UNIVERSITY OF ASIA PACIFIC

Department of Computer Science and Engineering

Course Code: CSE 304
Course Title: Data Communication Lab

Experiment No:01

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Objective: This lab aims to measure and analyze the attenuation in an optical fiber as a function of its length and wavelength using the cutback method. This involves understanding the relationship between fiber length and signal attenuation and calculating the attenuation coefficient in dB/km for the given optical fiber.

Theory: Optical power transmission through a fiber optic cable experiences attenuation, leading to a reduction in signal strength as light travels through the fiber. This attenuation is measured in decibels per kilometer (dB/km) and is referred to as the attenuation coefficient or attenuation rate. The attenuation rate depends on the type of fiber and the operating wavelength.

Silica-based optical fibers exhibit different attenuation characteristics, with single-mode fibers having lower attenuation than multimode fibers. Typically, attenuation decreases as the wavelength increases, a trend seen in the 800–1600 nm wavelength range commonly used for data and telecom applications.

Single-mode fibers, which operate mainly at 1310 nm or 1550 nm, experience minimal attenuation, making them ideal for long-distance communication. On the other hand, multimode fibers primarily function at 850 nm, and sometimes at 1300 nm, and are designed for shorter distances. Despite the higher attenuation at 850 nm, multimode fibers are cost-effective because they use more affordable optical sources. In general, the lower the wavelength, the less expensive the optics, which influences fiber choice for specific communication requirements.

List of Components:

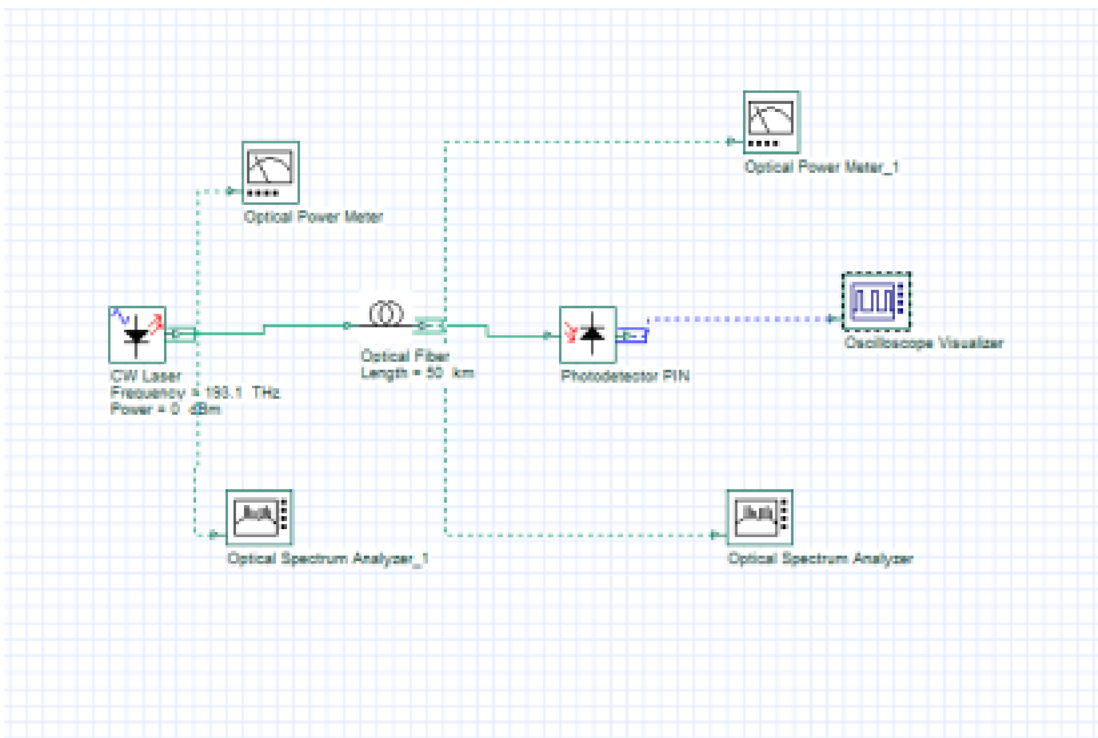
- CW Laser – 1
- Optical Fiber -1
- Photodetector PIN – 1
- Optical Power Meter – 2
- Optical Spectrum Analyzer – 2

- Oscilloscope Visualizer - 1

Formula :

