OPTICAL FIBER COMMUNICATIONS LAB-1

NAME- Rahil Alawat

REGISTRATION NUMBER- 21BEC2427

COURSE CODE-BECE308P

FACULTY – TANGUDU RAMJI

DATE OF SUBMISSION- 2/8/2024

Experiment - 1

Aim → Design a optical transmission link to analyze the BER performance for different line coding techniques, modulation based on wavelength and length of the fibre

Apparatus → For conducting this experiment we require simply the Optisystem software and analyze the output graph obtained

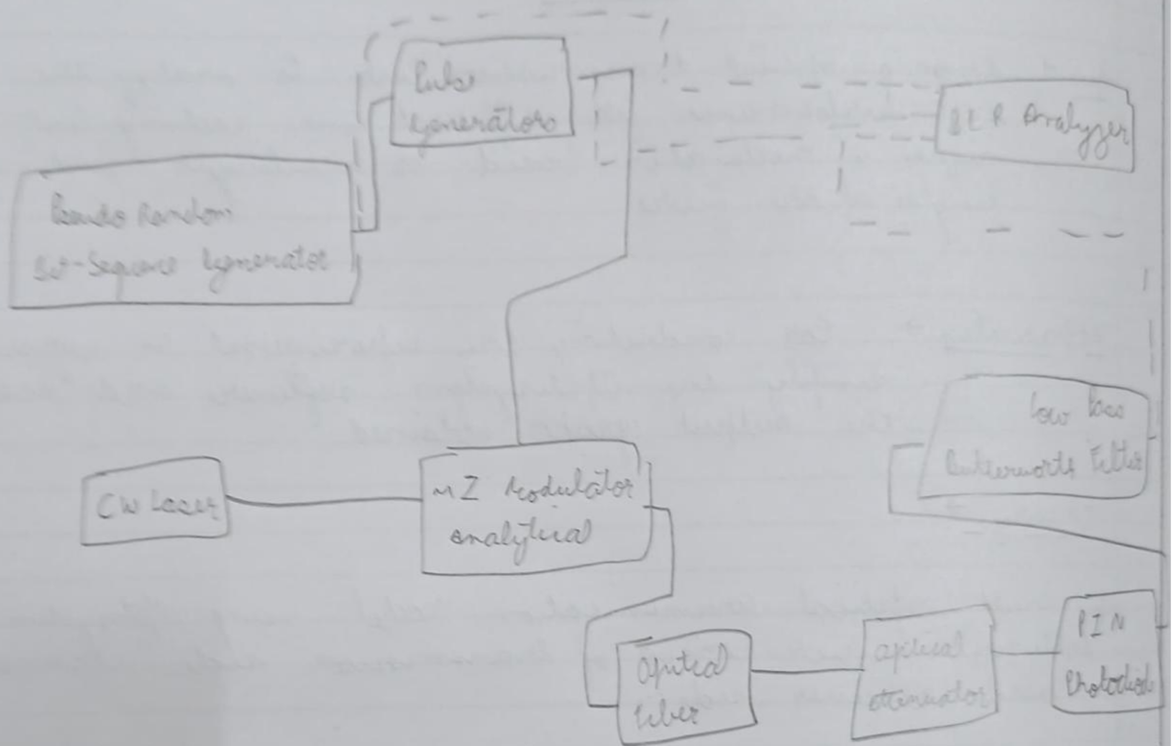
Theory →

We built optical communication model using Optisystem software which consist of transmission side, channel and reciever side.

Then we change the pulse generator to various other types in order to obtain the changes and to see the changes in corresponding BER for different signals

Finally we click on the BER analyser and obtain the eye diagrams for various pulse generators, which include NRZ, RZ, Gaussian, Sine pulse, DPSK, QAM, Raised cosine, Triangular pulse, saw up and saw down pulse generators respectively

Block-Diagram →



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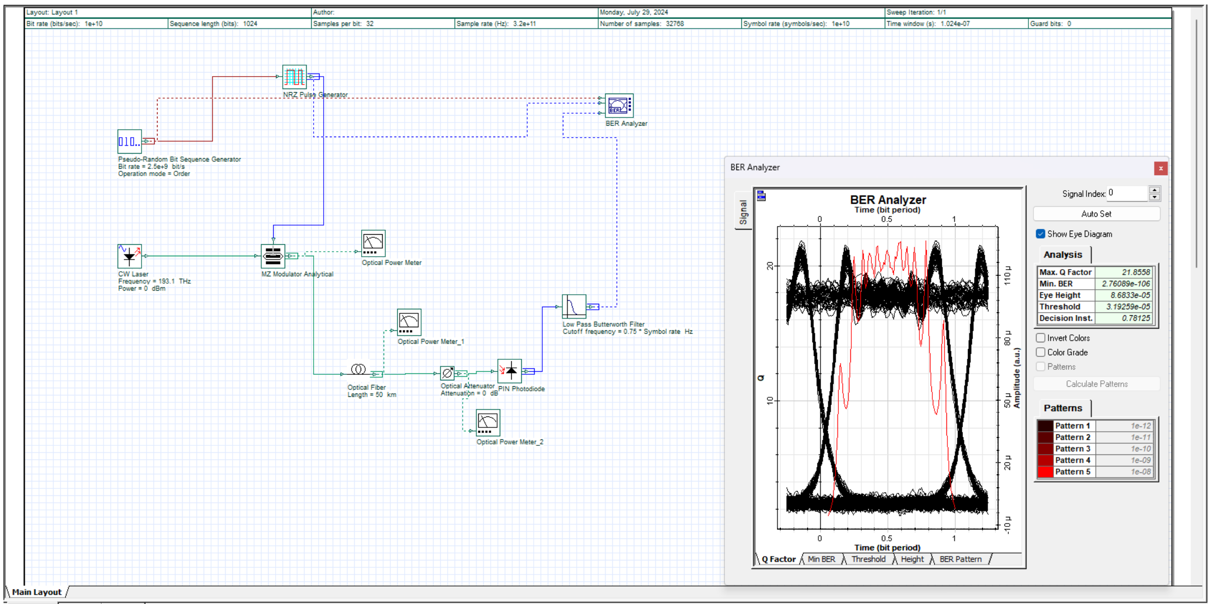
Result → As a result we obtain the eye diagram for various pulse generators giving the bit error rate vs time graph and we observe the changes for different Generators.

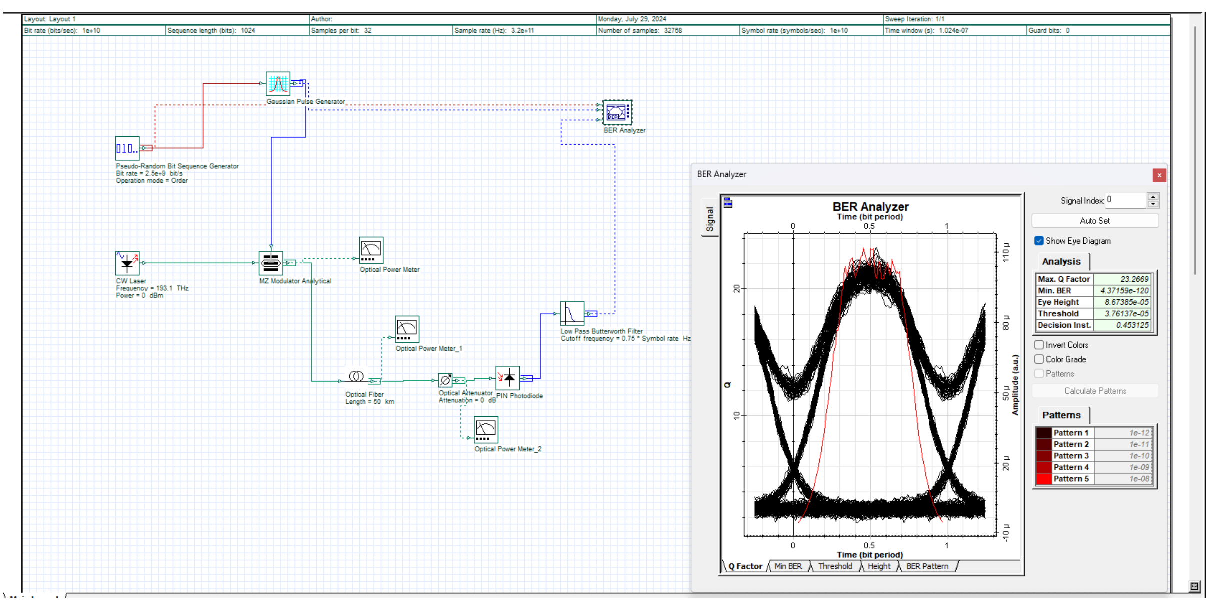
Conclusion → On analysis we found that BER (bit Error Rate) can be minimized (even to 0) by adjusting the value of given time period in a bit sequence generator which comes approximately (10) in case of NRZ, RZ & Gaussian signals & quite high in case of QPSK, QAM & PSK signals.

