8.49 A waveguide filled with a material whose $\varepsilon_r = 2.25$ has dimensions $a = 2$ cm and $b = 1.4$ cm. If the guide is to transmit 10.5-GHz signals, what possible modes can be used for the transmission?

Solution: Application of Eq. (8.106) with $u_{p_0} = c/\sqrt{\varepsilon_r} = 3 \times 10^8/\sqrt{2.25} = 2 \times 10^8$ m/s, gives:

$$f_{10} = 5 \text{ GHz (TE only)}$$
$$f_{01} = 7.14 \text{ GHz (TE only)}$$
$$f_{11} = 8.72 \text{ GHz (TE or TM)}$$
$$f_{20} = 10 \text{ GHz (TE only)}$$
$$f_{21} = 12.28 \text{ GHz (TE or TM)}$$
$$f_{12} = 15.1 \text{ GHz (TE or TM).}$$

Hence, any one of the first four modes can be used to transmit 10.5-GHz signals.