abstract We present Monte Carlo simulations of dusty spiral galaxies, modelled as bulge + disk systems, aimed to study their extinction and polarization properties. The extinction parameters (absorption and scattering) of dust grains are calculated from Mie’s theory for a full distribution of sizes and materials; the radiation transfer is carried on for the four Stokes parameters. Photometric and polarimetric maps of galaxies of different optical depths, inclinations and bulge-to-total ratios have been produced in the B and I bandpasses. As expected, the effect of scattering is to reduce substantially the extinction for a given optical depth, in particular for what concerns the obscuration of bright bulge cores. For the same reason, scattering reduces also the reddening, as evaluated from B-I maps. On the other hand the bluing directly due to forward scattering is hardly appreciable. Radial color gradients are often found. A comparison with “sandwich” models shows that they fail dramatically to reproduce the extinction - optical depth relation. The degree of linear polarization produced by scattering is usually of the order of a few percent; it increases with optical depth, and with inclination ($i \leq 80^\circ$). The polarization pattern is always perpendicular to the major axis, unless the dust distribution is drastically modified. There is little local correlation between extinction and polarization degree and there is a trend of increasing polarization from the B to the I band. We discuss implications and relevance of the results for studies of the structure and morphology of spiral galaxies and of their interstellar medium.