MJC-Physics

Sem I

Unit-II

THINGS TO DO

Equation of continuity in fluid flow →

The divergence of a vector field $\vec{A}$ that is, $\vec{\nabla}\cdot\vec{A}$ repersent the net outflow of $\vec{A}$ per unit volume. A quantity of fluid of density ρ flow with velocity $\vec{v}$ and consider the flow in a small vallume $d\tau$. Due to the out-flow of fluid, its density ρ inside $d\tau$ will decrease But by the principle of Conservation of mass, the total outflow of mass must equal the total decrease in mass in $d\tau$ due to change in density.

$$\therefore \vec{\nabla}\cdot(\rho\cdot\vec{v})d\tau = \frac{d\rho}{dt}d\tau$$

$$\Rightarrow \boxed{\vec{\nabla}\cdot(\rho\cdot\vec{v}) + \frac{d\rho}{dt} = 0} \quad \text{—— (i)}$$

the equation of continuity — For incompressible fluid, ρ = constant $= \frac{d\rho}{dt} = 0$ and the equation of continuity becomes:

Notes

$$\vec{\nabla}\cdot(\rho\vec{v}) = 0 \Rightarrow \vec{\nabla}\cdot\vec{v} = 0 \quad \text{—— (ii)}$$