Teacher's Signature

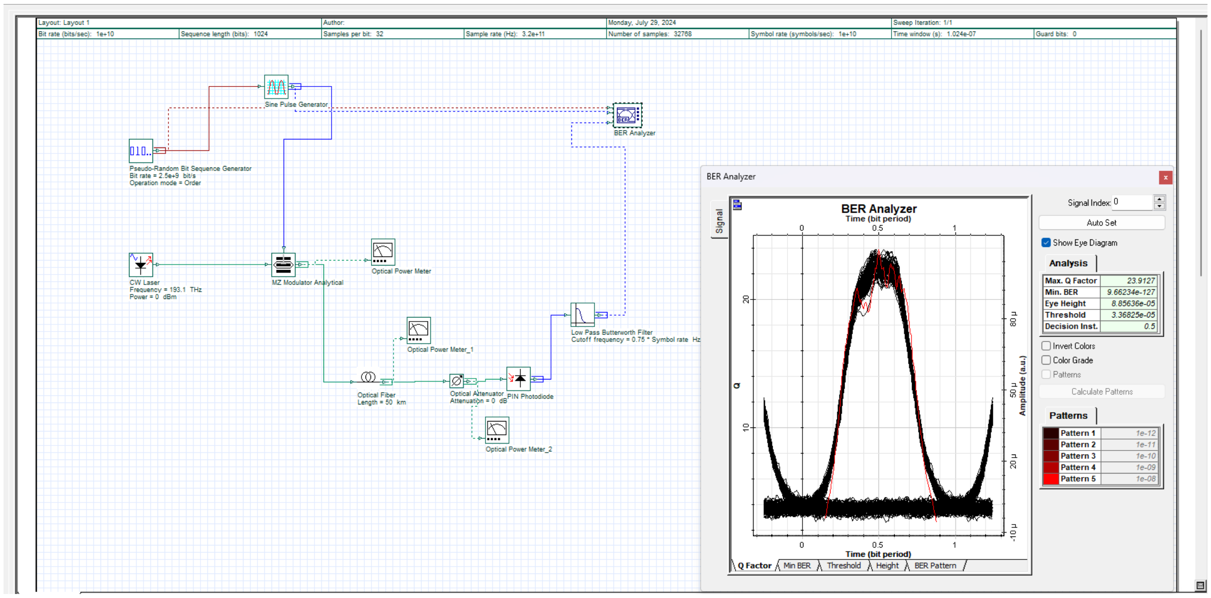
NRZ



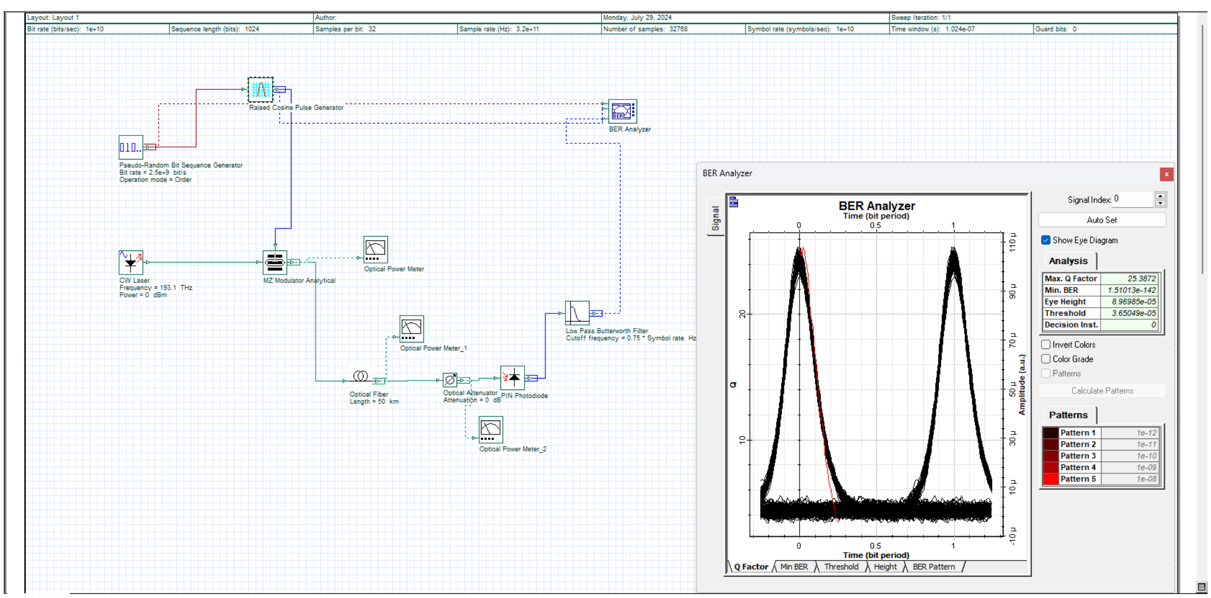
Gaussian



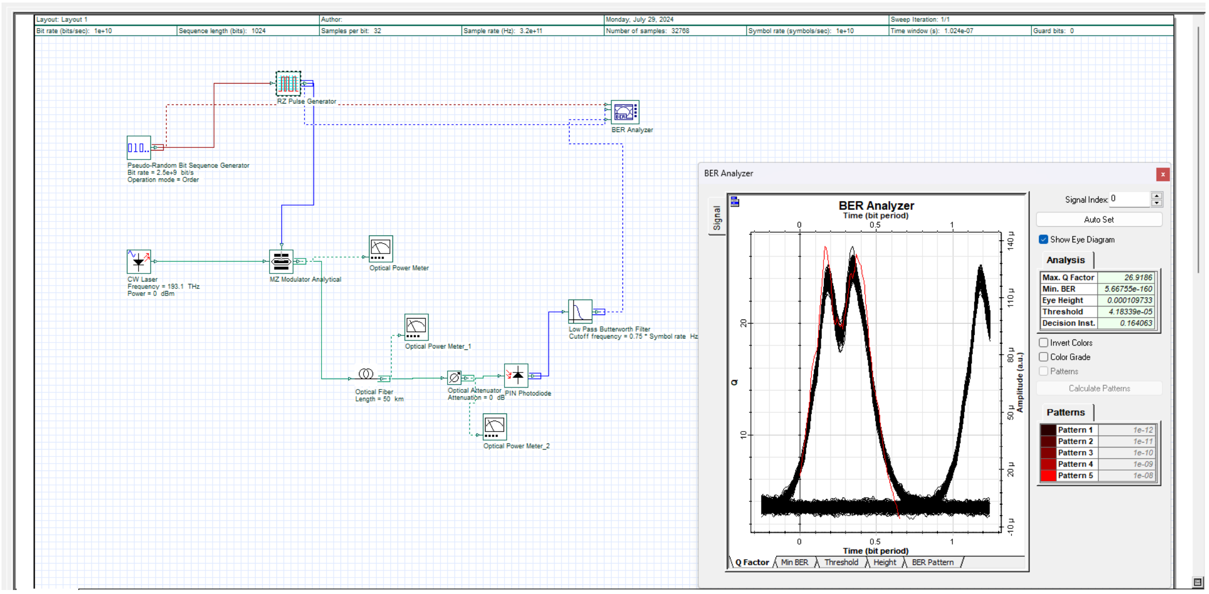
Sine Pulse



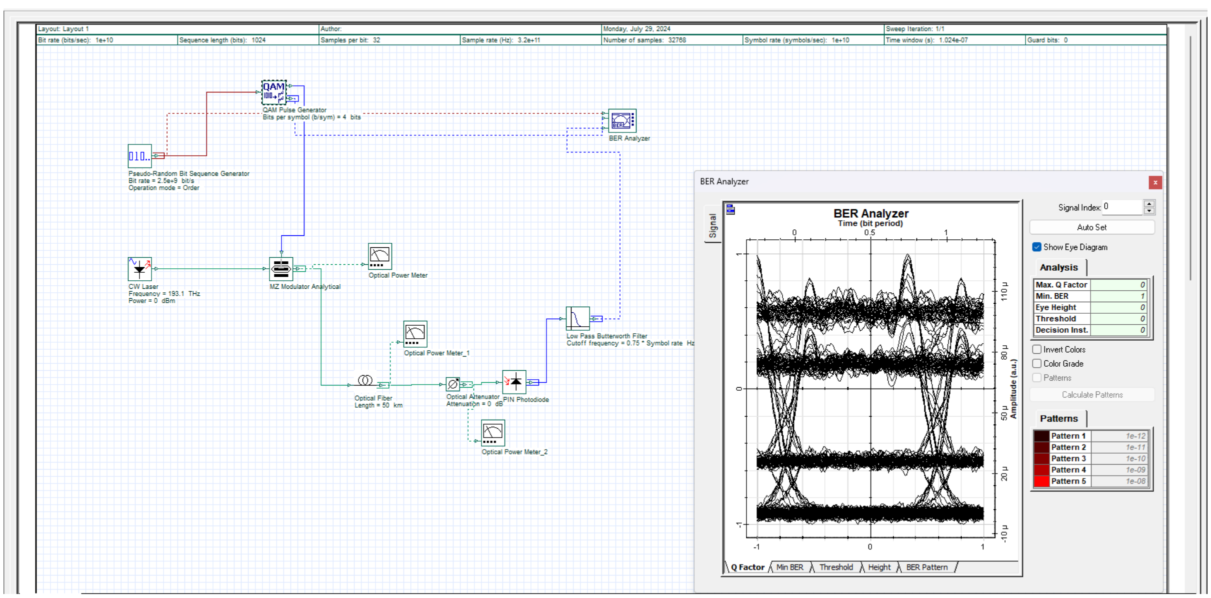
Raised Cosine Pulse



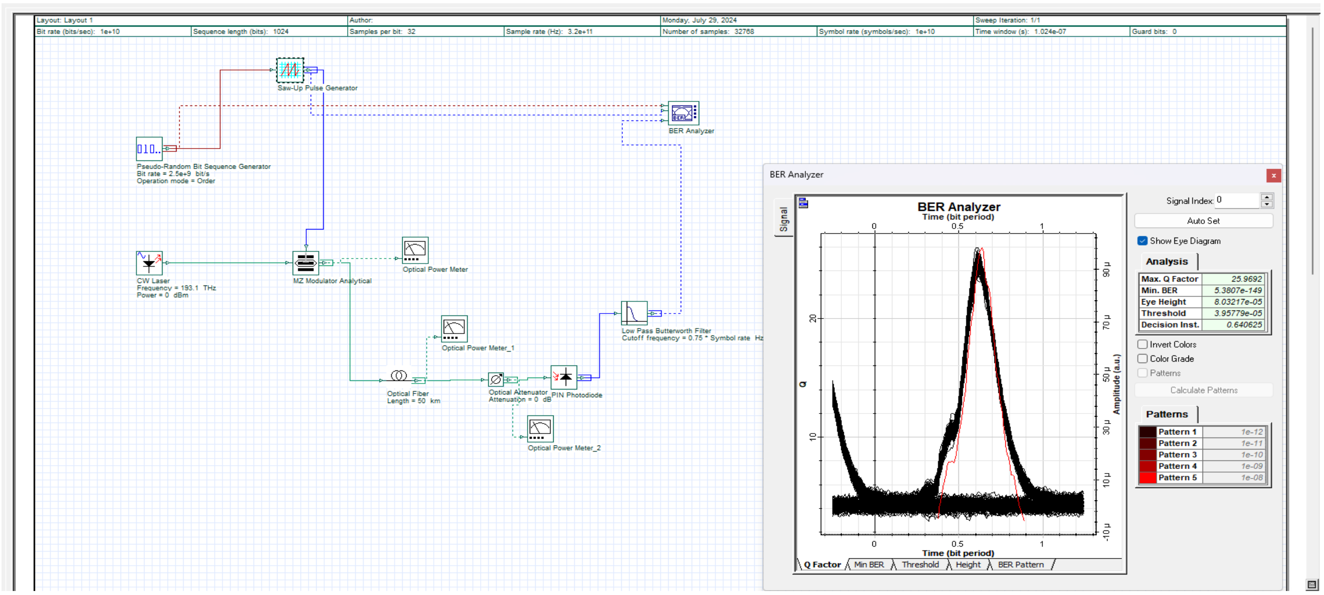
RZ



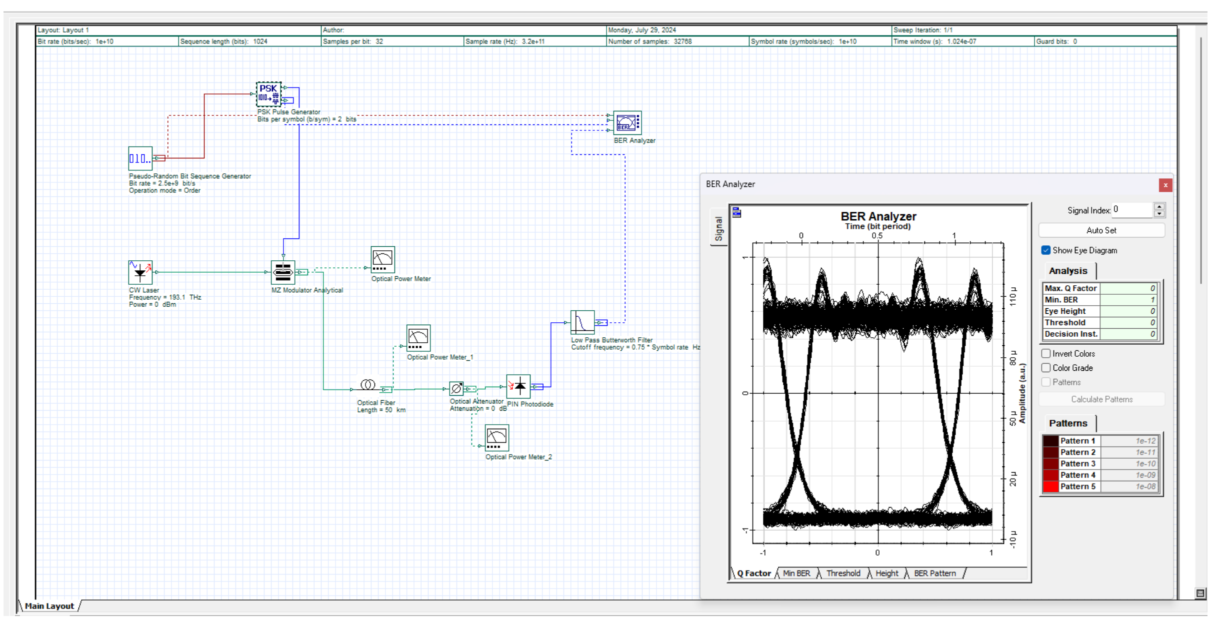
QAM



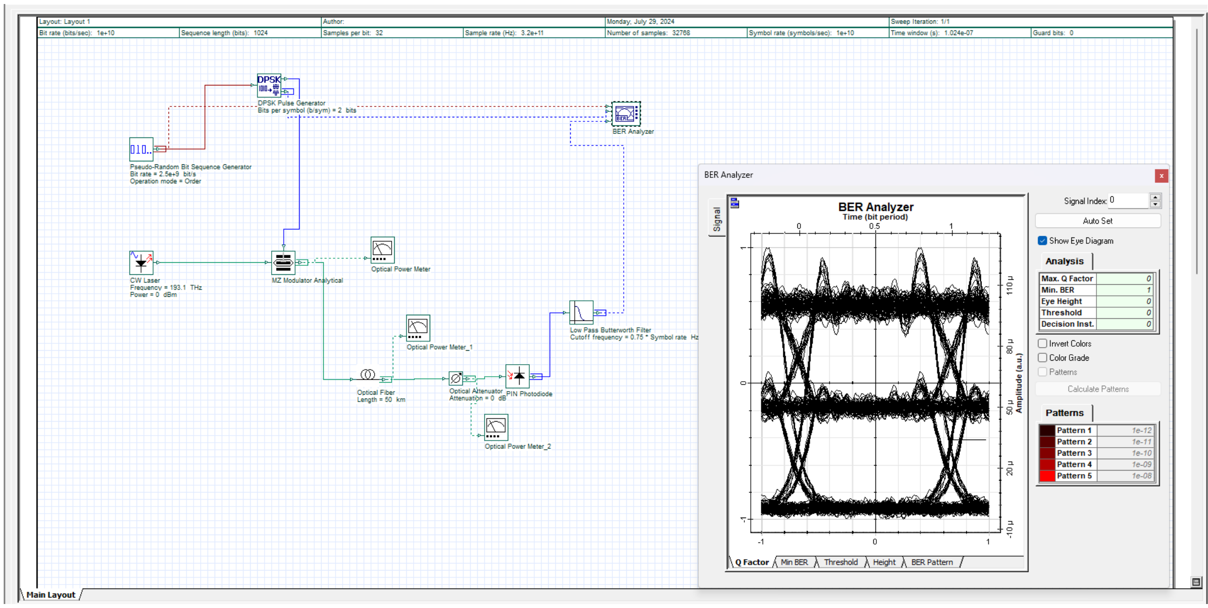
Saw up



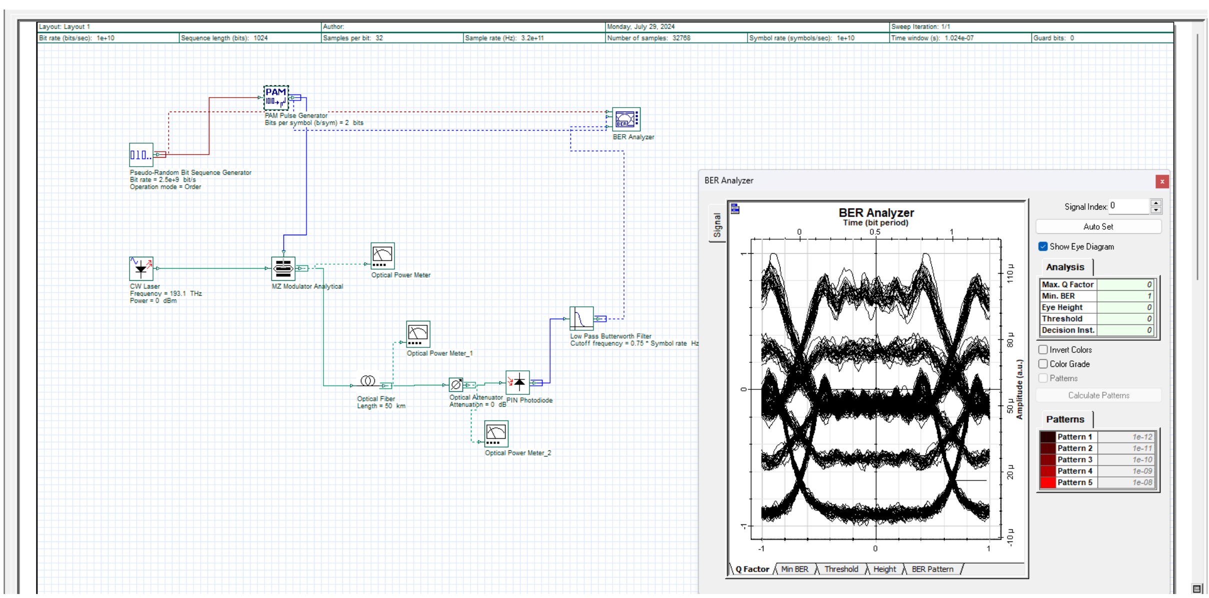
PSK



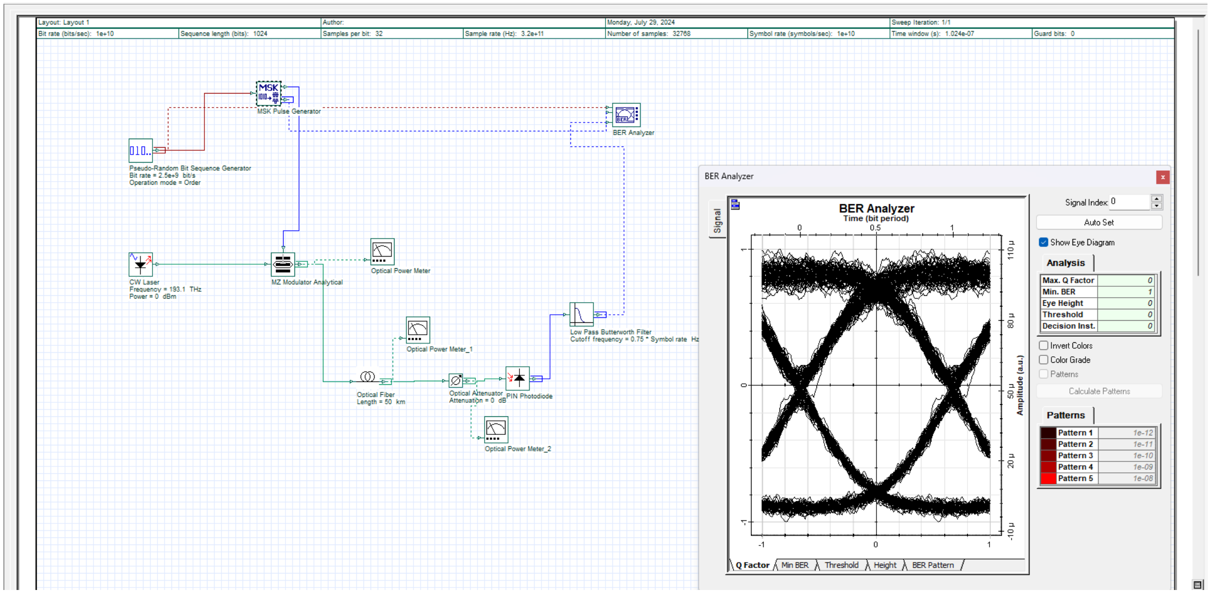
DPSK


BER Analyzer
Time (bit period)
Amplitude (a.u.)
DPSK Pulse Generator
Pseudo-Random Bit Sequence Generator
CW Laser
MZ Modulator Analytical
Optical Power Meter
Optical Fiber
Optical Attenuator
PIN Photodiode
Low Pass Butterworth Filter
Main Layout

PAM


BER Analyzer
Time (bit period)
Amplitude (a.u.)
PAM Pulse Generator
Pseudo-Random Bit Sequence Generator
CW Laser
MZ Modulator Analytical
Optical Power Meter
Optical Fiber
Optical Attenuator
PIN Photodiode
Low Pass Butterworth Filter

MSK



MSK Pulse Generator
BER Analyzer
Pseudo-Random Bit Sequence Generator
CW Laser
MZ Modulator Analytical
Optical Power Meter
Optical Power Meter_1
Optical Power Meter_2
Optical Fiber
Optical Attenuator
PIN Photodiode
Low Pass Butterworth Filter
BER Analyzer
Time (bit period)
Amplitude (a.u.)
Signal Index
Auto Set
Show Eye Diagram
Analysis
Max. Q Factor
Min. BER
Eye Height
Threshold
Decision Inst.
Invert Colors
Color Grade
Patterns
Calculate Patterns
Pattern 1
Pattern 2
Pattern 3
Pattern 4
Pattern 5
Q Factor
Min BER
Threshold
Height
BER Pattern

OPTICAL FIBER COMMUNICATIONS LAB-2

NAME- Rahil Alawat

REGISTRATION NUMBER-21BEC2427

COURSE CODE-BECE308P

FACULTY – TANGUDU RAMJI

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Experiment → 2

Aim →

The objective of this experiment is to investigate the impact of different wavelengths and fiber lengths on the performance of an optical transmission system. The primary focus is on evaluating the BER (Bit Error Rate) and signal quality for various wavelength and fibre lengths and analyzing how these parameter ~~the~~ influence the system overall performance.

Theory →

In optical communication, the choice of wavelength and fiber length are crucial parameters that affect the signal transmission. wavelength affects the attenuation dispersion and overall signal quality while fibre length determines the total loss and potential for signal degradation due to dispersion.

Wavelength:

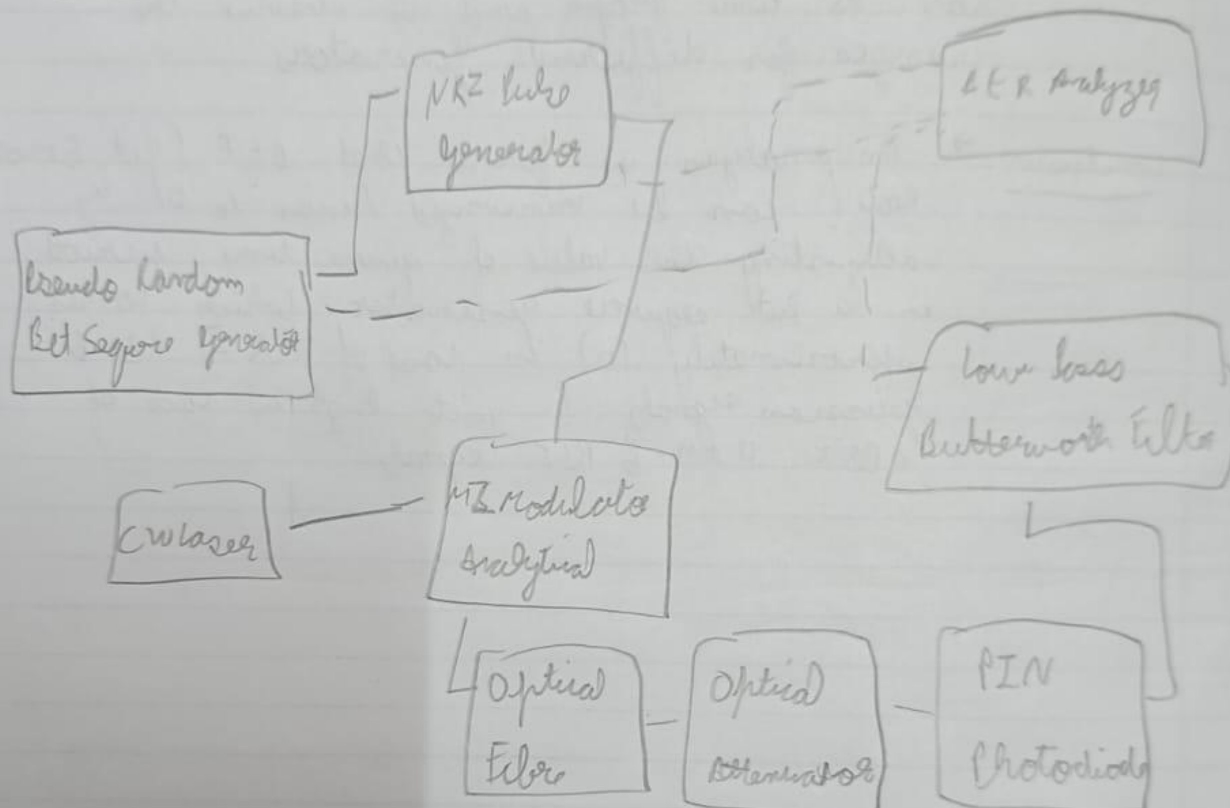
→ Attenuation: Different wavelengths experience different levels of attenuation in optical fibre. The lowest attenuation is of 1550 nm with 0.2 dB/km attenuation and lastly the 850 nm has the highest attenuation of 2.5 dB/km.

- Dispersion: Chromatic dispersion values varies with wavelength at 1310 nm it is near zero & it increases at 1550 nm.

Teacher's Signature

Block Diagram →

Indirect →



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Non-linear effect → Higher wavelengths can lead to non-linear affects such as four wave mixing (FWM) and others.

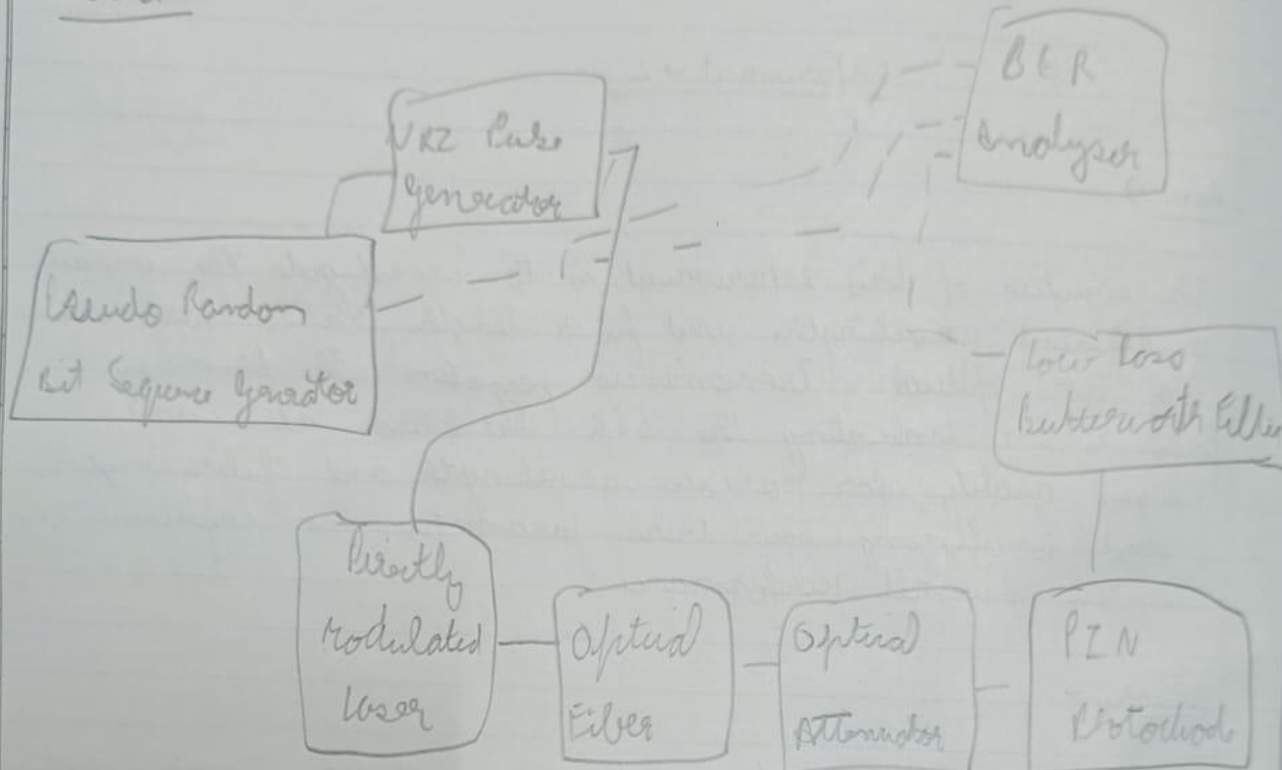
- Fibre length
  - Signal loss: the longer the fiber, the more attenuation and potential loss of signal strength. This necessitates the use of amplifiers or repeaters for long-distance communication.
  - Dispersion: Over long distance, dispersion causes pulse broadening, leading to Inter-symbol (ISI) and increased BER.
  - Non Linear Effects: longer fibres may also increase the impact of non linear effects further degrading the signal quality.

