{x}$  in  $\dot{A}$ :  $a k x + 5 \dot{y} = k (ax + 5 y)$   $\dot{m}$  $\frac{1}{2}$   $\frac{1}$  $\frac{3}{y} = \frac{k}{m} y - D$ Eq. (D<sup>2</sup> - K)  $\alpha = 0$ The auxillary ign  $m^2 = K + m = \pm \int K$ So,  $\chi = C_1 e^{\int K/m} \chi + C_2 e^{\int K/m} \chi$ and  $y = C_1 e^{\int K/m} y + C_2 e^{\int K/m} y$ 



$$7 + 2e^{-t} - 2bc_3 \int e^{-2t} dt$$
  
 $7 + 2e^{-t} - bc_3 e^{-2t} + c_4$ 

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