**Study Guide #3**

**Eulers Equation**

1. What terms are neglected when using Eulers Eqn. compared with the Navier-Stokes Eqns.?
   1. 

discuss the vector sense of each term

* 1. Consider a fluid with the material derivative of velocity equal to zero (what does this mean physically?) Under what conditions can you use this equation – think of some examples.
  2. What about steady flow? How is Eulers Eqn. simplified?
  3. In the use of Eulers Eqn. tems are neglected as stated above; what flow conditions might this be useful for and when not?

1. Streamlines – what is the mathematical definition; the physical definition?
2. Stream function, , this is a scalar quantity that can fully describe a two (and three) dimensional flow!!
   1.  and 
   2. Show how this satisfies conservation of mass in 2D – what are the conditions?
   3. The change in streamfunction between two points in space is related to the volume flow rate that occurs between those two points (2D). 
   4. Evaluation of streamfunction knowing velocity components and visa versa. To obtain  need to integrate u and v equations in 3.a but keep in mind these are partial derivatives so integration of u equations results in an unknown f(x) – not an integration “constant”.
3. Streamline coordinates (s,n) in 2D have s aligned with constant lines and n is normal to s. So knowing (x,y) gives s and n coordinates.
   1. These are “curvilinear coordinates” where unit vectors along s and n can change direction. This makes things a bit more complicated in writing acceleration along s and n.
      1. 
      2. 
   2. Eulers eqns. becomes for steady flow:
      1. 
      2. 
      3. What can be described in terms of variations of pressure versus changes in velocity from these two eqns.? Consider moving along a streamline and normal to a streamline.
4. Now it is possible to integrate Euler’s Eqn. but the path of integration needs to be specified (along s, n, x, y etc. or some arbitrary direction). Also can start form unsteady or steady flow eqn. We will keep it incompressible.
   1. Steady flow along a streamline: show how you get the often used Bernoulli Eqn.
   2. Discuss how this “momentum eqn.” can be interpreted as conservation of energy.
   3. We come back to the more general form a little later!