Procedure →

- We will construct the circuit diagram as shown in the block diagram.
- In layout we will make sweep iterations to be 10.
- Then in optical fiber we until select the sweep option for the length from 10 to 100 for iteration.
- After ~~[illegible]~~ which we will keep the bit rate of the layout properties to 1 Mbps.
- Then finally we will run the system.
- In report option we will go to the BER results to get min BER and Optical fiber parameters to get the length and then make graph for each case.

Teacher's Signature ________

Direct →


NRZ Pulse Generator
Pseudo Random Bit Sequence Generator
BER Analyser
Low Loss Butterworth Filter
Directly modulated laser
Optical Fiber
Optical Attenuator
PIN Photodiode

Date

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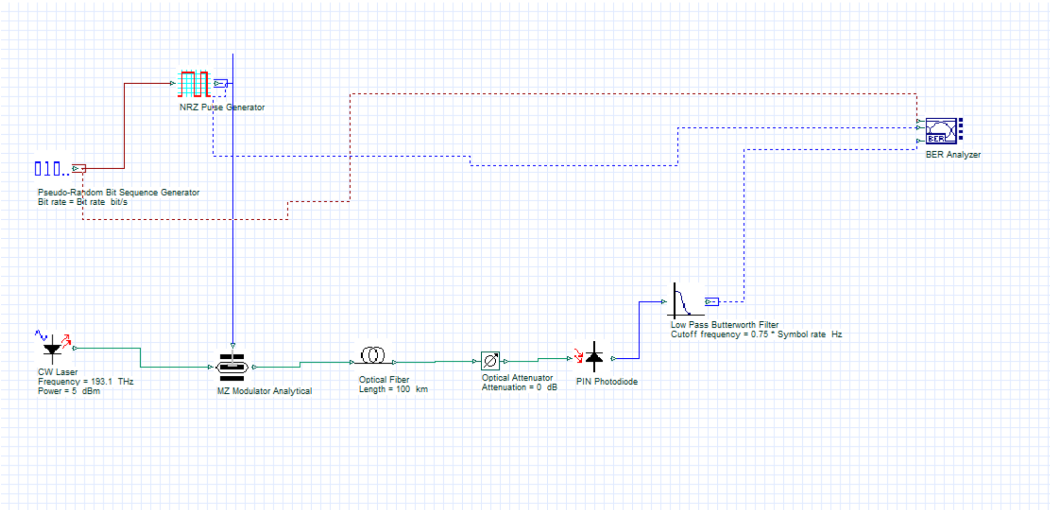
Results & Conclusion →

The result graphs are displayed

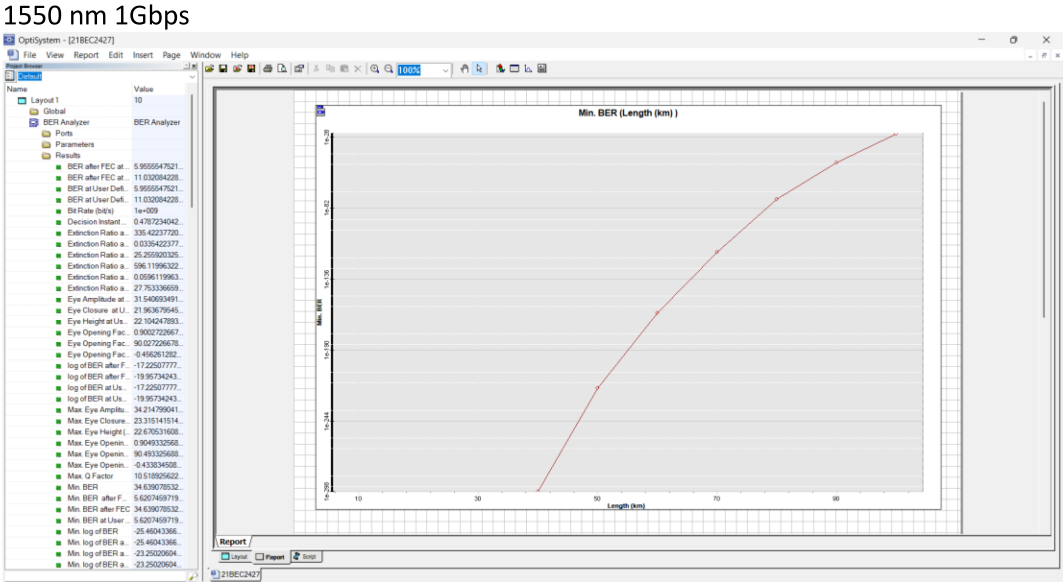
This experiment provides insights as to how the wavelengths & fiber length interact to affect the performance of an optical transmission system. By understanding these relationships, it becomes possible to optimize optical networks for better performance, reducing BER & improving signal quality

