most convenient mode of operation is that of Figure 3.5(b) with the test antenna used as a receiver. Antenna #2 is usually placed in the far-field of the test antenna (#1), and vice versa, in order that its radiated fields are plane waves in the vicinity of #1.

The receiving mode of operation of Figure 3.5(b) for the test antenna is most widely used to measure antenna patterns because the transmitting equipment is, in most cases, bulky and heavy while the receiver is small and lightweight. In some cases, the receiver is nothing more than a simple diode detector. The transmitting equipment usually consists of sources and amplifiers. To make precise measurements, especially at microwave frequencies, it is necessary to have frequency and power stabilities. Therefore, the equipment must be placed on stable and vibration-free platforms. This can best be accomplished by allowing the transmitting equipment to be held stationary and the receiving equipment to rotate.

An excellent manuscript on test procedures for antenna measurements of amplitude, phase, impedance, polarization, gain, directivity, efficiency, and others has been published by IEEE [5]. A condensed summary of it is found in [6], and a review is presented in Chapter 17 of this text.

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PROBLEMS

3.1. If $\mathbf{H}_e = j\omega\epsilon\nabla \times \mathbf{\Pi}_e$, where $\mathbf{\Pi}_e$ is the electric Hertzian potential, show that

(a) $\nabla^2\mathbf{\Pi}_e + k^2\mathbf{\Pi}_e = j\dfrac{1}{\omega\epsilon}\mathbf{J}$ (b) $\mathbf{E}_e = k^2\mathbf{\Pi}_e + \nabla(\nabla \cdot \mathbf{\Pi}_e)$

(c) $\mathbf{\Pi}_e = -j\dfrac{1}{\omega\mu\epsilon}\mathbf{A}$

3.2. If $\mathbf{E}_h = -j\omega\mu\nabla \times \mathbf{\Pi}_h$, where $\mathbf{\Pi}_h$ is the magnetic Hertzian potential, show that

(a) $\nabla^2\mathbf{\Pi}_h + k^2\mathbf{\Pi}_h = j\dfrac{1}{\omega\mu}\mathbf{M}$ (b) $\mathbf{H}_h = k^2\mathbf{\Pi}_h + \nabla(\nabla \cdot \mathbf{\Pi}_h)$

(c) $\mathbf{\Pi}_h = -j\dfrac{1}{\omega\mu\epsilon}\mathbf{F}$

3.3. Verify that (3-35) and (3-36) are solutions to (3-34).

3.4. Show that (3-42) is a solution to (3-39) and (3-43) is a solution to (3-31).

3.5. Verify (3-57) and (3-57a).

3.6. Derive (3-60) and (3-61).