University of California, Berkeley
Physics 105 Fall 2006 Section 2 (*Strovink*)

ASSIGNMENT 1

Reading:
SCCM 1.1-1.5.
Taylor 1.7, p. 623, 4.8, Example 15.6, 9.3-4, pp. 401-402.

1. Taylor Problem 1.23. *Hint:* Because $\mathbf{c} = \mathbf{b}\times\mathbf{v}$ is $\perp$ to $\mathbf{v}$, $\mathbf{v}$ lies in the plane defined by two different vectors that are both $\perp$ to $\mathbf{c}$. Take these two vectors to be $\mathbf{b}$ and $\mathbf{b}\times\mathbf{c}$. Write $\mathbf{v}$ as a linear sum of them and solve for the linear coefficients.

2.

(**a.**)
Prove for any vector $\mathbf{b}$ and index i that

$$\epsilon_{ijk} b_j b_k = 0 \ ,$$

where ϵ_{ijk} is the Levi-Civita density, and summation over repeated indices is implied.

(**b.**)
Prove for any i, j, l, m that

$$\epsilon_{ijk}\epsilon_{klm} = \delta_{il}\delta_{jm} - \delta_{im}\delta_{jl} \ ,$$

where δ_{ij} is the Kronecker delta function.

3. Work Taylor Problem 1.23 again, as before starting from

$$\mathbf{v} = \alpha\mathbf{b} + \beta\mathbf{b}\times\mathbf{c} \ ,$$

but this time writing all vector products in component form using the Levi-Civita density. Do not use any vector relations or identities. The results of Problem 2 will help.

4. Taylor Problem 1.47.

5. Taylor Problem 1.48.

6.

(**a.**)
Deduce from first principles the general form of a real orthogonal 2×2 matrix.

(**b.**)
Suppoes this 2×2 matrix is a submatrix of a 3×3 matrix, whose third row and third column vanish except for the (3,3) element which is unity. What restrictions are placed upon the form of the 2×2 matrix if the 3×3 matrix corresponds to a proper rotation? To an improper (parity-inverting) rotation? Explain.

7. Taylor Problem 10.48.