If Pi represents the input power and Po is the output power after passing
through an optical fiber of Length L km.
Attenuation, A in dB = 10 log Pi/P0
Attenuation coefficient, α dB/km = A/L = 10/L log Pi/Po

Diagram of Optisystem :



Simulation results:

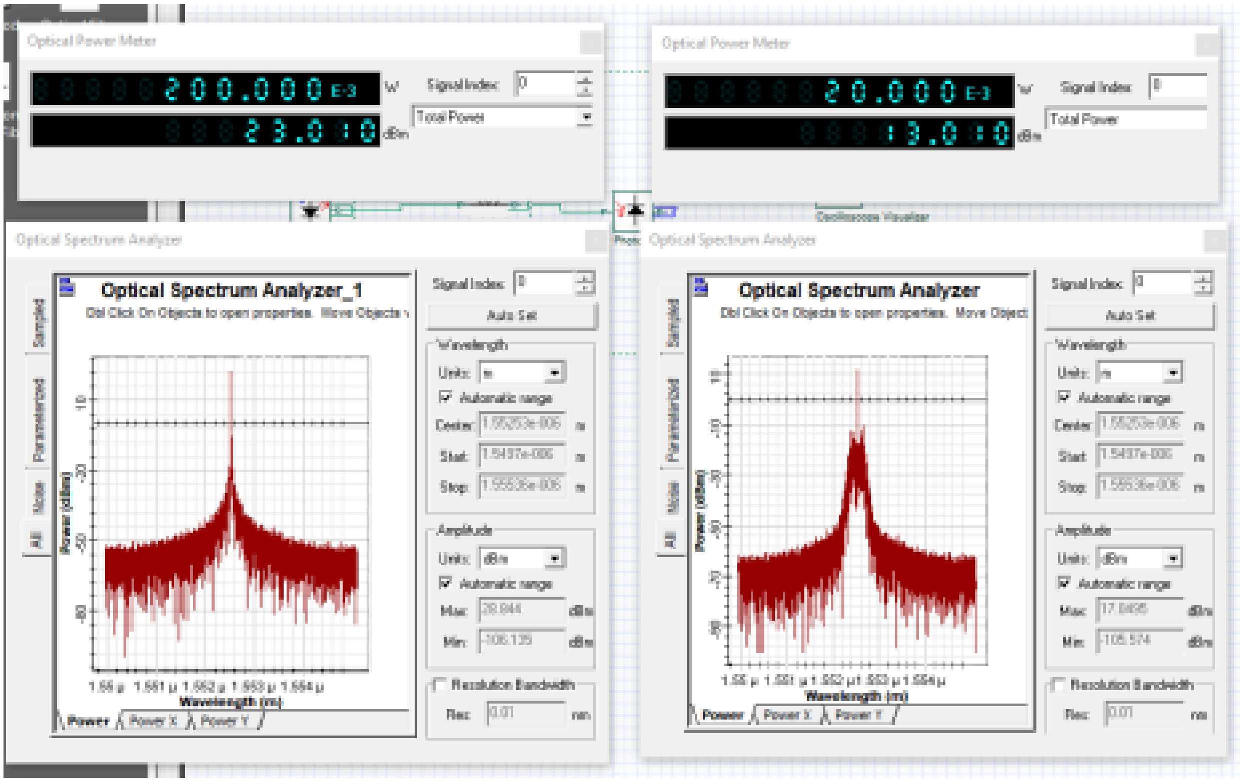


Diagram: Simulation of Optical Power Levels and Optical Spectrum

Spectrum of oscilloscope visualizer at the end of the receiver:

