1. Design a 1% power splitter using a directional coupler operating at 1550 nm.
2. Design a Mach–Zehnder interferometer with a free-spectral range of 10 nm operating at a 1310 nm wavelength with 400 nm strip waveguides.
3. Design a critically coupled all-pass ring resonator filter with a free-spectral range of 1 nm. In anticipation of designing a ring modulator, assume a waveguide propagation loss of 10 dB/cm (see Section 6.2.2 from the course book: Silicon Photonics Designs).
4. Design an add-drop ring resonator filter with a free-spectral range of 1 nm and a quality factor of 5000. Assume a waveguide propagation loss of 10 dB/cm.
5. Design a uniform Bragg grating with a centre wavelength of 1550 nm (first nulls), bandwidth of 5 nm, and peak reflectivity of 99%. Design for both 193 nm and electron-beam lithography using strip waveguides with oxide cladding.
6. Find the group and phase velocity of light for the fundamental TE and TM modes in the following waveguides:
   * slab waveguide, 220 nm thick, at 1550 nm;
   * slot waveguide, in a 500 nm wide strip, with a 150 nm fully etched gap in the middle.
7. What is the single-mode condition for the rib waveguide TE mode, for a slab thickness of 90 nm? What is the maximum width for the waveguide before it supports more than one mode? What is the minimum width for the silicon before it does not support a mode?
8. Design a single-mode (TE/TM) waveguide for 1310 nm operation, for a silicon thickness of 150 nm, and 220 nm.