Solutions **Opti 501**

Problem 2-17) $\nabla \cdot \boldsymbol{S}(\boldsymbol{r}) = \nabla \cdot [\boldsymbol{E}(\boldsymbol{r}) \times \boldsymbol{H}(\boldsymbol{r})] = \boldsymbol{H}(\boldsymbol{r}) \cdot \nabla \times \boldsymbol{E}(\boldsymbol{r}) - \boldsymbol{E}(\boldsymbol{r}) \cdot \nabla \times \boldsymbol{H}(\boldsymbol{r})$.

In static situation $\nabla \times \boldsymbol{E}(\boldsymbol{r}) = -\partial \boldsymbol{B}(\boldsymbol{r})/\partial t = 0$.

Also, $\nabla \times \boldsymbol{H}(\boldsymbol{r}) = \boldsymbol{J}_{\text{free}}(\boldsymbol{r}) + \partial \boldsymbol{D}(\boldsymbol{r})/\partial t = \boldsymbol{J}_{\text{free}}(\boldsymbol{r})$ in magnetostatics.

Therefore, $\nabla \cdot \boldsymbol{S}(\boldsymbol{r}) = -\boldsymbol{E}(\boldsymbol{r}) \cdot \boldsymbol{J}_{\text{free}}(\boldsymbol{r}) = 0$.
