Quiz 02: Linear response theory

The electric field $\mathbf{E}(\mathbf{r},t)$ acts on a conductive medium, in which it induces a current density $\mathbf{j}(\mathbf{r},t)$.

1) Which integral formula describes the time dependence of each vector component $j_i(\mathbf{r},t)$ (with $i=x,y,z$) of the current density on the vector components $E_j(\mathbf{r},t)$ (with $j=x,y,z$) of the electric field? (4 points)
2) Which other formula can be used to describe the frequency dependence of $\overline{j}_i(\mathbf{r},\omega)$ on $\overline{E}_j(\mathbf{r},\omega)$? (3 points)
3) How is the function determining the time-dependence in task 1) connected to the function, which determines the frequency dependence in task 2)? (3 points)

You have 10 minutes!