

SELECTED TOPICS IN ADVANCED ELECTRONICS

Edited by
Khalid A. S. Al-Khateeb



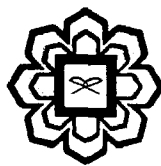
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CHAPTER 14

THEORY OF ERBIUM DOPED FIBER LASERS (EDFLS) AND ERBIUM DOPED FIBER AMPLIFIERS (EDFAS)

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Synopsis

The theoretical study of the phenomena involved in the principles of Erbium Doped Fiber Lasers and Amplifiers is rather complicated, due to the physical complexity that involves the interdependence of the energy levels with the light spectrum, the Stark split, and the influence of the crystal field as well as the complex rate equation which determines the signal strength, the amplified spontaneous emission (ASE) and the required pump power (E. Desurvire, 1994). The theoretical study is necessary for the investigations that aim at developing new designs to enhance the gain characteristics, to improve the noise figure of the fiber amplifiers and, to increase the efficiency of the fiber lasers. The variety of topics that are involved in theoretical background behind the behavior of these devices requires an approach that involves classical electromagnetism, quantum mechanics and laser physics, in order to formulate a meaningful theoretical model.

1 Introduction

Many research papers have been published since the beginning of the theoretical studies that lead to principles of stimulated emission at the turn on the twentieth century. Much of the research was devoted to the explanation of the phenomenon of light amplification and laser action. These studies had to take into consideration all factors and parameters