Teacher's Signature

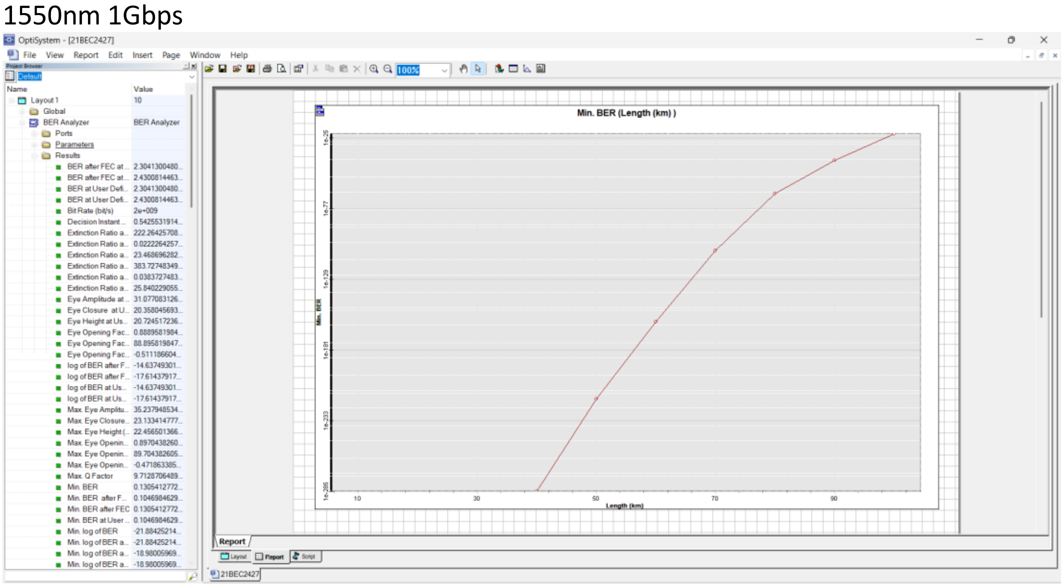
Indirect Modulation



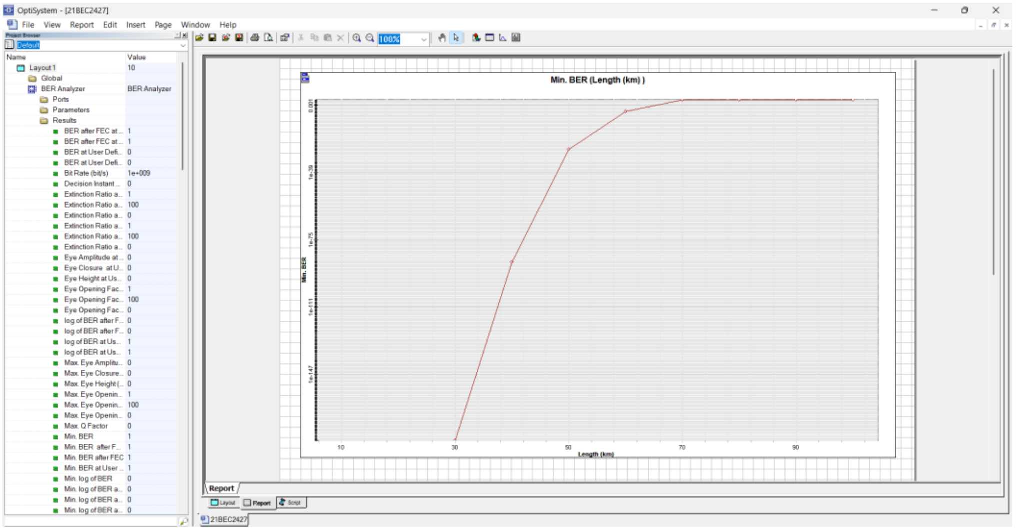
1550 nm 1Gbps



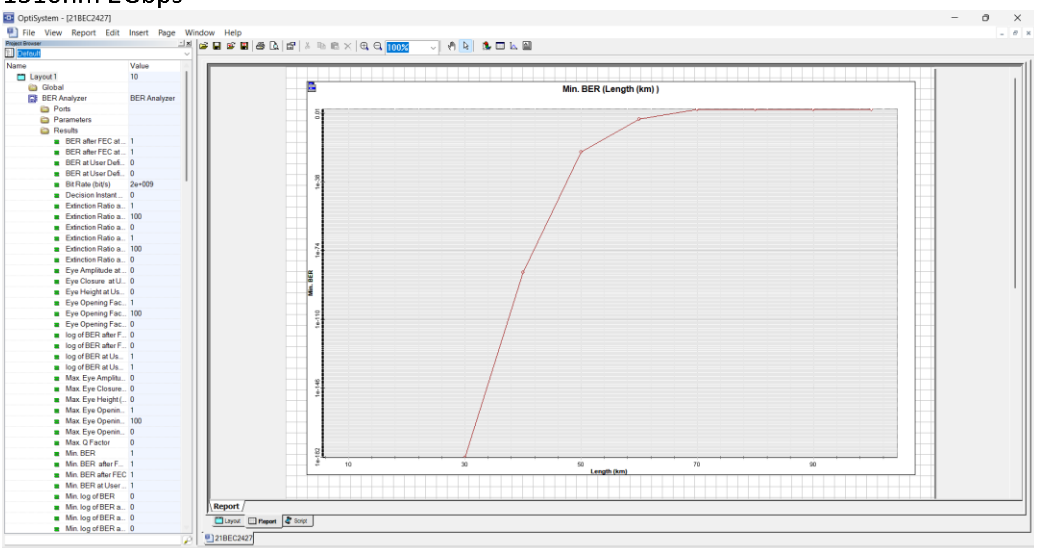
1550nm 1Gbps



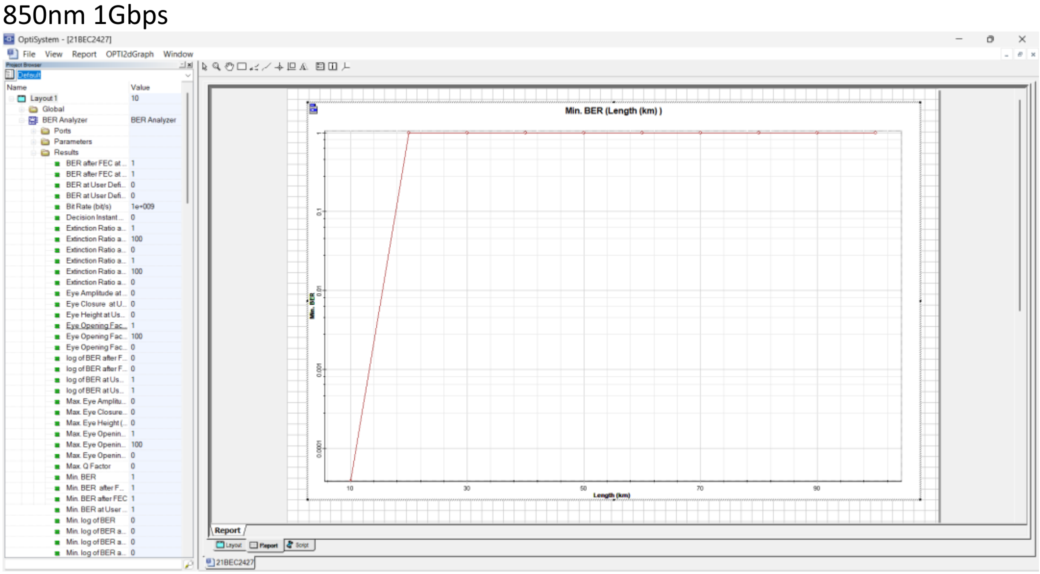
1310nm 1Gbps



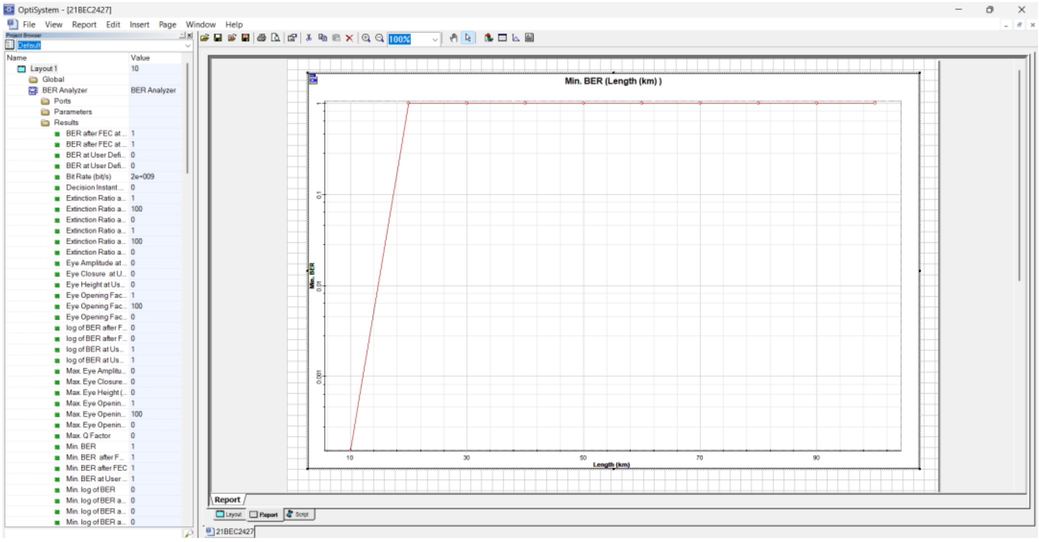
1310nm 2Gbps



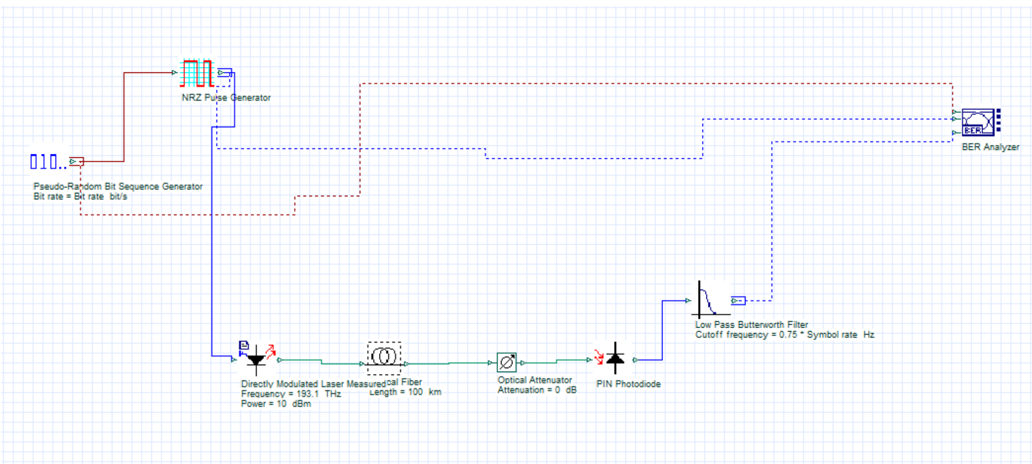
850nm 1Gbps



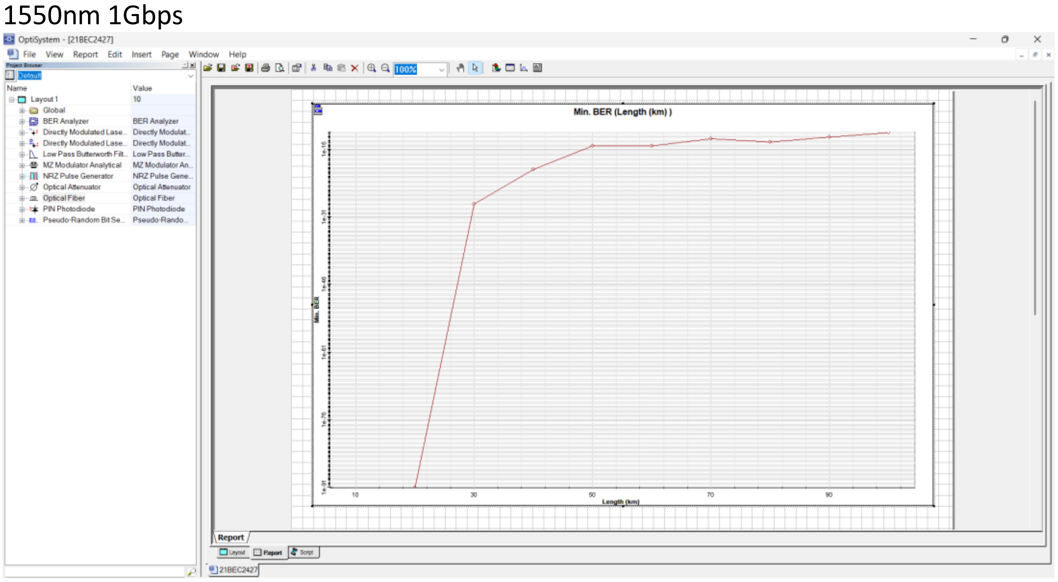
850nm 2Gbps



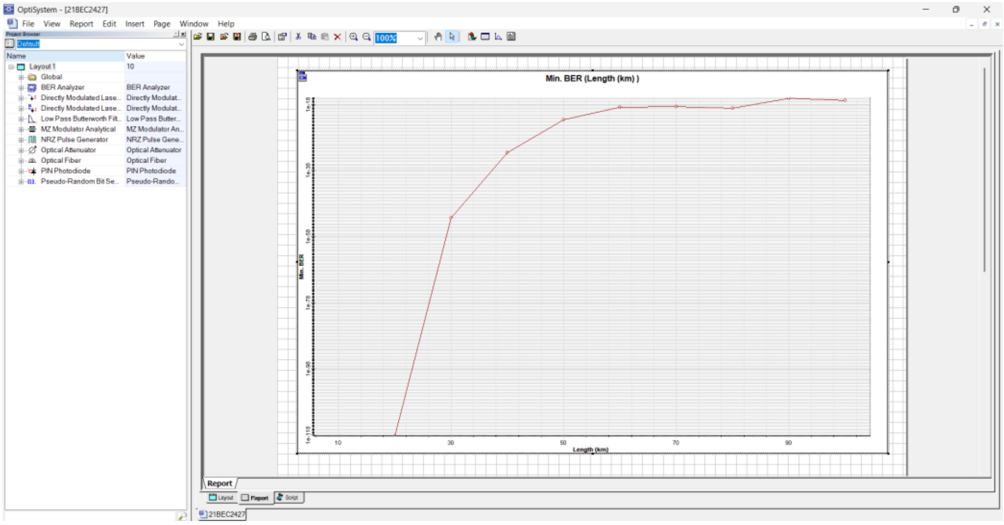
Direct Modulation



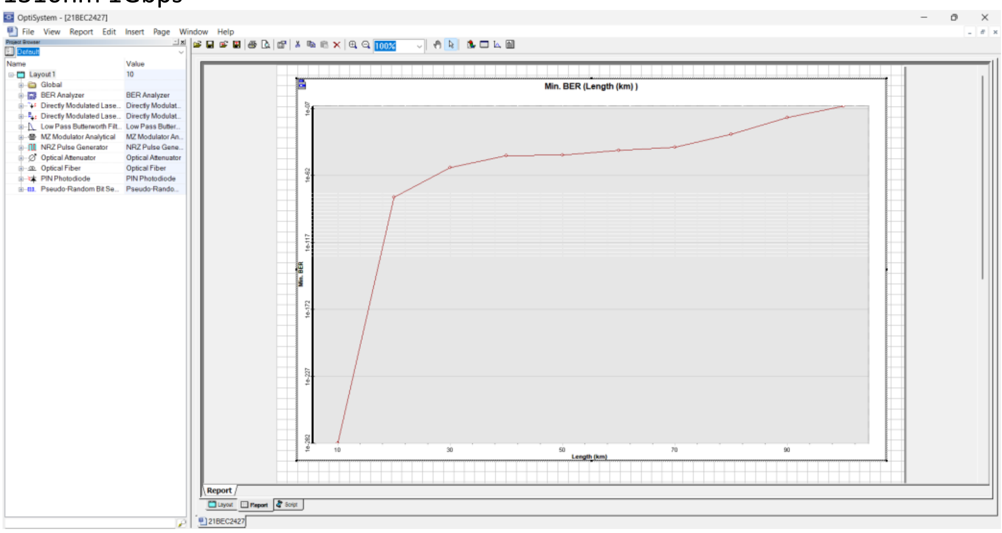
1550nm 1Gbps



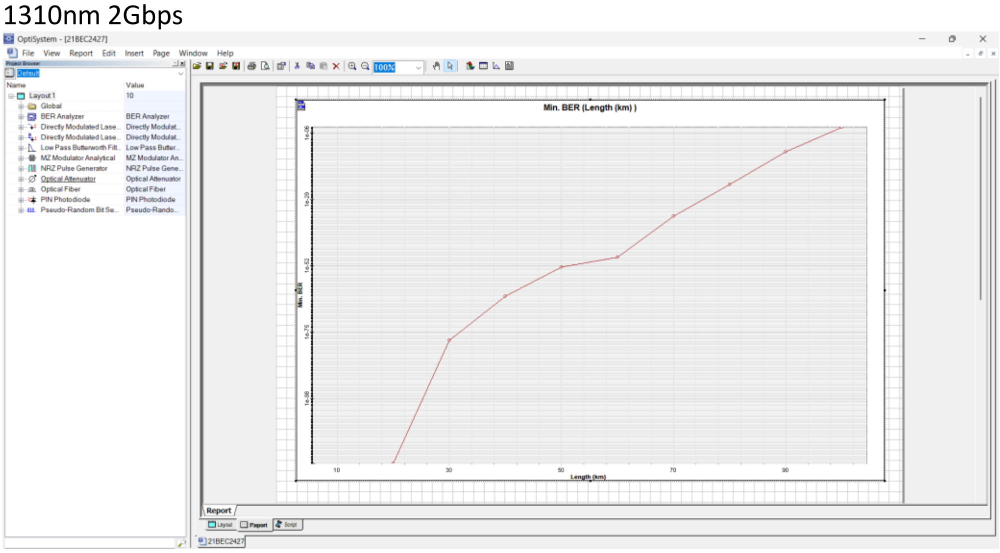
1550nm 2Gbps



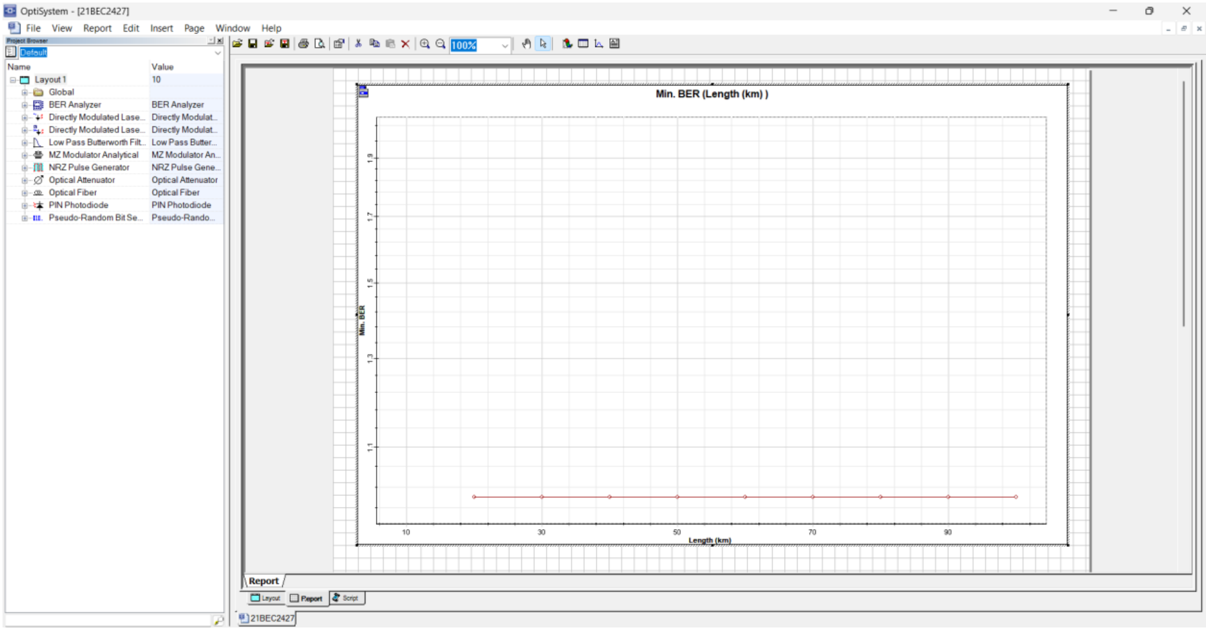
1310nm 1Gbps



1310nm 2Gbps

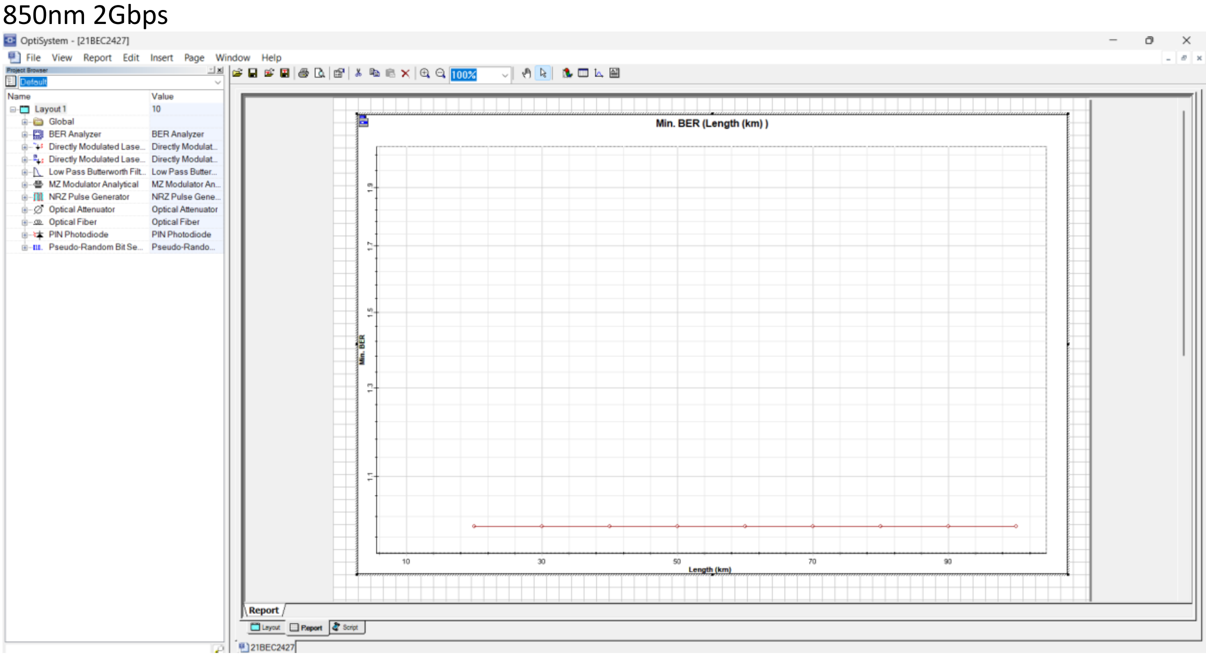


850nm 1Gbps



OptiSystem - [21BEC2427]
File View Report Edit Insert Page Window Help
Min. BER (Length (km))
Min. BER
Length (km)

850nm 2Gbps



OptiSystem - [21BEC2427]
File View Report Edit Insert Page Window Help
Min. BER (Length (km))
Min. BER
Length (km)

OPTICAL FIBER COMMUNICATIONS LAB-3

NAME- Rahil Alawat

REGISTRATION NUMBER-21BEC2427

COURSE CODE-BECE308P

FACULTY – TANGUDU RAMJI

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Date

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Experiment -3

Aim → The experiment is conducted to compare the gain of the different amplifiers which are Erbium doped Fiber Amplifier (EDFA) and SOA (Semiconductor Optical Amplifier)

Apparatus → Optisystem software 21.0.0

Theory →

EDFA

• gain: EDFA provides gain by using a doped fiber erbium ions, which are excited by a pump laser. When the signal passes through the doped fiber, it simulates the emission of photons leading to amplification.
• Noise Figure (NF): The noise figure of an EDA is primarily due to amplified spontaneous emission (ASE) noise, which occurs when erbium ions spontaneously decay & emit photons.
• saturation: At high input power levels, the gain of the EDFA starts to saturate, meaning the output power no longer increases linearly with input power.

SOA

gain: SOA provides gain through the simulated emission of photons in a semiconductor material. The gain is achieved by current into the active region of the SOA.

Teacher's Signature

Date

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Noise Figure (NF): the noise figure in SOA is influenced by ASE, similar to EDFA, but SOA's tend to have higher noise figures due to their design.
Saturation: SOA's saturate at lower power levels compared to EDFA's due to carrier depletion in the active region.

Procedure →

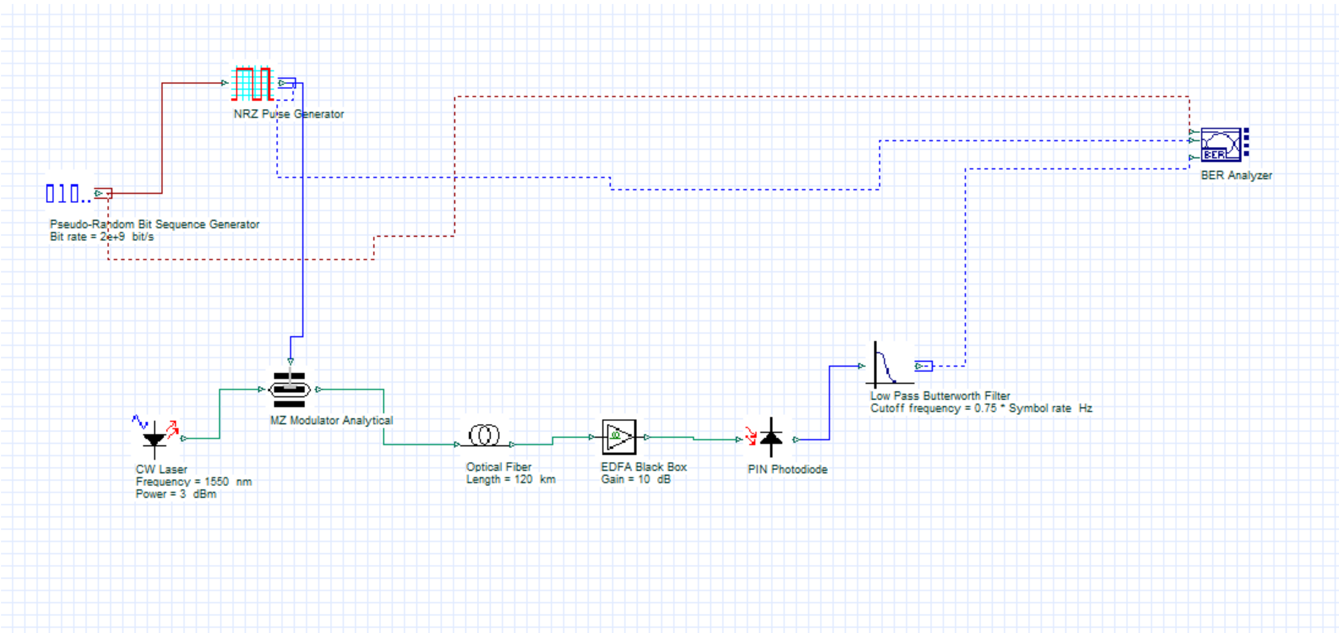
→ We will build the circuit as given in the figure and then we will execute the steps.
→ We will set the Total iteration to 7 (-3 to 3).
→ Power of the CW laser is in sweep.
→ -3 dB to 3 dB is the range.
→ We will then again create the plot of report
→ The plot has max-Q factor on y-axis
→ The power (in dB) in x-axis.

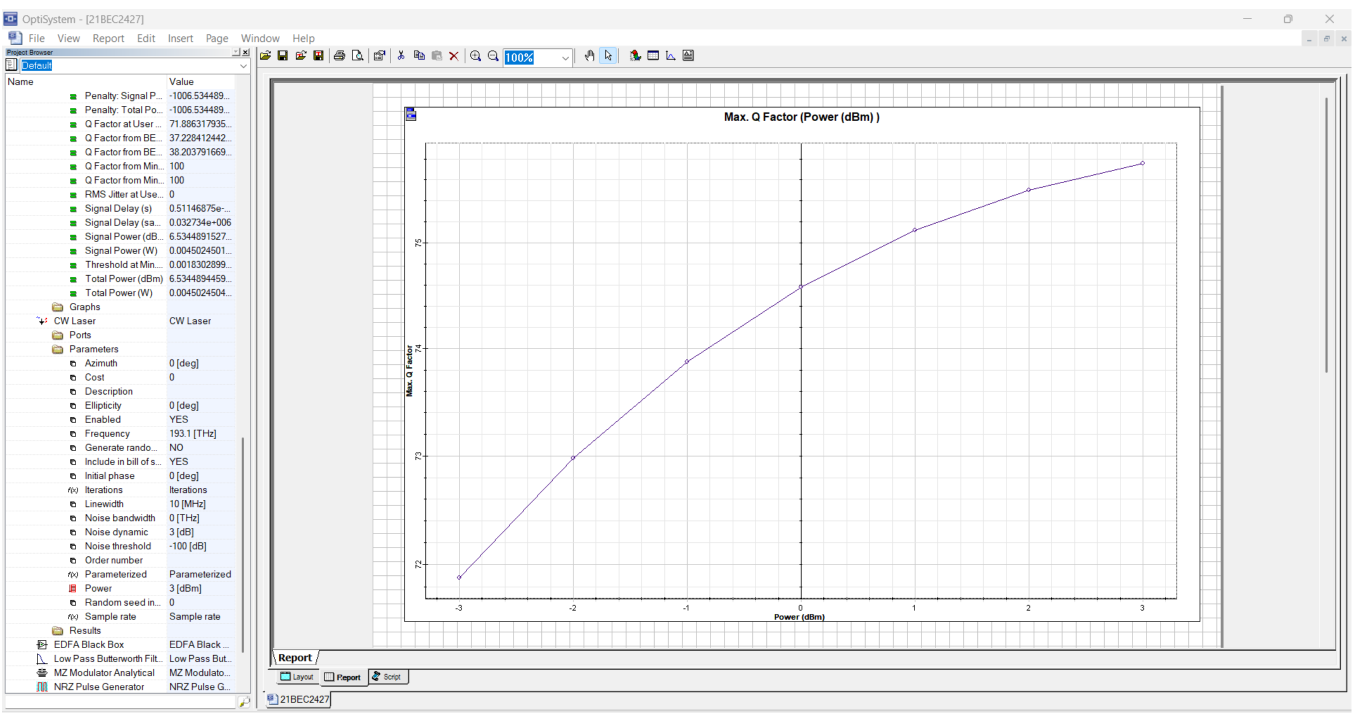
Results & Conclusion →

The observation we observed were that without any amplifier with just one value with the 3 dB at the power. The EDFA will have the best Q-factor among the two & SOA has lesser Q factor.