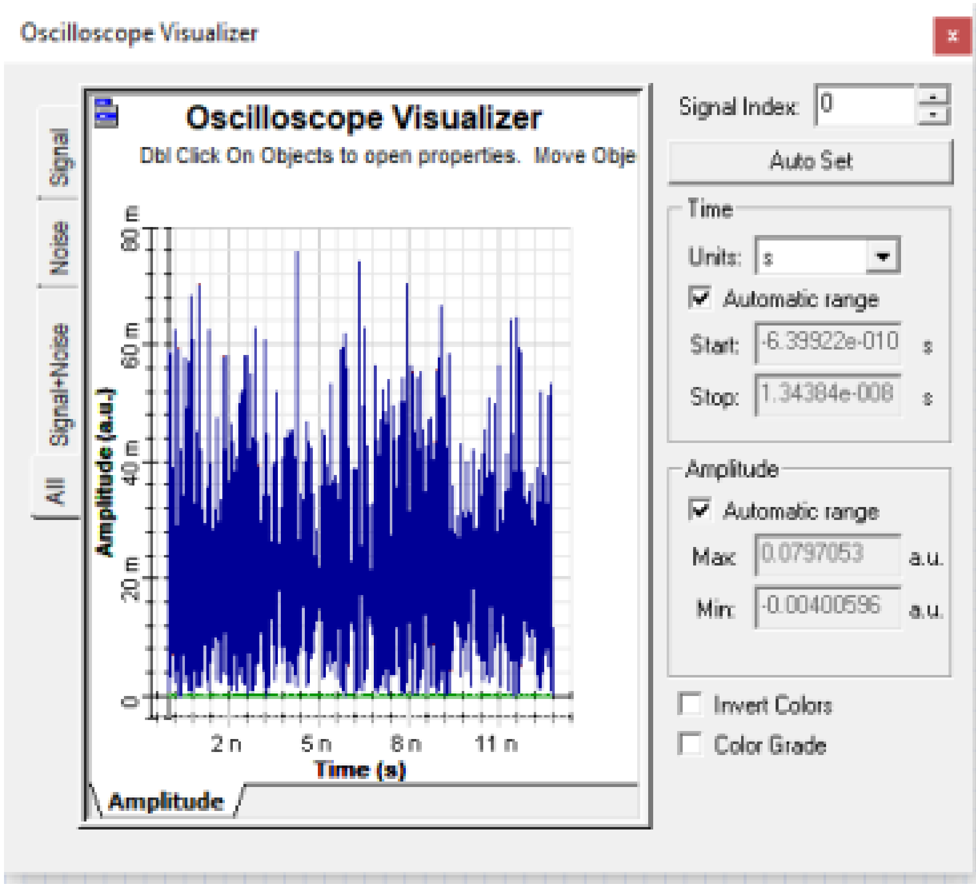


Diagram: Diagram of oscilloscope visualizer at the end of the receiver

OBSERVATION TABLES

Table 1: Practical Attenuation of fiber as a function of length and wavelength

Att. in dB

Wavelength (nm) | Length L (Km) Input | Power, P_1(mW) Output Power, | P_0(mW) A | $=10 \log P_1/P_0$ Att. per Km | A/L Average

5 200 158.866 0.999 0.1999

1550 0.1997

10	200	126.191 2.00	0.2
20	200	79.621 4.00	0.2

50	200	20.000 10	0.2
60	200	12.619 12.00	0.2
70	200	7.962 14.00	0.2

80 200 5.024 15.846 0.198

Att. in dB

Wavelength (nm) Length L (Km) Power, P_1(mW) P_0(mW) A/L Average

Input Output Power, A

=10 log P_1/P_0

Att. per Km

10 100 63.095 2.00 0.2

15	150 75.178 3.00	0.2
20	200 79.621 4.00	0.2
25	250 79.057 4.99	0.199
30	300 75.356 6.000	0.2
35	350 89.834 5.906	0.145

1550 0.1919

40 400 63.396 7.99 0.199

Table 2: Practical Attenuation of fiber as a function of length and wavelength

Graphs for Attenuation in dB vs Length in Km:

