

A new 5-point and a 7-point nonuniform mesh finite-difference scheme is introduced to approximate the second-derivative operator. The scheme is applied using the method of lines. The necessary interface conditions for the TE and TM fields at an index discontinuity are appropriately included in the derivation. This scheme can model lossy dielectrics as well as metallic layers in a unified way. Numerical results are given for the fundamental TE and TM modes of a high-contrast waveguide and for a metal/dielectric single interface TM surface-plasmon mode showing excellent convergence behavior to the analytical results.