UNIVERSITI PUTRA MALAYSIA

DESIGN AND ANALYSIS OF NEW ERBIUM DOPED FIBER AMPLIFIERS AND LASERS

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DESIGN AND ANALYSIS OF NEW ERBIUM DOPED FIBER AMPLIFIERS AND LASERS

By

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Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia, in Fulfilment of the Requirements for the Degree of Doctor of Philosophy

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To My Son Mohamed

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Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfilment of the requirement for the degree of Doctor of Philosophy

DESIGN AND ANALYSIS OF NEW ERBIUM DOPED FIBER AMPLIFIERS AND LASERS

By

BELLOUI BOUZID

April 2004

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Erbium doped fiber amplifiers and lasers have a great impact on optical communication due to their ideal advantages for the compensation of light energy during transmission through the fiber optic systems. This has been the focus of many research groups. Replacing the bottleneck electronic amplifier by the optical amplifier, a great improvement is made for the optical communication systems.

New configurations have been conceived and realized in this thesis. They have shown a great enhancement in amplifier and laser performance parameters. Several new configurations, for example double pass with filter which also supports multiple wavelengths, have been demonstrated and investigated.

The design and performance parameters of the new configurations are thoroughly characterized, showing an improvement in gain, noise figure,

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output power flatness efficiency and side mode suppression ratio. Enhancement of results has been experimentally demonstrated, where a higher gain (56dB) and flat output power (<0.7dB), a higher signal to noise ratio (77dB) and a higher efficiency (22%) are demonstrated.

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Abstrak tesis yang dikemukakan kepada senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Doctor Falsafah

MEREKACIPTA DAN MENGANALISA PEMBESAR FIBER TERDOPAN ERBIUM DAN LASER

Oleh

BELLOUI BOUZID

April 2004

Pengerusi: Profesor Madya Mohd. Khazani Abdullah, Ph.D.

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Pengganda gentian pendopan Erbium (EDFA) dan laser mempunyai impak yang besar di dalam komukasi optik kerana kebaikannya yang dapat mengantikan tenaga cahaya semasa penghantaran melalui sistem gentian optik. Perkara ini telah difokuskan oleh banyak kumpulan penyelidikan. Dengan mengantikan pengganda elektronik dengan pengganda optikal, suatu penambahbaikan yang besar telah dapat dibuat di dalam sistem komukasi optik.

Suatu konfigurasi baru telah di perkenalkan dan telah di realisasikan di dalam tesis ini. Dimana ianya merupakan suatu peningkatan yang besar didalam parameter prestasi pengganda dan laser. Beberapa konfigurasi baru tersebut adalah seperti double pass dengan penapis yang mana juga boleh menambung multiwavelength telah di analisa dan direalisasikan. Daripada parameter rekabentuk dan prestasi bagi konfigurasi yang baru ini telah

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dikaji dan dianalisa dan ianya menunjukan peningkatan didalam gandaan, tahap kebisingan, kecekapan kuasa keluaran mendatar dan SMSR. Keputusan yang menunjukkan peningkatan ini telah di tunjukan secara amali, dimana gandaan yang tinggi (56dB) dan keluaran kuasa mendatar(<0.7dB), mempunyai kadar isyarat kebisingan yang tinggi (77dB) dan kecekapaan yang tinggi (22%).

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Praise be to ALLAH the greatest, who has said:

"والله غالب علىأمره ولكنأكثرالناس لايعلمون"

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