Abstracts

Generalized Solutions for Optical Maser Amplifiers

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The optical maser amplifier is treated from the transient analysis point of view using the Laplace transform method as opposed to the conventional sinusoidal steady-state analysis that sometimes leads to inconsistent results especially for the region beyond threshold. Firstly, the wave equations are expressed in terms of laplace transforms, and then the generalized solutions for both the transmission and the reflection mode of operation are derived taking the transient terms into account. Finallly, the inverse laplace transforms are obtained yielding the generalized solutions in terms of real-time functions. In order to emphasize the point of the argument and also to compare the results of the usual sinusoidal steady-state analysis, use is made of the simplest possible model of a one-dimensional system consisting of three media, air, active medium, and air. An incident coherent transverse electromagnetic wave, which falls normally on the surface of the system, is assumed. The generalized solutions derived agree, in the region below threshold, exactly with that of the sinusoidal steady-state analysis obtained previously by other investigators. However, for the region beyond critical threshold, the generalized solutions indicate that the device goes into a state of self-oscillation with oscillation frequencies that strictly coincide with those of the Fabry-Perot type resonator. Thus, the limitation of applicability of the conventional sinusoidal steady-state analysis is clarified. Some remarks are also given on the design problem of optical maser amplifiers in connection with the transient terms involved.

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