

Department of Electronic & Telecommunication Engineering

Subject: Optical Communication (UECL424)

TAE – 1

Topic: Erbium Doped Fiber Amplifier.

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Submitted To: Dr.Kapil Jajulwar.

Signature

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Title : Erbium Doped Fiber Amplifier.

Introduction:

Erbium-Doped Fiber Amplifiers (EDFAs) are essential for long-distance fiber-optic communication due to their high gain and low noise at the 1550 nm wavelength, where silica fibers exhibit minimal loss. However, conventional EDFA designs are large, complex, and difficult to assemble, requiring multiple discrete optical components and fusion-spliced fiber pigtails.

Goal of the Research

To develop compact optical modules that:

- Integrate multiple functions (e.g., WDM coupler, isolator, photodiodes)
- Reduce space and simplify assembly
- Maintain performance equivalent to full-size EDFAs

Technical Highlights

- Two types of modules: Forward and Backward (for pump configuration)
- Size of each module: only $32 \times 14 \times 7$ mm □ Key features:
 - Use of dielectric filters, beam splitters, and HR mirrors
 - Anti-reflection coating and angled fiber ends to reduce reflection
 - YAG laser welding for precise fiber and lens alignment
 - Designed for easy combination and modular flexibility

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Performance and Results

- The modules were used to build a compact EDFA ($120 \times 95 \times 10$ mm)
- Output Power: >14.5 dBm across 1530–1560 nm □ Noise Figure: <8.5 dB at high pump power (91 mW)
- Polarization Dependence: Very low (<0.1 – 0.2 dB)
- Return Loss: >50 dB
- Endurance Tests: Passed all (thermal, mechanical, vibration) with minimal degradation.

Conclusion:

The new compact optical modules:

- Significantly reduce EDFA size while retaining performance □ Simplify production and improve reliability
- Are well-suited for booster amplifier applications.

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