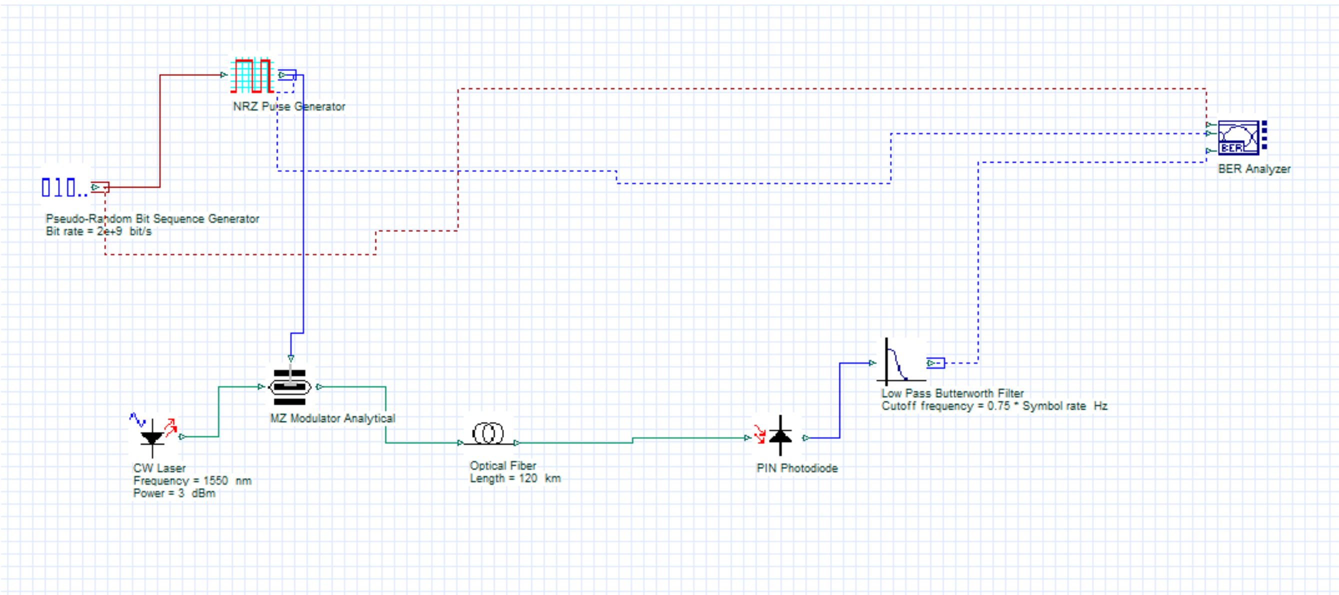
Teacher's Signature

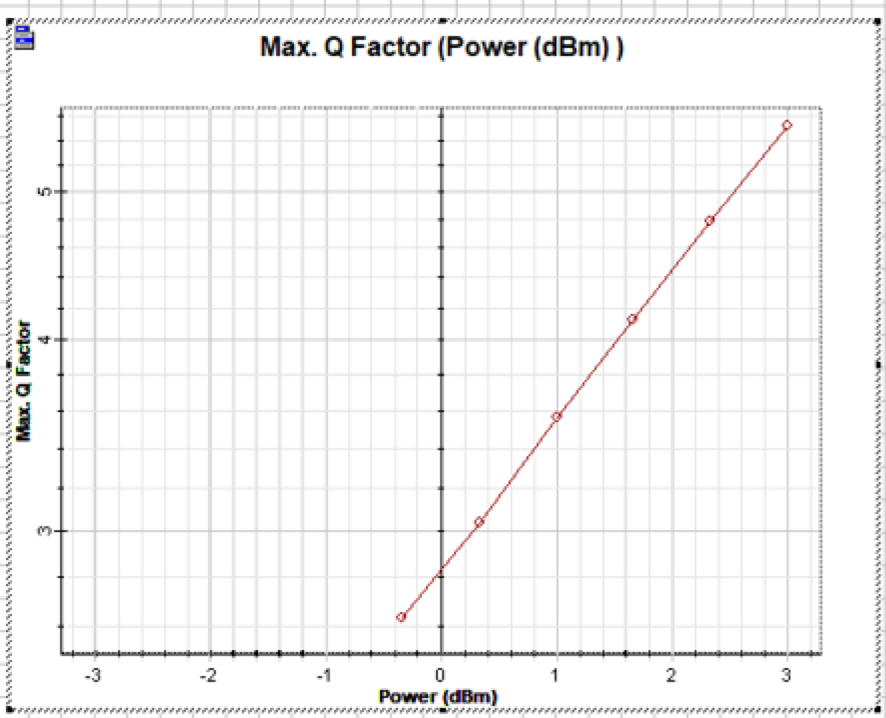
Post amplifier With EDFA



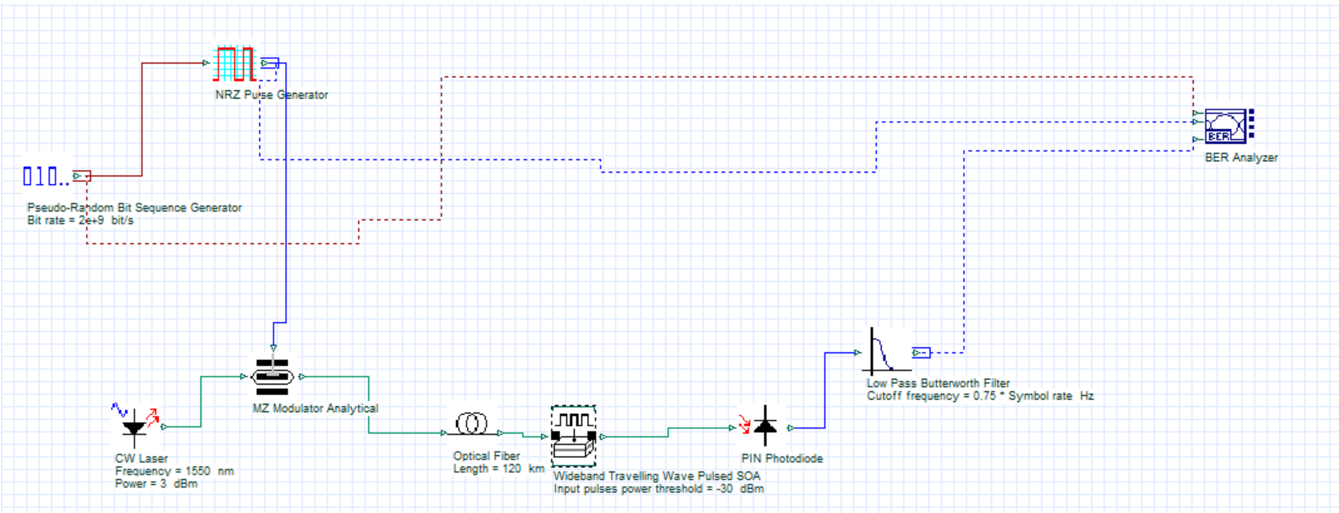


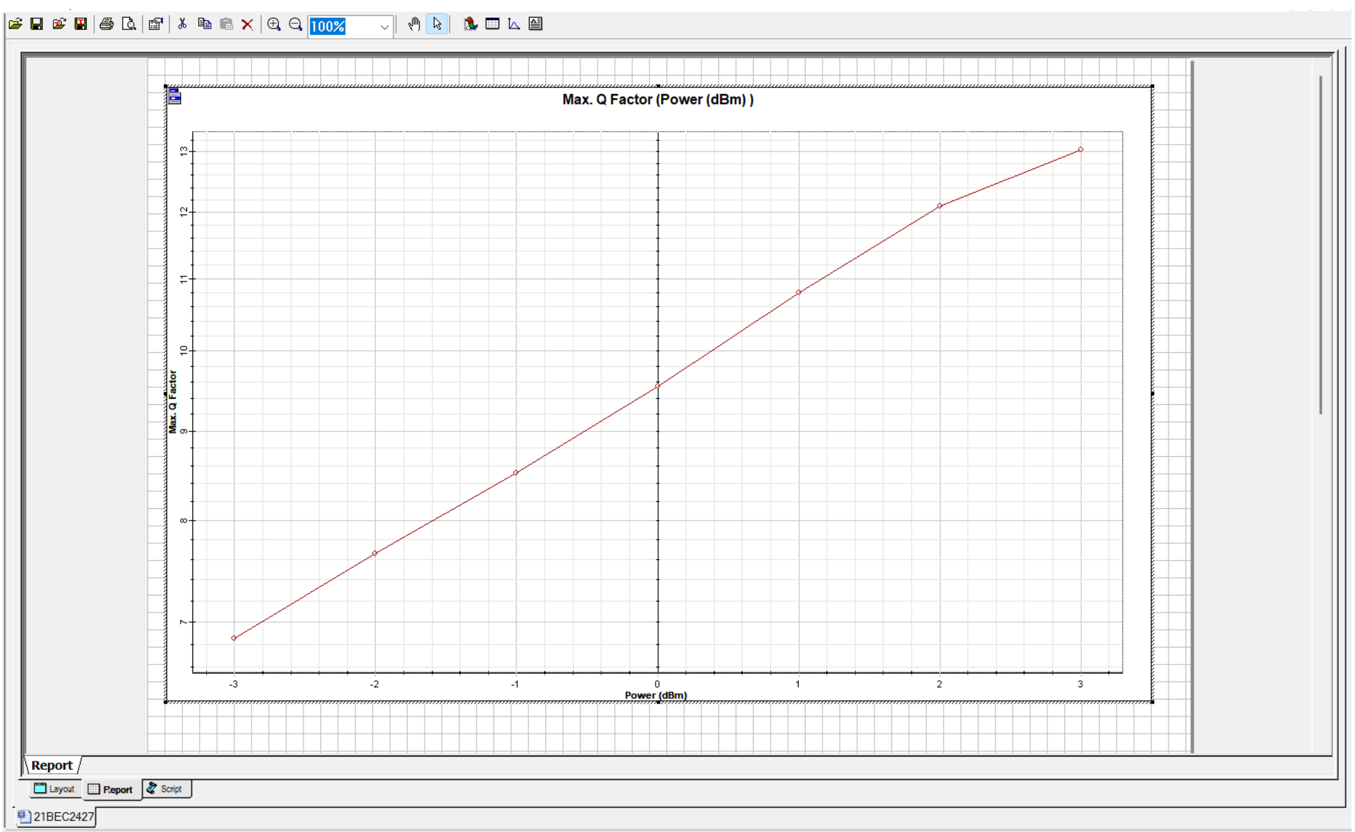
Post amplifier Without EDFA



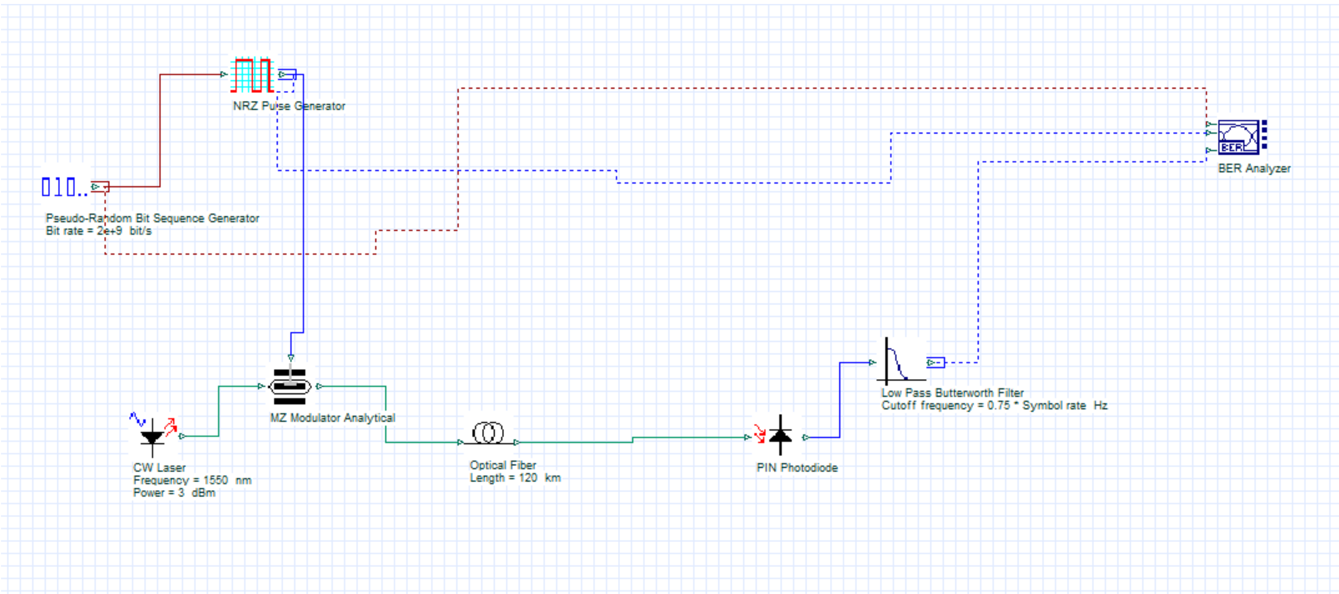


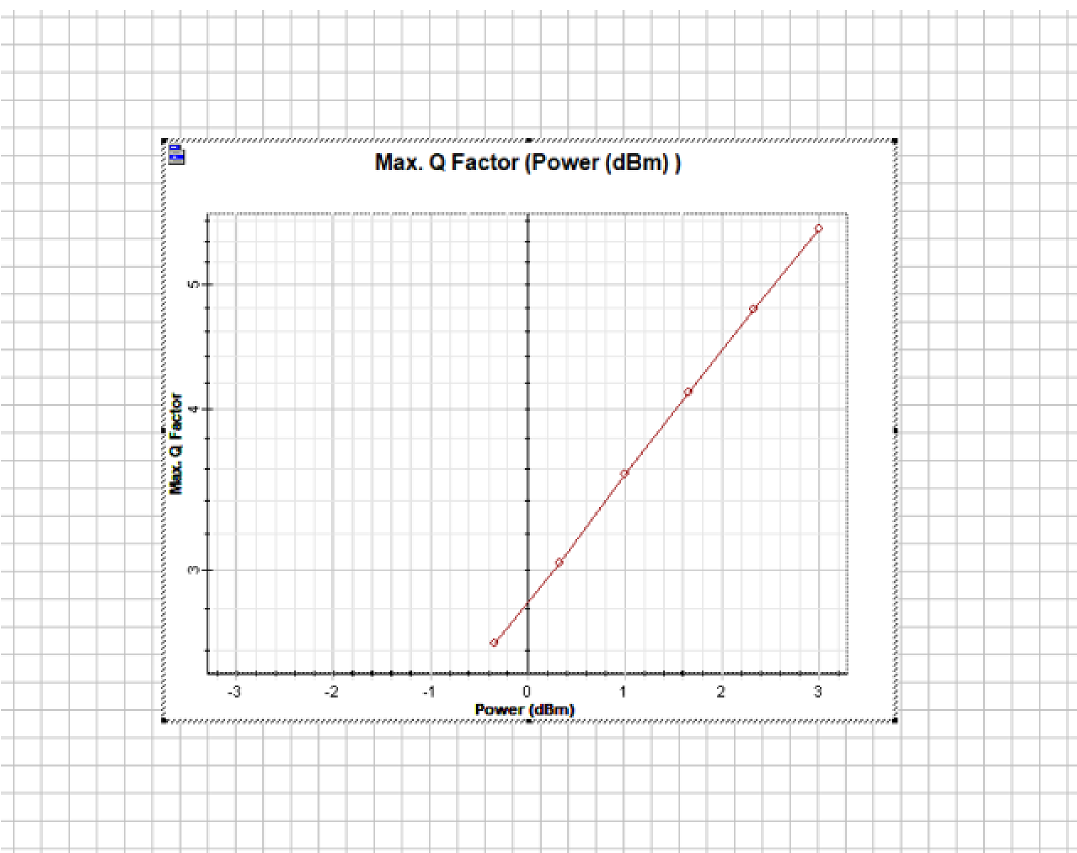
Post amplifier With SOA



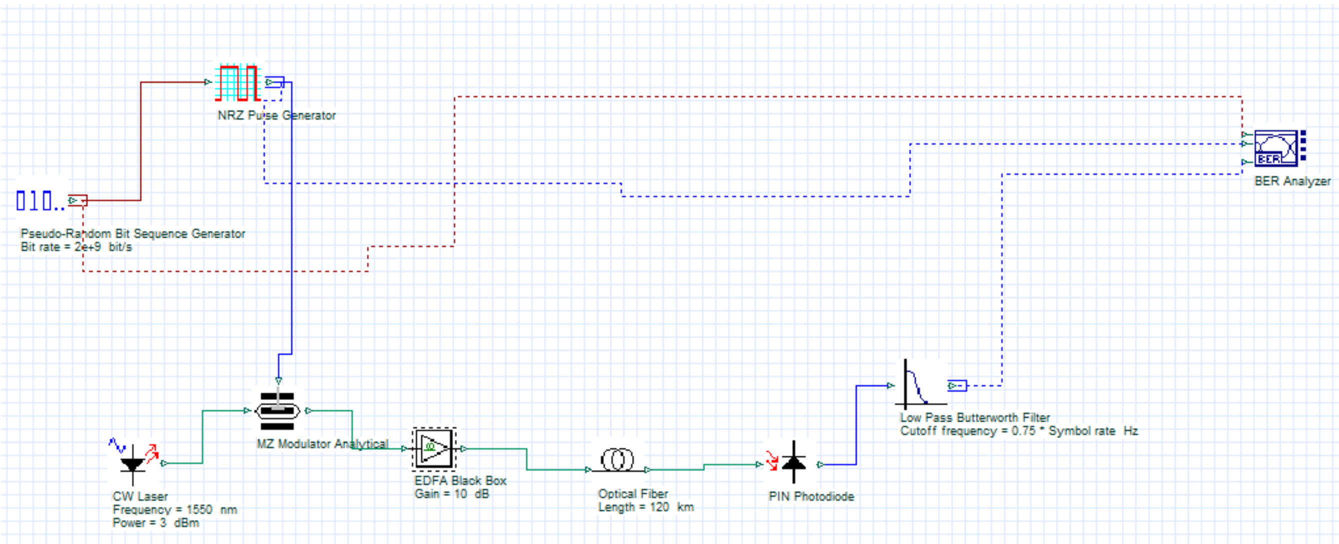


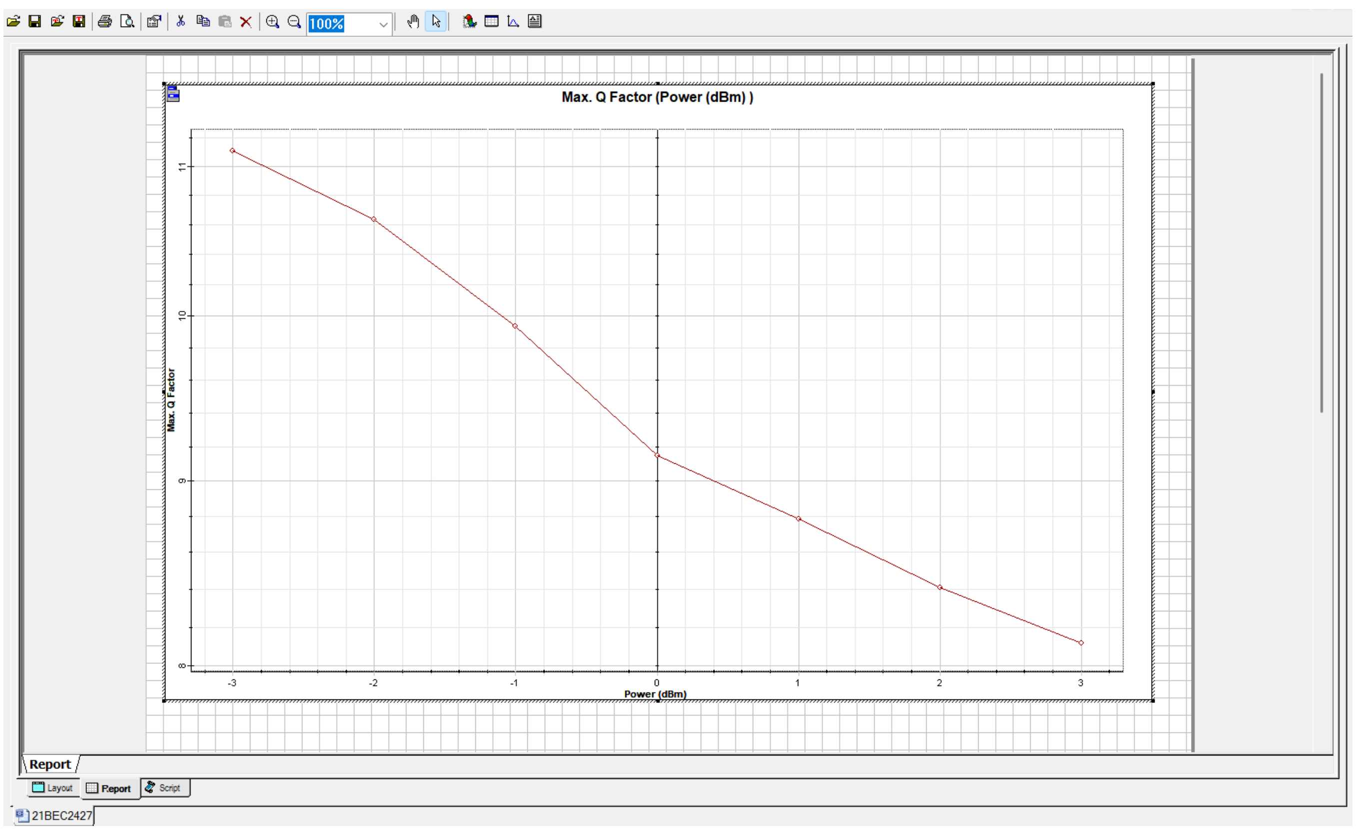
Post amplifier Without SOA



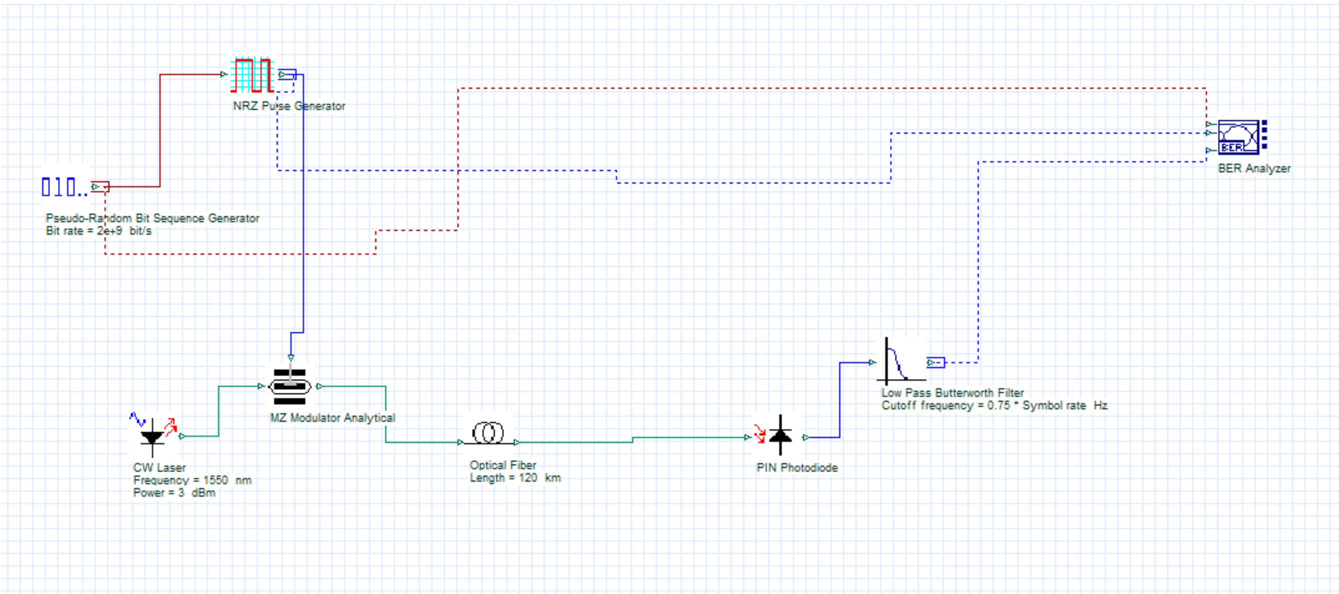


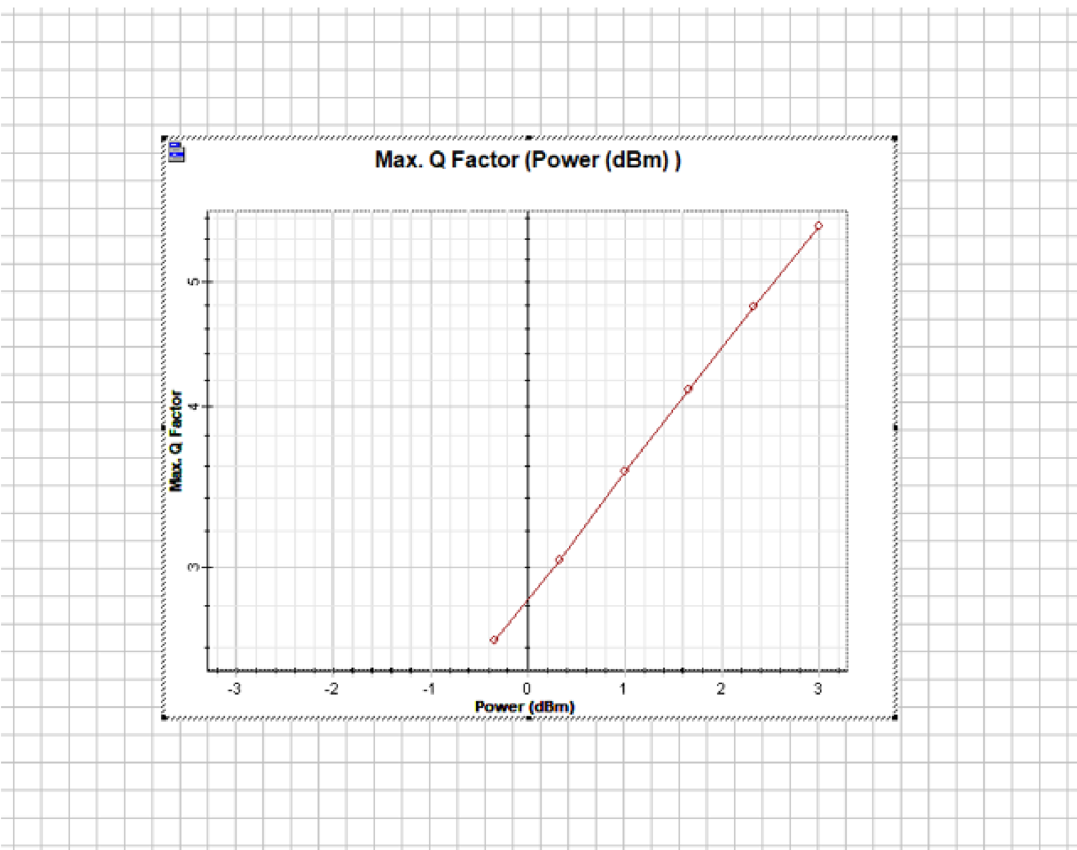
Pre amplifier With EDFA



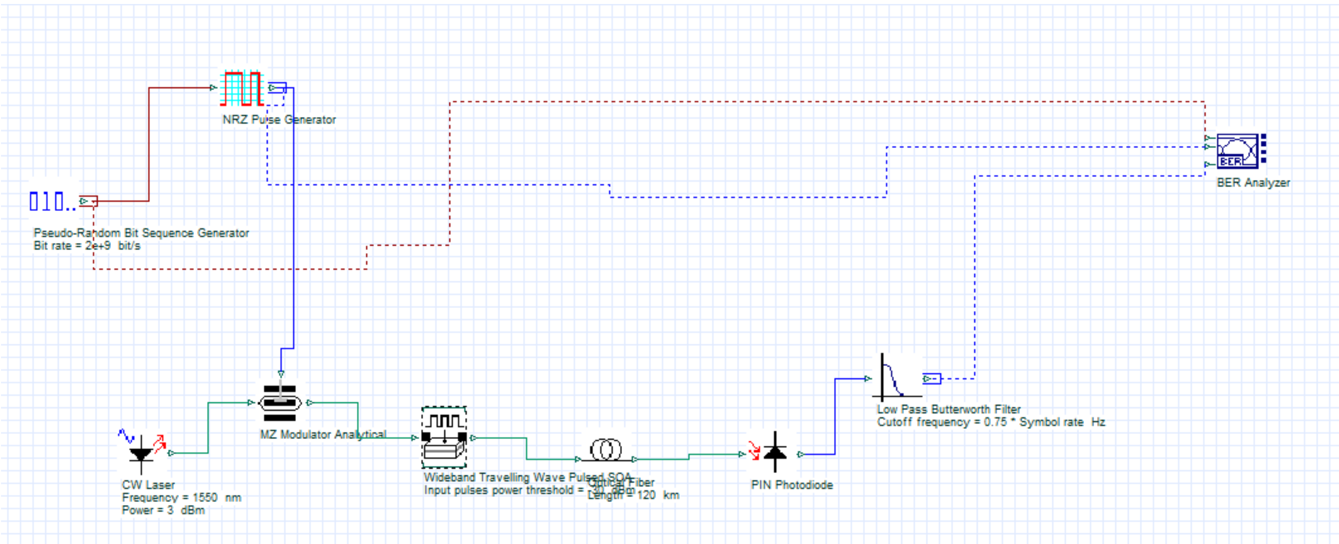


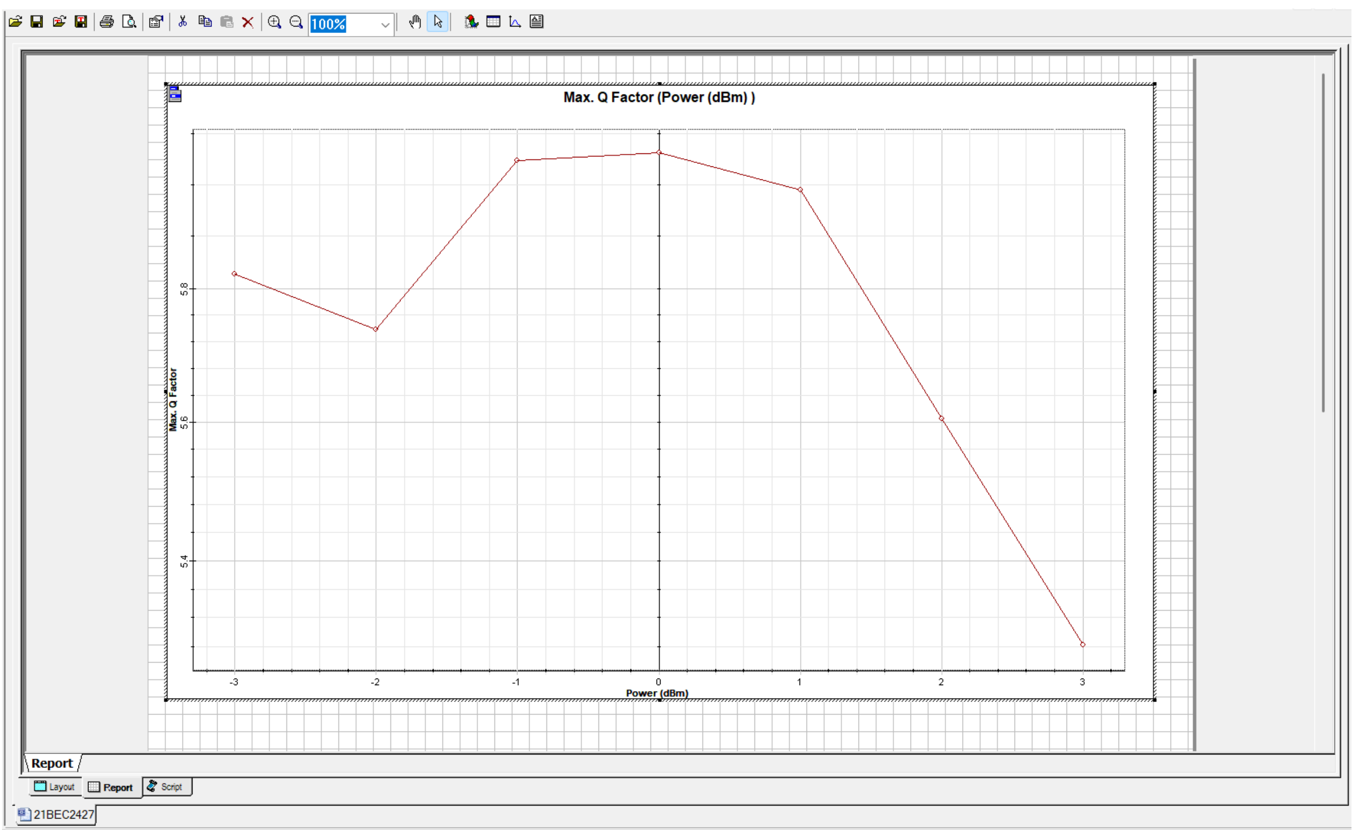
Pre amplifier Without EDFA



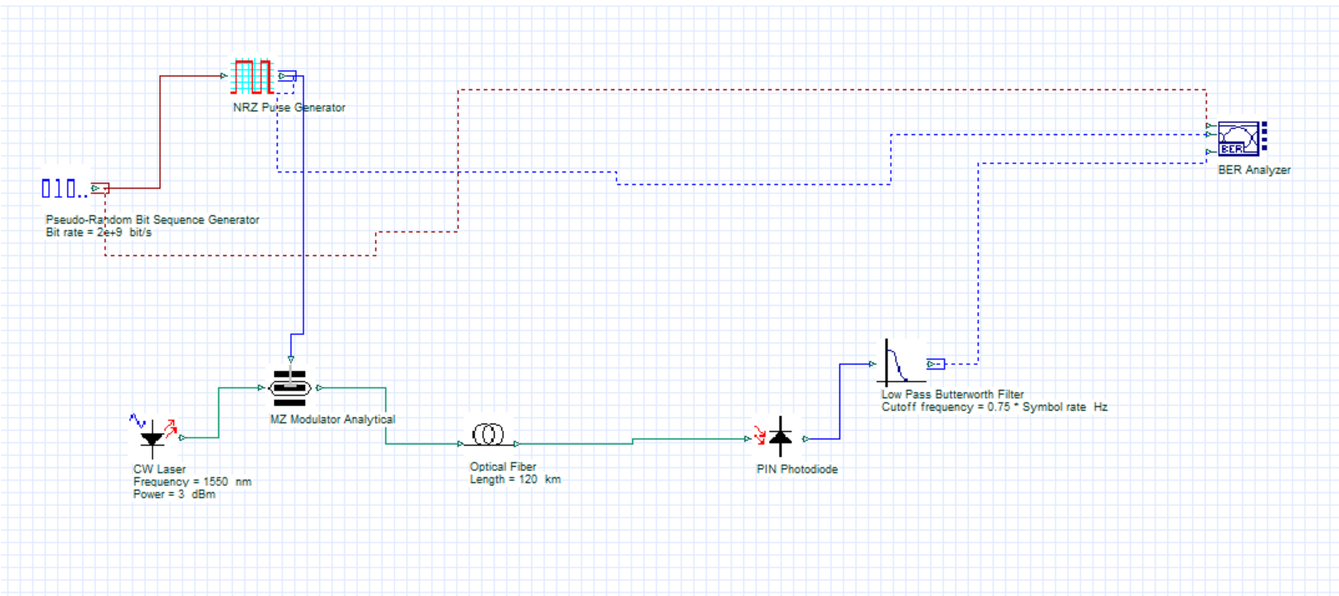


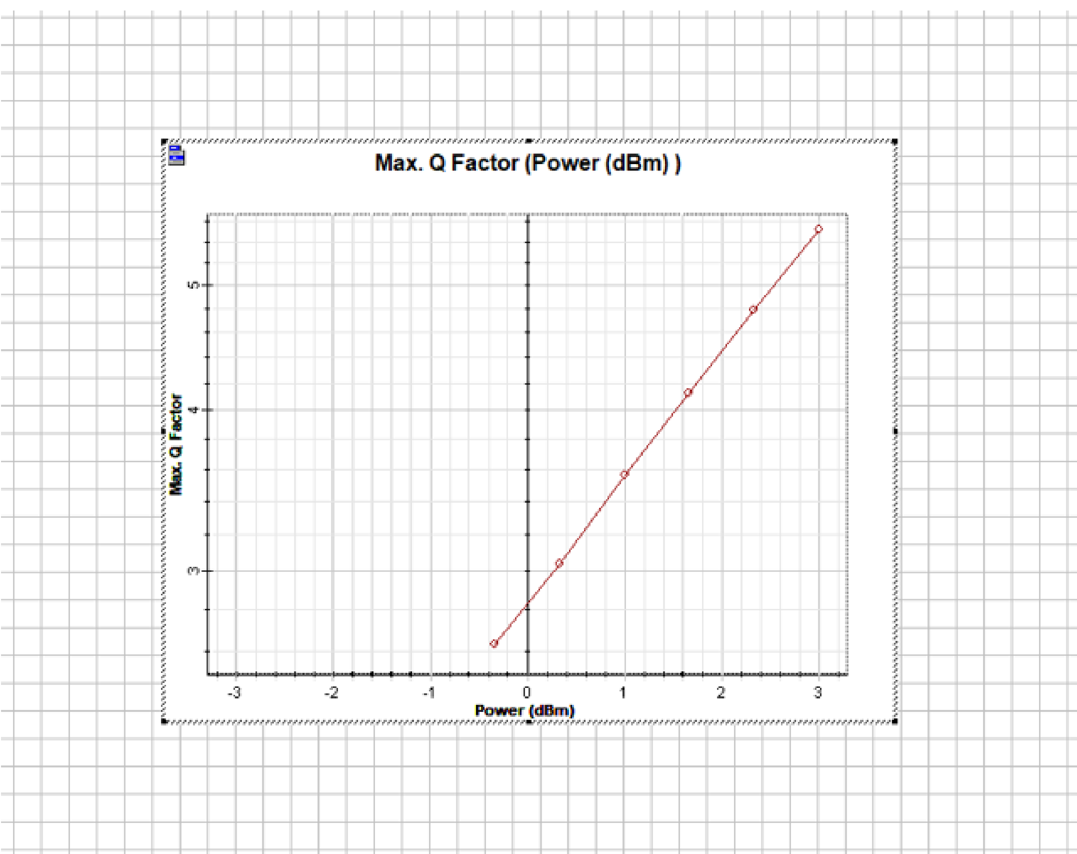
Pre amplifier With SOA





Pre amplifier Without SOA





Date

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Experiment - 4

Aim → To analyse the performance of WDM technique in optical communication system. The experiment will focus on evaluating key parameters such as BER, channel spacing, cross talk, & overall system performance.

Apparatus → light Runner

Theory → Wavelength Division multiplexing (WDM) is a Technology that multiplexes multiple optical carries signals onto a single optical fiber by using a different wavelength of laser light. This allows for simultaneous transmission of multiple data streams, significantly increasing the capacity of the optical fibre.

Key parameters → Channel spacing → The difference in wavelength between adjacent channels. Narrow spacing increases capacity but leads to crosstalk.

· BER → A critical measure of system performance indicating the number of bit error per unit time.

Procedure →

1. Using the hardware light Runner system
2. The wavelength are 1510 nm, 1530 nm, 1550 nm & 1570 nm.
3. We will connect i/P. of the wavelength with the connecting fibers.

Teacher's Signature

Date

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④ The we will select WDM option from system.
⑤ Then we will connect it to receivers.
⑥ We see that there is crossfall & there are different amplitude we will get the output.
⑦ then we will connect input to mux & the MUX to DEMUX & then DEMUX to output then note down readings.
⑧ Finally we will keep 1st reading null & check for the could talk interference.

