

Problem 3.19 Vector field \mathbf{E} is given by

$$\mathbf{E} = \hat{\mathbf{R}} 5R \cos \theta - \hat{\boldsymbol{\theta}} \frac{12}{R} \sin \theta \cos \phi + \hat{\boldsymbol{\phi}} 3 \sin \phi.$$

Determine the component of \mathbf{E} tangential to the spherical surface $R = 2$ at point $P = (2, 30^\circ, 60^\circ)$.

Solution: At P , \mathbf{E} is given by

$$\begin{aligned} \mathbf{E} &= \hat{\mathbf{R}} 5 \times 2 \cos 30^\circ - \hat{\boldsymbol{\theta}} \frac{12}{2} \sin 30^\circ \cos 60^\circ + \hat{\boldsymbol{\phi}} 3 \sin 60^\circ \\ &= \hat{\mathbf{R}} 8.67 - \hat{\boldsymbol{\theta}} 1.5 + \hat{\boldsymbol{\phi}} 2.6. \end{aligned}$$

The $\hat{\mathbf{R}}$ component is normal to the spherical surface while the other two are tangential. Hence,

$$\mathbf{E}_t = -\hat{\boldsymbol{\theta}} 1.5 + \hat{\boldsymbol{\phi}} 2.6.$$
