Reading

Textbook: *Elements of Electromagnetics*, 7th Ed.
Matthew N. O. Sadiku
Oxford University Press

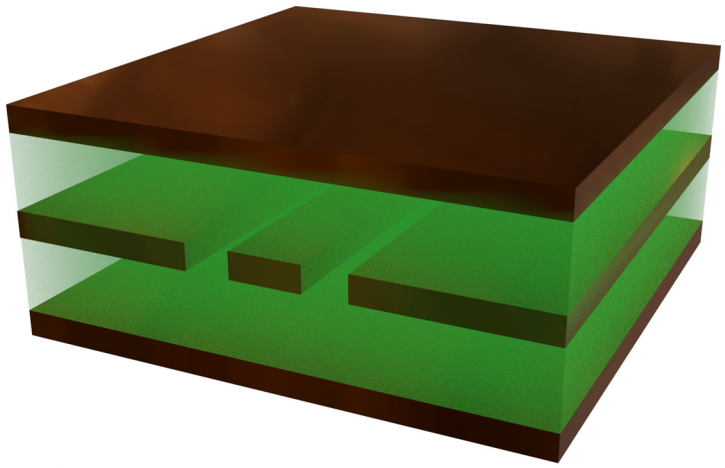
Website: *https://empossible.net/emp3302/*

Assignment: Read Chapter 12
Work through Topic 8

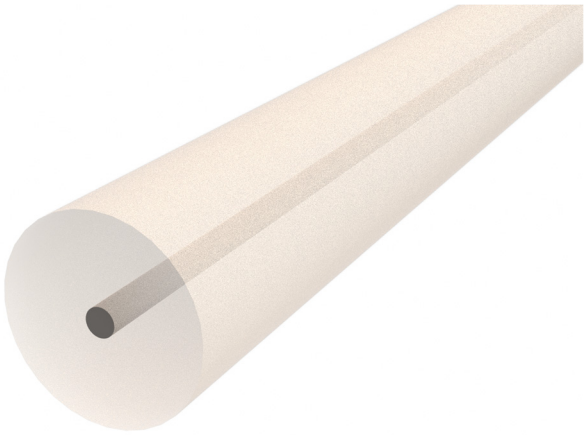
TEM, TE, TM Supporting Waveguides

For the following waveguides, list the supported modes. If no TEM, TE, or TM modes are supported, write "Hybrid modes only." Justify your answer.

Problem #1 – Embedded Coplanar Waveguide



Problem #2 – Optical Fiber

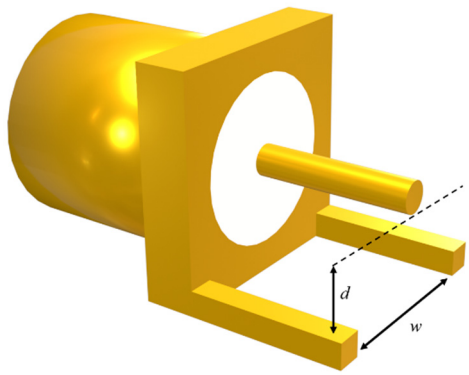


Problem #3 – Rectangular Waveguide Modes

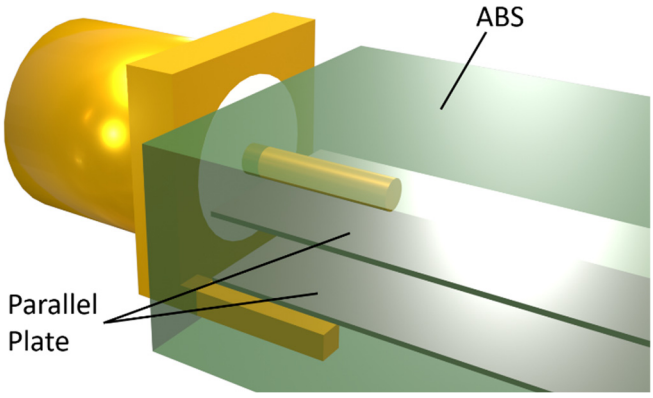
Determine the cutoff frequencies of the first five TE and TM modes for an air-filled WR90 rectangular waveguide. The dimensions of the cross section are 22.86 mm × 10.16 mm. What is the fractional bandwidth of the fundamental mode?

Problem #4 – 3D-Printed Parallel Plate Waveguide

A *subminiature version A* (SMA) connector is a popular choice to connect thin coaxial cables to different kinds of waveguides and transmission lines. A modified SMA connector is shown below, where the width between its two ground pins is w and the height from the top of the square ground pins to the bottom of the cylindrical signal pin is d.



Design a 75 Ω parallel plate waveguide that is to be 3D printed with ABS plastic as the dielectric and CB028 conductive paste as the conductor. The SMA connector has a 75 Ω characteristic impedance, a height of $d = 1.73$ mm, and a width of $w = 9.53$ mm. The top plate of the waveguide will touch the bottom of the center SMA pin, and the bottom plate of the waveguide will touch the tops of the bottom SMA ground pins. This is illustrated in the next picture.



ABS plastic has a dielectric constant of $\varepsilon_r = 2.6$. What should the width of the parallel plate waveguide need to be in order to make its characteristic impedance 75 Ω? Will the plate width be large enough to connect to the two ground pins?