Department of Electronic & Telecommunication Engineering

Subject: Optical Communication (UECL424)

TAE – 1

Topic: Erbium Doped Fiber Amplifier.

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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 × 14 × 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

Performance and Results

- The modules were used to build a compact EDFA (120 × 95 × 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.