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Planar waveguides with losses or gain and their analysis

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A method for analysis of planar waveguides with losses or gain is developed. At grating presence these waveguides are main elements of distributed feedback (DFB) microlasers. For radiation, which waveguide laser is pumped by, such waveguide will be absorbent but at wavelength of generation it will be amplifying.

For analysis of DFB lasers it is necessary to know propagation constants at different generation conditions. Moreover, these calculations should be carried out very quickly, in hundredths of a second. Traditional methods to search propagation constants are quite continued. That's why the method based on variation of constants is worked out. The essence of this method is that propagation constants and appropriate fields of lossless waveguide (its permittivity is a real function) are calculated by known methods. They provide high accuracy; for example, in a frequency domain at usage of Fourier transform [1]. If, in a waveguide there are losses or gain, an additional component of permittivity appears, and it is already imaginary. So, the solution will be represented as linear combination of unperturbed waveguide fields where variable field amplitudes depends on coordinate along which waveguide modes propagate. The solution proposed is substituted in a wave equation; as a result, a system of second order differential equations with constant coefficients in regard to field amplitudes is obtained.

By the method proposed a number of waveguides was analyzed and their propagation constants were found. In particular, dielectric waveguides with losses, waveguides with structures such as metal-dielectric-metal and dielectric-metal-dielectric were considered. It should be noted that this method is accurate when all modes are taken into account including leaky ones. When only guided modes are taken into account it will be accurate in some cases, but at little perturbation it will be accurate enough for all cases.

1. *Fitio V.M., Romakh V.V., Bobitski Ya.V.* The Fourier transform application to search for localized modes of gradient planar waveguides // Journal of Radiophysics and Electronics.-2013.-**4(18)**, N 4.-P. 21-26.