Homework for Physics 456/656

Introduction to Accelerator Physics and Technology (Hoffstaetter)

Due Date: Thursday, 09/25/03 - 11:40 in 110 Rockefeller Hall

Exercise 1:
(a) Describe the magnetic field and the magnetic scalar potential in a duodecapole ?
(b) How strong is a duodecapole for which the distance from the central axis to the iron pole is given by a and around each pole is a winding of n wires each having a current I ?

Exercise 2:
A magnetic field has midplane symmetry. The particle motion through this field is described by a transport map $\vec{M}$ with $\vec{z}(s) = \vec{M}(s, \vec{z}_0)$ for the phase space vector $\vec{z} = (x, p_x, y, p_y)$.
(a) Explain why midplane symmetry requires the condition

$$\underline{S} = \begin{pmatrix} \underline{1} & \underline{0} \\ \underline{0} & -\underline{1} \end{pmatrix} \ , \quad \vec{M}(s, \vec{z}_0) = \underline{S}\vec{M}(s, \underline{S}\vec{z}_0) \ . \tag{1}$$

The matrices $\underline{0}$ and $\underline{1}$ are the 2×2 dimensional zero and unit matrix.
(b) What conditions do the Taylor coefficients $M_i^{\vec{k}}$ of the transport map satisfy when it is expanded as

$$M_i(\vec{z}_0) = \sum_{j=1}^{4} \sum_{k_j=1}^{\infty} M_i^{\vec{k}} x_0^{k_1} p_{x0}^{k_2} y_0^{k_3} p_{y0}^{k_4} \ . \tag{2}$$