UNIVERSITY of ARKANSAS
1871

MEEG 4703 **Name:** _____

(Underline your **last name**.)

Test I **ID#:** _____

1. (25%) Making use of the *laws of transformation* for Cartesian tensors, prove the orthonormal condition that

$$a_{ik}\, a_{jk} = \delta_{ij}$$

2. (25%) Using index notation, prove the identity

$$\mathbf{(P \times Q)\cdot(Q \times R)\times(R \times P)} = \mathbf{(P \cdot Q \times R)}^2$$

3. (25%) Using index notation, prove the identity

$$\nabla\times(\mathbf{A}\times\mathbf{B})+(\mathbf{A}\cdot\nabla)\mathbf{B}+(\nabla\cdot\mathbf{A})\mathbf{B}+\nabla(\nabla\cdot\mathbf{A})=\nabla\times(\nabla\times\mathbf{A})+\nabla^2\mathbf{A}+(\mathbf{B}\cdot\nabla)\mathbf{A}+(\nabla\cdot\mathbf{B})\mathbf{A}$$

4. (25%) The rotation from the $Oy_1y_2y_3$ Cartesian coordinate system to the $Oy_1'y_2'y_3'$ Cartesian coordinate system is defined by the rotation matrix

$$\left[a_{ij}\right]=\begin{bmatrix} 0.48 & 0.6 & -0.64 \\ -0.36 & 0.8 & 0.48 \\ 0.8 & 0 & 0.6 \end{bmatrix}$$

If $A_i \Rightarrow (4, -7, -4)$ and $B_i' \Rightarrow (-3, 4, 12)$, determine A_i' and B_i.