Result & conclusion →

The direct connection will have close to nothing of loss when we MUX - DEMUX then there is significant loss of the signal. And finally we will see the cross talk signal outputs in the final one.

Teacher's Signature

Case-I i/p → nm
o/p → uW

Duty cycle (constant) 50%

Optical Source	Laser Power	PD Output
1510 nm	50	67 uW
1530 nm	93	219 uW
1550 nm	70	202 uW
1570 nm	30	0

Case-II (Individual through MUX)
Stop & Run Again

Optical Source (nm)	Laser Power	PD Output (uW)
1510	50	29
1530	93	157
1550	70	56
1570	30	0

Case-III Disable (1530 nm) → from i/p

OS (nm)	Laser Power	PD output (uW)
1510	50	27
⇒ 1530	93	2
1550	70	58
1570	30	0

OPTICAL FIBER COMMUNICATIONS LAB-4

NAME- Rahil Alawat

REGISTRATION NUMBER-21BEC2427

COURSE CODE-BECE308P

FACULTY – TANGUDU RAMJI

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Expt. No. 5

Date

Page No.

Experiment - 5

Aim → Objective of this experiment is to do the performance analysis of the passive optical component like the circulator, coupler and splitter

Apparatus → Light Runner system

Theory →

Optical circulator : It is a multiport device with non-reciprocal transmission characteristics. When light enters through port 1 of the circulator it exits through port 2 of the circulator. But when light enters through port 2 then it will exit through port 3 showing the non-reciprocity of the circulator

Optical Coupler : They are photonic devices enable of directing an optical signal to different ports or it is used to couple or merge 2 different signals and give 1 single output.
The merging and division occurs in terms of a fixed proportion. There are different proportions in which the signal are combined or divided.

Teacher's Signature

Date

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Procedure →

- First we will start the light Runner Equipment then we will set the input to the 1530 & 1550 nm waves.
- we will then set up the circulator circuit where the 1530 will be the input and then we will take output from port 2 & port 3 & finally compare the output of the both.
- Then we will setup for the output of the coupler and splitter. The input of the coupler is 1530 and 1550 nm and then we will take the output.
- The spitter will have the power of input as the difference of the power between the two outputs.

Results and Conclusion →

We can see the effects of the passive optical components in the circuits as we use the light Runner Equipment and the power difference readings clearly show us the funtionalities are proved.

Teacher's Signature

Observation →

Circulator →

Input	Direct Connection	Circulator Output
1530nm	222 uW	216 uW (P_2)
	222 u W	14 uW (P_3)

Splitter →

Input	Direct Connection	Splitter
1530 nm	-0.34 dBm	-5.21 dBm
		-4.80 dBm

Coupler →

Input	Direct Connection	Coupler
1530	-1.27 dBm	-3.39 dBm
1550	-2.44 dBm	

Date

Expt. No. 6

Page No.

Experiment - 6

Aim → To analyse the performance of different dispersion compensation techniques, specifically using dispersion compensation fiber (DCF) and fiber bragg grating (FBG), and compare their effectiveness in mitigating dispersion in optical fiber communication system using optisystem software.

Apparatus / Components → Optisystem 21.0.0

Theory → In optical communication systems, dispersion is one of the primary factors that degrade the signal quality over long distance. Chromatic dispersion causes different wavelengths of a light pulse to travel at diff. speeds, leading to pulse broadening, into symbol interference and ultimately limiting the transmission of data rate.

Dispersion Compensation Techniques →

Dispersion Compensating Fibers →

- DCF is special type of fiber with a negative dispersion coefficient, when inserted in series with standard SMF, DCF compensates for the positive dispersion accumulated in SMF, thereby reducing overall dispersion.

Teacher's Signature

Date

Expt. No. 6

Page No.

Fiber Bragg Grating (FBG)

- FBG is a type of grating embedded in optical fiber that reflects specific wavelengths while allowing other to pass FBG can be used to compensate for dispersion by reflecting and delaying different spectral components aligning them properly to counteract dispersion effects

Procedure →

- Construct circuit as shown in the block diagram.
- Place the DCT optical fiber in 3 different state
- Take readings for the without any compensation technique.
- Then we will take readings for pure compensation, post compensation and inline compensation
- Repeat the same with the FBG filter

Results →

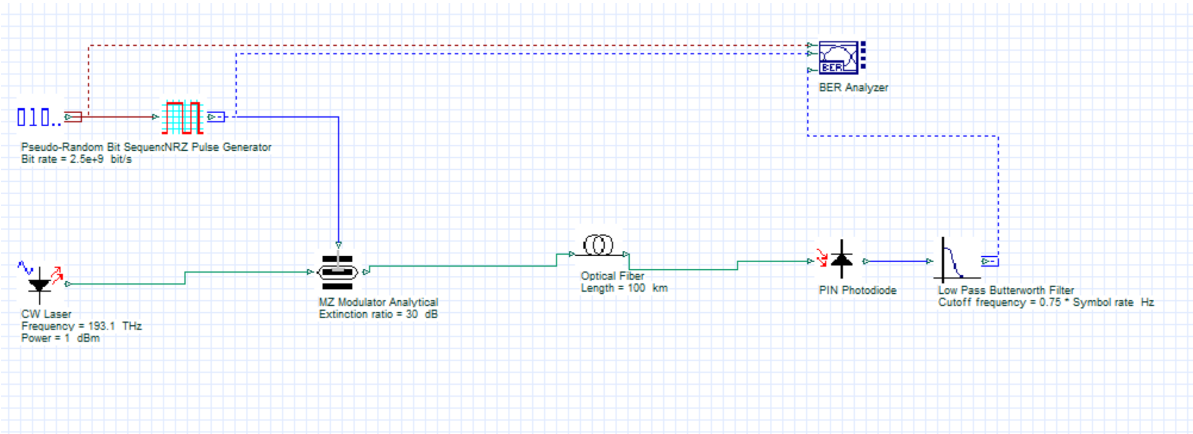
The without compensation has the least Q factor then b/w the compensation technique FBG is better than DCT and pure + post are the same & are better than Inline compensation

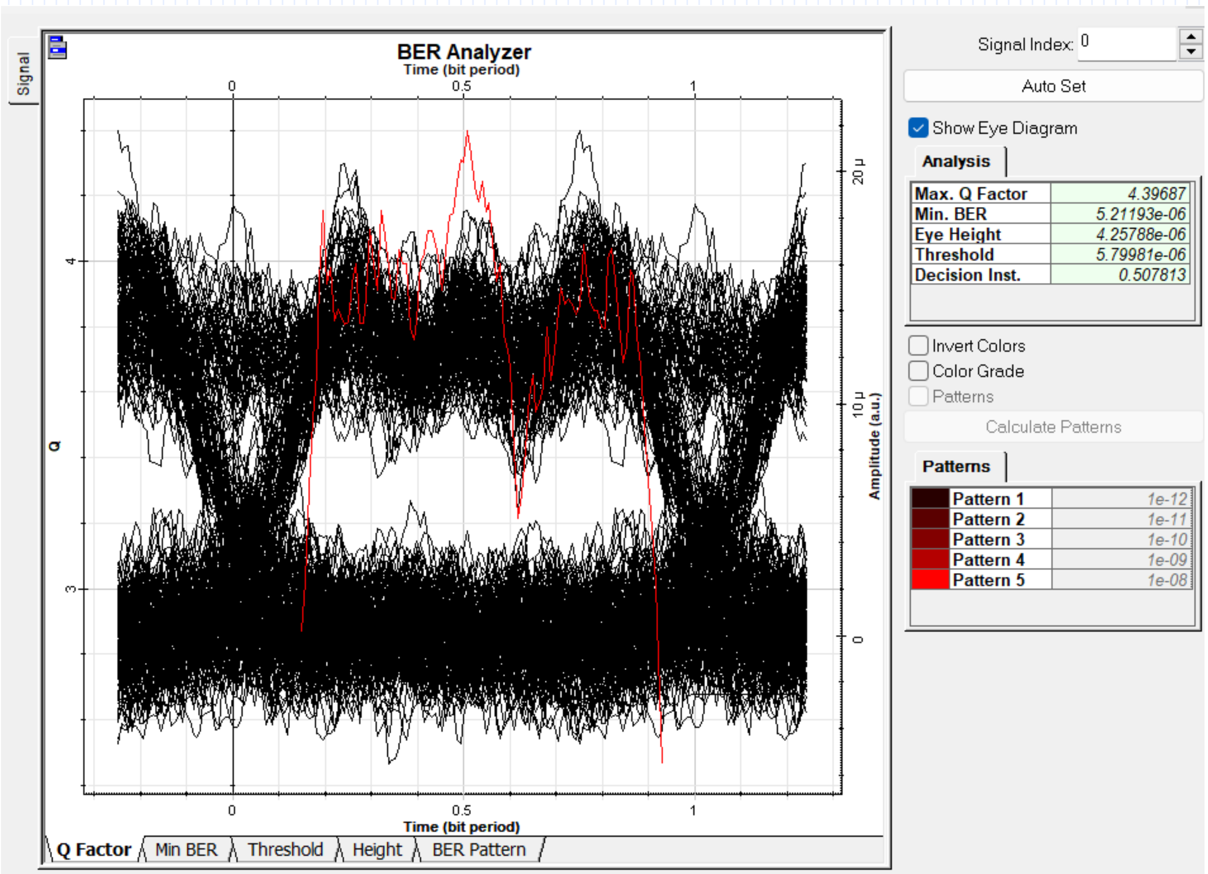
Teacher's Signature

EXPT 6

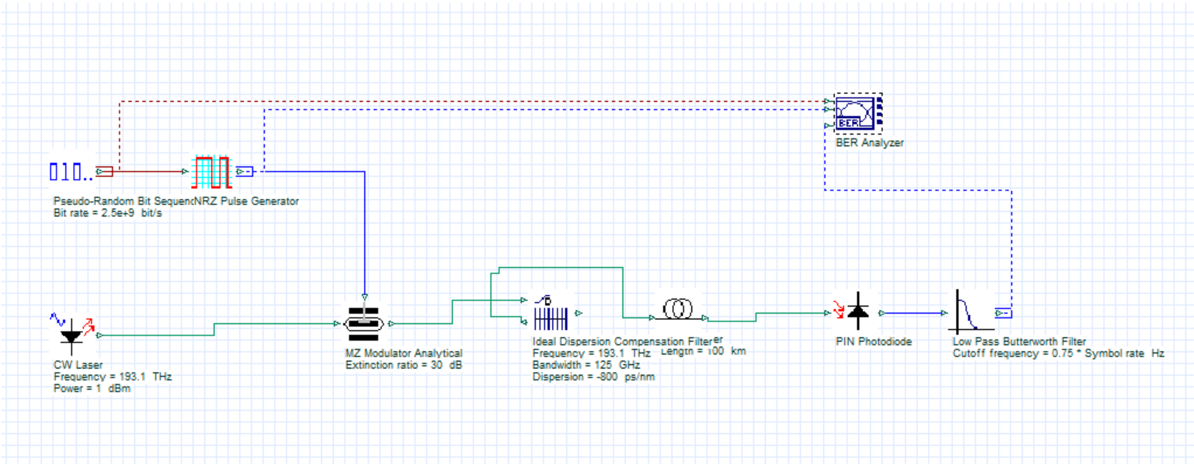
DISPERSION COMPENSATION FIBER

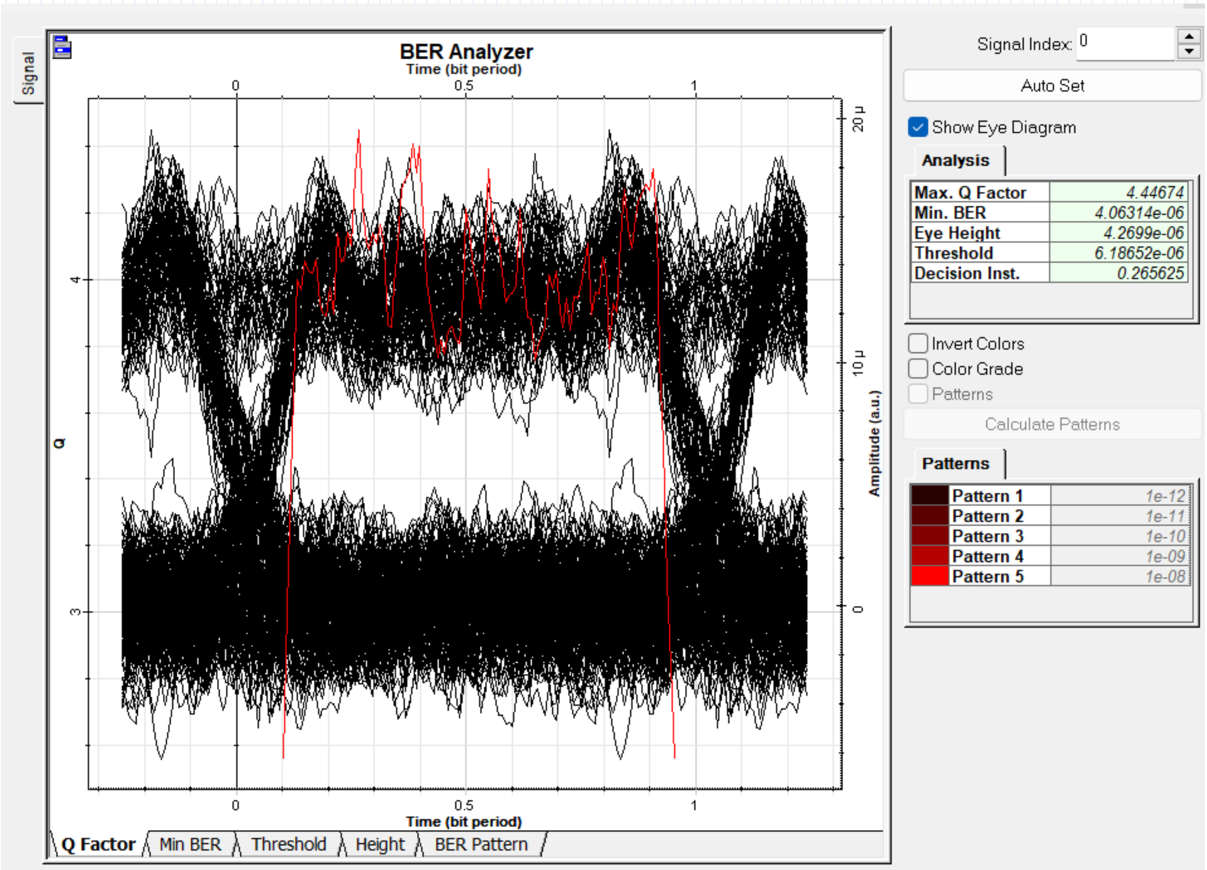
WO DISPERSION:



