1. What is the quantum efficiency of a germanium detector that has a responsivity of 0.7 A/W? If the absorption rate is constant with length and there are no losses due to scattering, metal, and all photo-generated carriers contribute to the current, what would the quantum efficiency be after doubling the length?
2. The intrinsic region of a germanium detector is 1 μm wide. The detector is biased to saturation velocity. The detector series resistance is 300and the capacitance is 50 fF. Is the detector transit time limited or RC limited? What modifications could be done to the geometry of the detector enhance the bandwidth?
3. Given a silicon avalanche region with 1 μm width, a charge region width of 100 nm and a germanium width of 2 μm calculate the approximate voltage and doping (in Atoms/cm2) required for the SACM APD shown in Figure 7.14b (from the course book: Silicon Photonics Designs) such that the electric field in the germanium is at saturation and the electric field in the silicon avalanche region is at breakdown.
4. Calculate the voltage and doping required for the SACM APD shown in Figure 7.14b which appears in the course book: Silicon Photonics Designs.
5. Perform simulations for the detector whereby the Ge metal electrode is split into two to reduce optical absorption. How much performance improvement is expected?
6. Simulate the mode profile of a hybrid silicon laser. Calculate the optical confinement factor.
7. Consider a fabrication process where the width and thickness of a 500 nm × 220 nm strip waveguide are both expected to vary by up to 1 nm. A wavelength division multiplexed system consisting of series-coupled ring resonators is to be implemented for a sensor application, where it is necessary to be able to distinguish between each ring. What is the minimum free spectral range and maximum ring radius necessary for resonators operating near 1550 nm?
8. Consider a coarse wavelength division multiplexing (CWDM) communication system utilizing on-chip lasers where the wavelength is defined by a Bragg grating. Assuming maximum variations of up to 10 nm in each fabrication parameter, what is the anticipated wavelength variation? Identify suitable parameters for the CWDM system and necessary optical multiplexers, specifically, the channel spacing and bandwidth.