due 11월 13일

Exercise 1.3. Readers who wish to test their understanding of this chapter by a simple graphical exercise may try the following.

[1] The electrical conductivity tensor of a certain crystal has the following components referred to axes x_1, x_2, x_3 :

$$[\sigma_{ij}] = \begin{bmatrix} 25\times10^7 & 0 & 0 \\ 0 & 7\times10^7 & -(3\sqrt{3})\times10^7 \\ 0 & -(3\sqrt{3})\times10^7 & 13\times10^7 \end{bmatrix}$$

in m.k.s. units(ohm^{-1}m^{-1}). The axes are now transformed to a new set x_1', x_2', x_3' given by the following angles:

$$x_1'Ox_1 = 0^\circ,\ x_2'Ox_2 = 30^\circ,\ x_2'Ox_3 = 60^\circ,\ x_3'Ox_3 = 30^\circ$$

Draw up a table of the form (11) (p.9) for this transformation, and check that the sum of the squares of the a_{ij} in each row and column is 1.

[2] Determine the values of the components σ'_{ij}, and comment on the result obtained.

[3] Draw on the new axes x_2', x_3' a section of the conductivity ellipsoid (representation quadric) in the plane $x_1' = 0$, and notice that this is a principal section.

Insert the old axes x_2, x_3 on the drawing.

[4] Draw a radius vector *OP* in the direction whose cosines referred to the old axes are (0, $\frac{1}{2}$, $\sqrt{3}/2$). Measure the length of this radius vector and so find the electrical conductivity in this direction.

[5] Check the last result by using an analytical expression.

[6] Assume an electric field of 1 volt/m to be established in the direction *OP*. Calculate the components E_i along the x_i axes, and hence calculate the components of current density j_i.