

Micro-optics

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Exercise 10

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Discussion sections: Jan 23 & 24 2008

1 Mirror waveguides (50)

Light of wavelength $\lambda = 633$ nm is transmitted through a mirror waveguide ($n = 1$) whose mirrors are separated by $t = 10$ μm .

- Determine the number of TE modes supported by the mirror waveguide.
- Give an expression for the group velocity

$$v = \frac{d\omega}{d\beta},$$

as a function of the mode specific angles of incidence (c independent on ω). Hint: First derive β , then express k and λ by ω , ...

- Determine the group velocities of the fastest and slowest mode.
- Assuming that the waveguide carries all modes of a narrow light pulse, calculate the intermodal dispersion (max. path time difference, spreading of the pulse) which occurs over a distance of 1 m.

2 Dielectric waveguide design (50)

Assume a symmetric waveguide with a GaAs core ($n_g = 3.35$) and AlGaAs upper and lower cladding ($n_c = n_s = 3.12$).

- Design a 2-mode TE waveguide at $\lambda_0 = 1550$ nm which supports only 3 modes at $\lambda_0 = 850$ nm.
- What are N , β and θ at the longer wavelength (at minimum thickness)?
Hint: Use the characteristic equation for symmetric waveguides, and find either numerical or graphical solutions for N .
- Give a limit for the core thickness at 1550 nm, if the waveguide should only support a single mode.