ME 637 **HW SET 1**

1. Express the following equations in vector (Gibbs) notation:

   $a_i = 5b_i$, $a = b_i c_i$, $a_i = \varepsilon_{ijk} b_j c_k$.

2. Suppose v_i is the velocity at a point in a fluid. Show that $T_{ij} = v_i v_j$ is a tensor.

3. Acceleration is given as

   $$\mathbf{a} = \frac{D\mathbf{v}}{Dt} = \frac{\partial \mathbf{v}}{\partial t} + \mathbf{v} \cdot \nabla \mathbf{v}.$$

   Express the acceleration in indicial notation.

4. Vorticity is given as

   $$\boldsymbol{\omega} = \nabla \times \mathbf{v}.$$

   Compute $\boldsymbol{\omega}$ for a rotating fluid with

   $$\mathbf{v} = \boldsymbol{\Omega} \times \mathbf{r},$$

   where $\boldsymbol{\Omega}$ is a constant angular velocity.

5. Using indicial notation show that

   $$\nabla \times \nabla \times \mathbf{u} = \nabla \nabla \cdot \mathbf{u} - \nabla^2 \mathbf{u}.$$

6. Show that

   $$\varepsilon_{ijk} \varepsilon_{njk} u_n = 2u_i.$$