

# Tutorial Sheet 1

CLL110 Transport Phenomena  
Department of Chemical Engineering, IIT Delhi  
Semester 1, 2025–26 (B Slot)

July 30, 2025

**Reading Assignment:** Appendix A, *Transport Phenomena*, BSL

**Prove**

1.  $\vec{u} \cdot (\vec{v} \times \vec{w}) = \vec{v} \cdot (\vec{w} \times \vec{u})$
2.  $(\vec{u} \times \vec{v}) \cdot (\vec{w} \times \vec{z}) = (\vec{u} \cdot \vec{w})(\vec{v} \cdot \vec{z}) - (\vec{u} \cdot \vec{z})(\vec{v} \cdot \vec{w})$
3.  $\nabla^2 \vec{v} = \nabla(\nabla \cdot \vec{v}) - \nabla \times (\nabla \times \vec{v})$
4.  $\nabla \cdot (s\vec{v}) = \nabla s \cdot \vec{v} + s\nabla \cdot \vec{v}$
5.  $\nabla \cdot (\vec{v} \times \vec{w}) = \vec{w} \cdot (\nabla \times \vec{v}) - \vec{v} \cdot (\nabla \times \vec{w})$
6.  $(\vec{u} \times \vec{v}) \times (\vec{w} \times \vec{z}) = ((\vec{u} \times \vec{v}) \cdot \vec{z})\vec{w} - ((\vec{u} \times \vec{v}) \cdot \vec{w})\vec{z}$