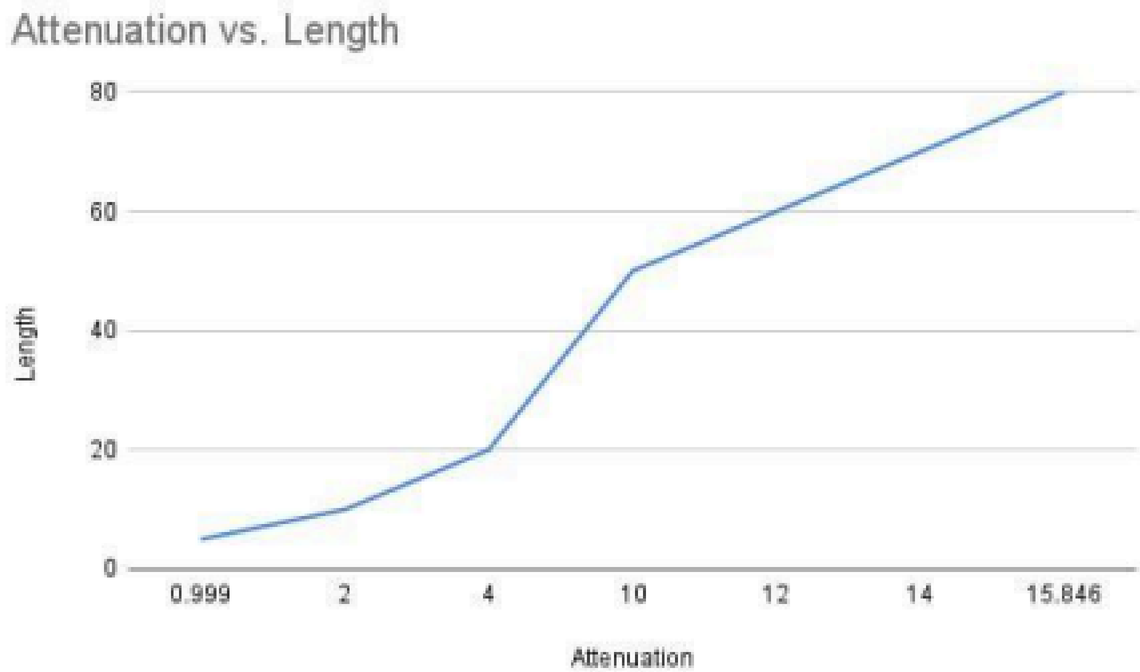


Figure: Attenuation in dB vs Length in km for the same input power

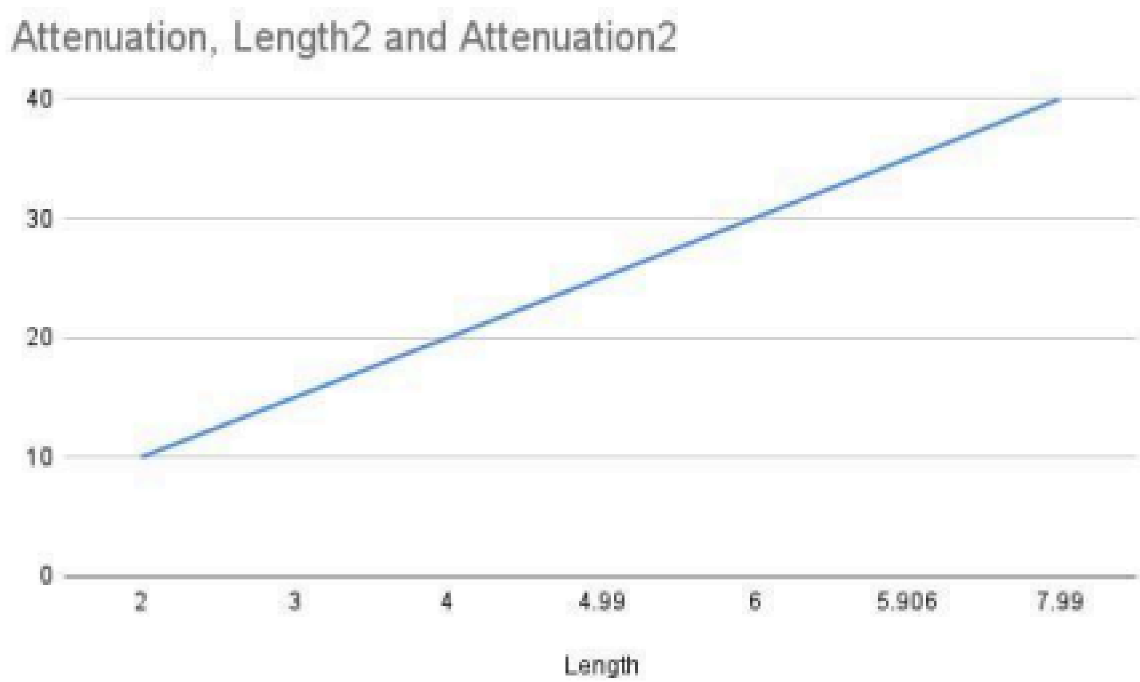


Figure: Attenuation in dB vs Length in km for the same input power

Discussion: In our lab experiment on optical fiber attenuation, we examined how the intensity of light decreases as it travels through a fiber optic cable over a certain distance. This reduction, known as attenuation, is influenced by factors like absorption, scattering, and losses due to bending in the fiber.

We observed that the light intensity dropped exponentially as the distance increased. This reduction is caused by the absorption of light by the fiber material, scattering from impurities or imperfections, and bending of the fiber.

Understanding these causes of attenuation is crucial for designing and optimizing fiber optic communication networks. By minimizing signal loss and maximizing transmission efficiency, we can significantly improve the performance of these systems.