Continuity Equation:

The equation based on the principle of conservation of mass is called continuity equation. Thus for a fluid flowing through the pipe at all the cross-section, the quantity of fluid per second is constant. Consider two cross-sections of a pipe as shown in figure

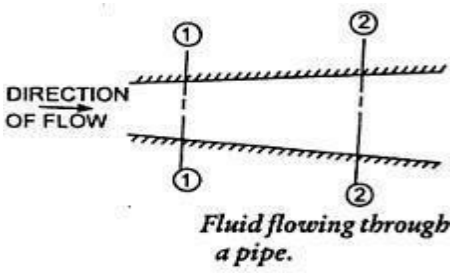

Fig.5. Continuity Equation

Let V_1=Average velocity at cross-section at 1-1
ρ_1 =Density at section 1-1 A_1=Area of pipe at section 1-1 and
V_2, ρ_2, A_2 are corresponding values at section 2-2
Then rate of flow at section 1-1 = $\rho_1 A_1 V_1$ Rate of flow at section 2-2 = $\rho_2 A_2 V_2$
According to law of conservation of mass,

Rate of flow at section 1-1 = Rate of flow at section 2-2

$$\rho_1 A_1 V_1 = \rho_2 A_2 V_2 \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

The above equation applicable to the compressible as well as incompressible fluids is called Continuity Equation. If the fluid is incompressible, then $\rho_1 = \rho_2$ and continuity equation (1) reduces to

$$A_1 V_1 = A_2 V_2$$

Energy Equations: This is equation of motion in which the forces due to gravity and pressure are taken into consideration. The common fluid mechanics equations used in fluid dynamics are given below

Let, Gravity force F_g, Pressure force F_p, Viscous force F_v, Compressibility force F_c, and Turbulent force F_t.

$$F_{net} = F_g + F_p + F_v + F_c + F_t$$

1. If fluid is incompressible, then $F_c = 0$
   This is known as Reynolds equation of motion.
2. If fluid is incompressible and turbulence is negligible, then
   This equation is called as Navier-Stokes equation.
3. If fluid flow is considered ideal then, viscous effect will also be negligible. Then

$$F_{net} = F_g + F_p$$