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Lasers Design and Laser Systems
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Fiber and Waveguide Lasers: Section
Introduction

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One of the major technological advances in laser systems was the development of fibre optics [1]. This allowed laser light to be accurately and efficiently delivered to distant targets over ranges from several millimetres to many kilometres. The combination of laser sources and fibre optic delivery systems has led to important applications such as modern telecommunication systems and non-invasive laser surgery. The next step in this technology development is to combine the fibre delivery system and the laser into one device. Since fibres are made out of glass, they can act as the host material for rare earth laser ions to make fibre lasers. All of the fundamental science and technology of rare-earth-doped glass laser materials discussed in Chapter 1 are relevant for fibre lasers. The major difference is that the length of a single pass of light in a fibre laser is much longer than in a rod or slab laser. This requires significantly different resonator design techniques.

The basic spectroscopic properties discussed in Chapter 1 and the waveguide theory discussed in Chapter 24 form the basis for fibre lasers. Because of the length of the gain media, non-linear optical effects play an important role in fibre lasers. Non-linear optical processes can be the limiting factor in determining the power output of a fibre laser. At the same time, non-linear processes such as stimulated Raman scattering can form the basis of the fibre laser itself.

The development of the technology to produce fibres with special shapes and properties has led to the ability to make fibre lasers with very low loss over very long distances. By controlling the core size and shape, and using Bragg gratings for distributed feedback, the power, mode structure, dispersion and wavelength of the laser can be designed. Rare-earth-doped fibre amplifiers have become standard devices in optical telecommunication systems. All of these topics are discussed in this section.

REFERENCE