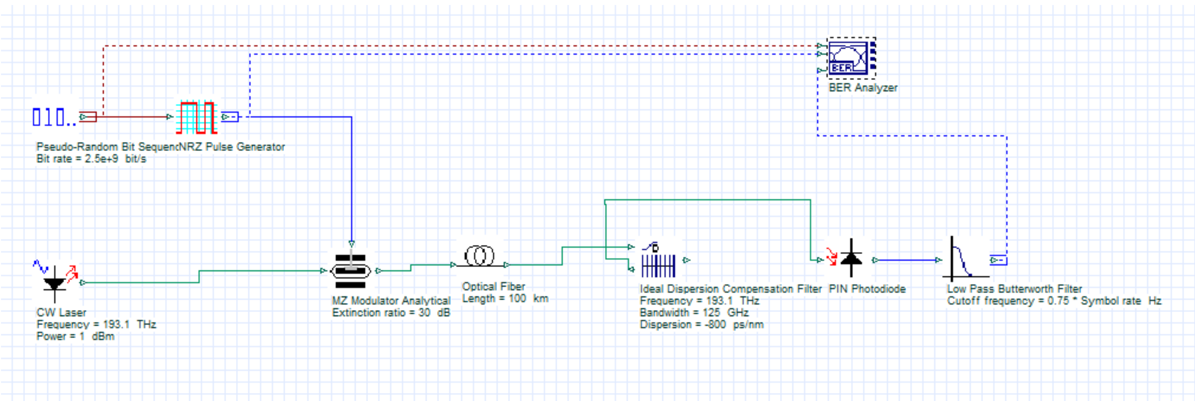


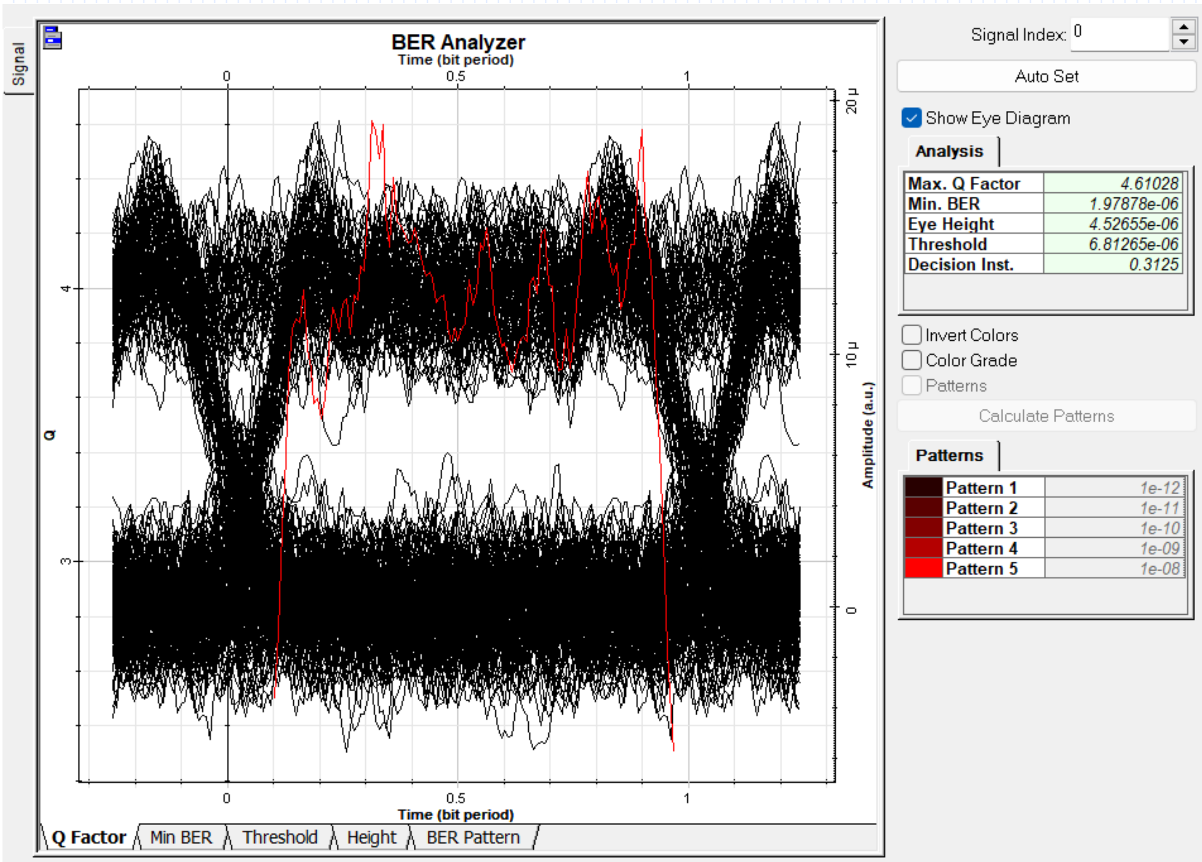
PRE DISPERSION COMP



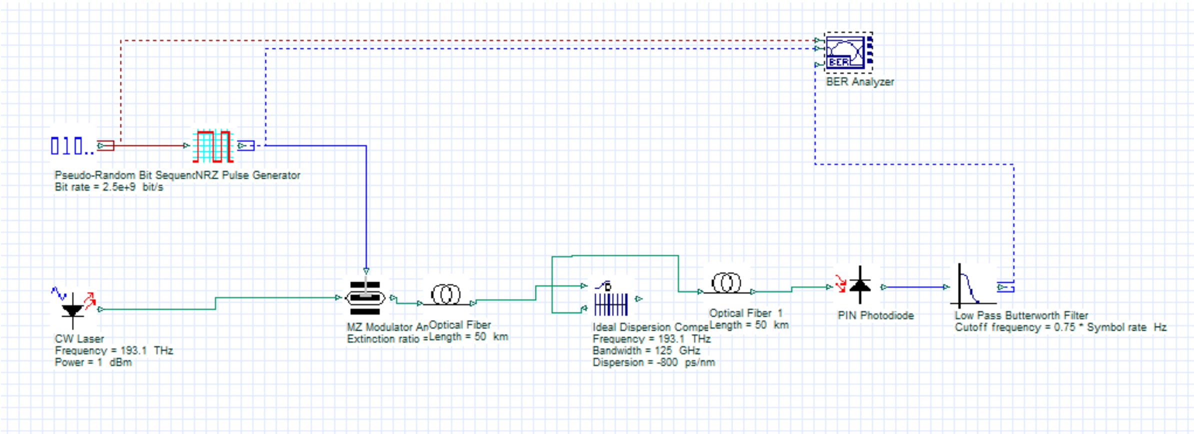


POST COMP

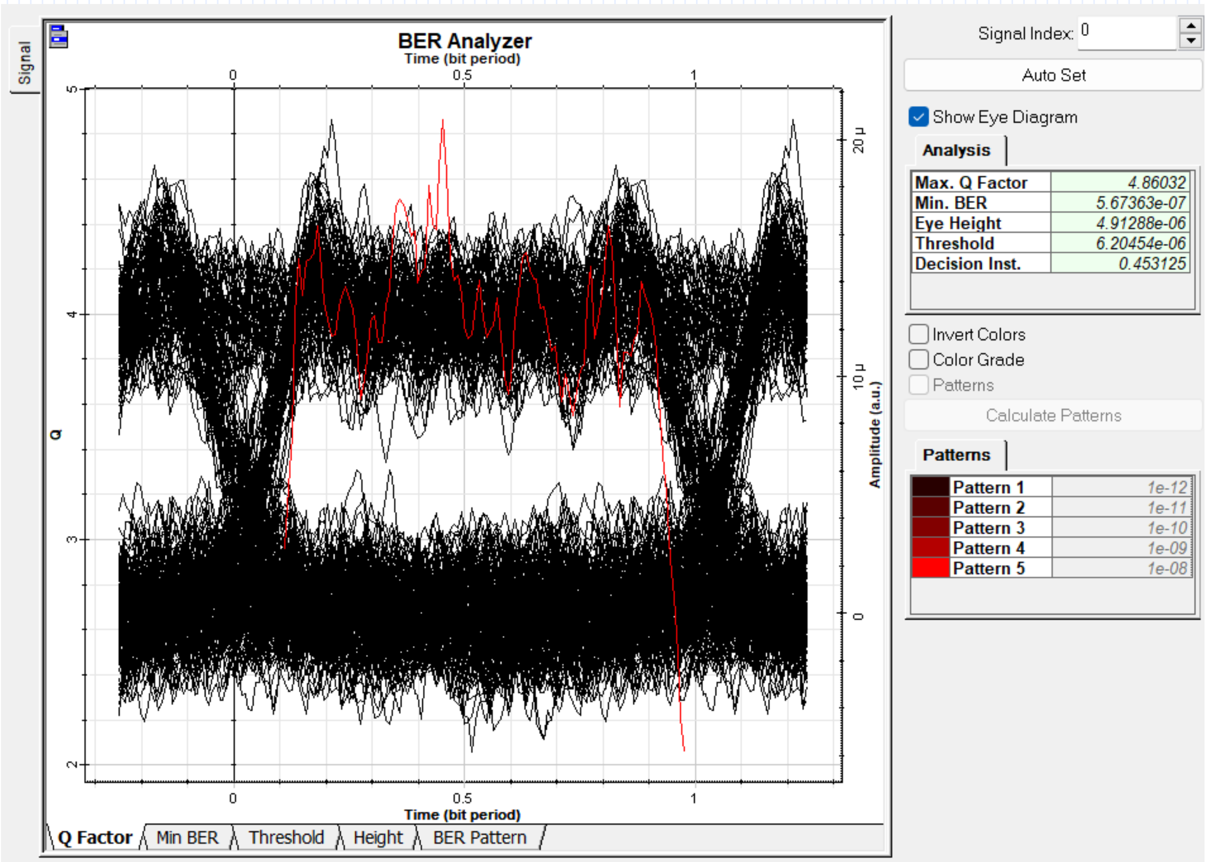

BER Analyzer
Pseudo-Random Bit SequencNRZ Pulse Generator
Bit rate = 2.5e+9 bit/s
CW Laser
Frequency = 193.1 THz
Power = 1 dBm
MZ Modulator Analytical
Extinction ratio = 30 dB
Optical Fiber
Length = 100 km
Ideal Dispersion Compensation Filter
Frequency = 193.1 THz
Bandwidth = 125 GHz
Dispersion = -800 ps/nm
PIN Photodiode
Low Pass Butterworth Filter
Cutoff frequency = 0.75 * Symbol rate Hz


Signal
BER Analyzer
Time (bit period)
Q
Amplitude (a.u.)
Signal Index: 0
Auto Set
Show Eye Diagram
Analysis
Max. Q Factor 4.61028
Min. BER 1.97878e-06
Eye Height 4.52655e-06
Threshold 6.81265e-06
Decision Inst. 0.3125
Invert Colors
Color Grade
Patterns
Calculate Patterns
Patterns
Pattern 1 1e-12
Pattern 2 1e-11
Pattern 3 1e-10
Pattern 4 1e-09
Pattern 5 1e-08
Q Factor
Min BER
Threshold
Height
BER Pattern

INLINE



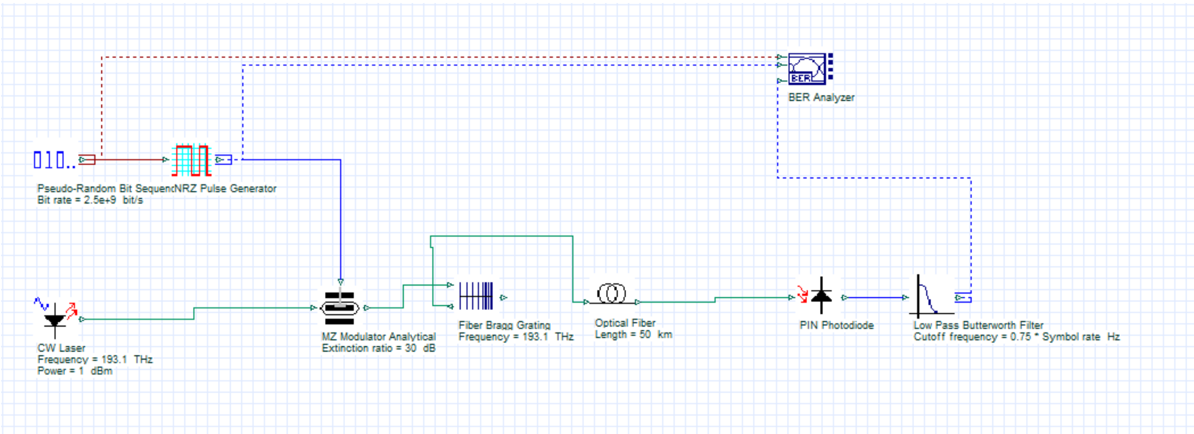
BER Analyzer
Pseudo-Random Bit Sequence
Bit rate = 2.5e+9 bit/s
NRZ Pulse Generator
CW Laser
Frequency = 193.1 THz
Power = 1 dBm
MZ Modulator Analytical
Extinction ratio =
Optical Fiber
Length = 50 km
Ideal Dispersion Compensation
Frequency = 193.1 THz
Bandwidth = 125 GHz
Dispersion = -800 ps/nm
Optical Fiber 1
Length = 50 km
PIN Photodiode
Low Pass Butterworth Filter
Cutoff frequency = 0.75 * Symbol rate Hz

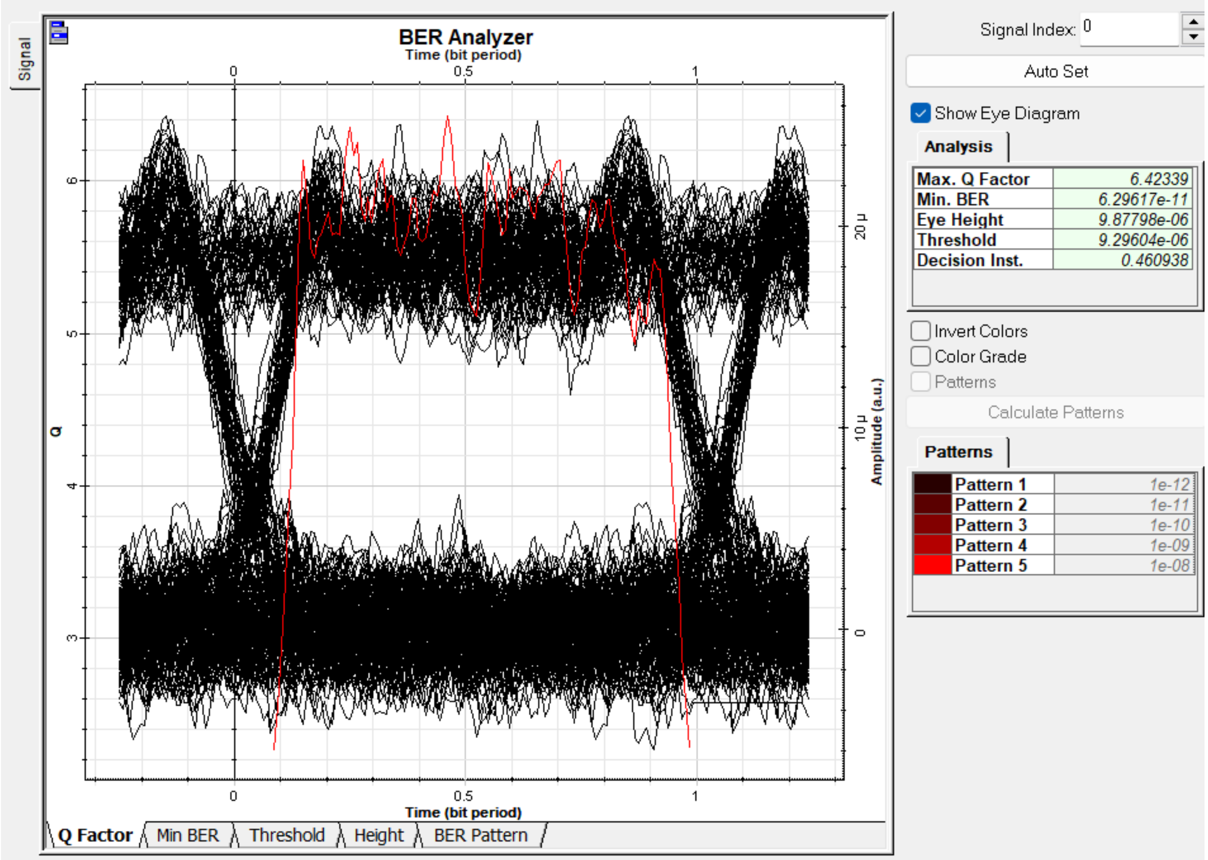


Signal
BER Analyzer
Time (bit period)
Q
Amplitude (a.u.)
Q Factor
Min BER
Threshold
Height
BER Pattern
Signal Index: 0
Auto Set
Show Eye Diagram
Analysis
Max. Q Factor 4.86032
Min. BER 5.67363e-07
Eye Height 4.91288e-06
Threshold 6.20454e-06
Decision Inst. 0.453125
Invert Colors
Color Grade
Patterns
Calculate Patterns
Patterns
Pattern 1 1e-12
Pattern 2 1e-11
Pattern 3 1e-10
Pattern 4 1e-09
Pattern 5 1e-08

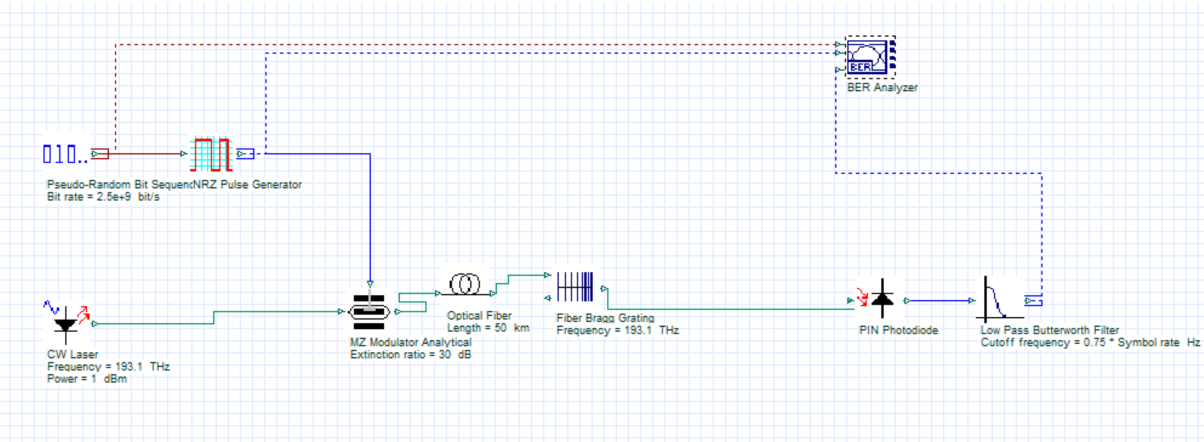
FIBER BRAGGG

PRE

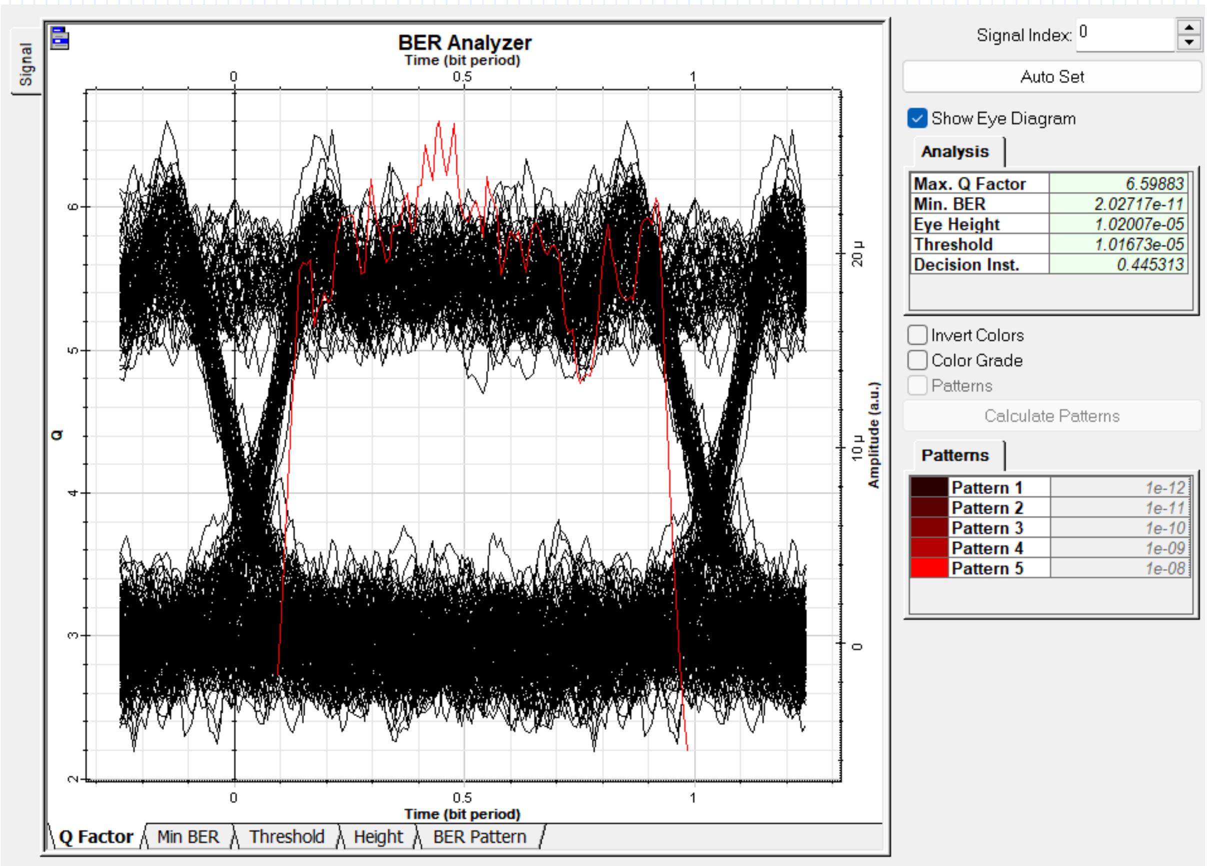




POST

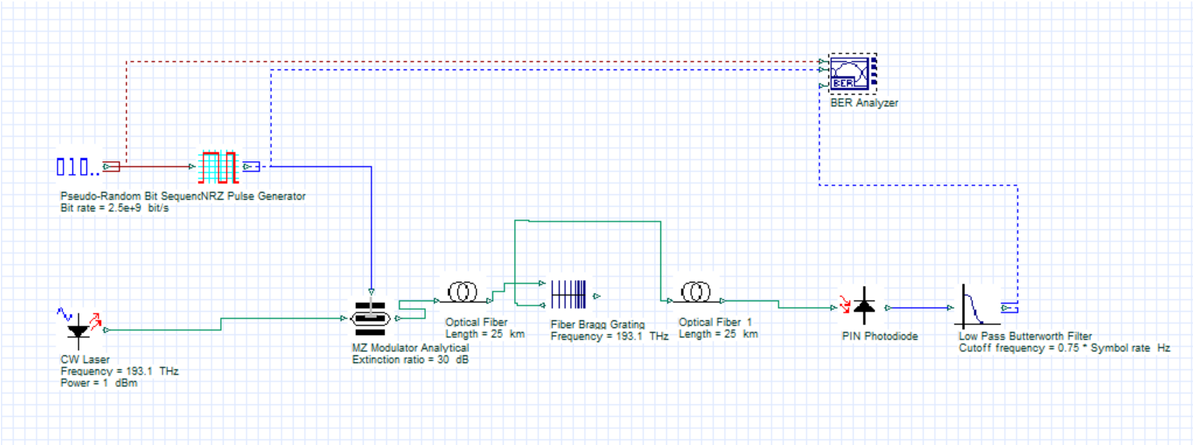


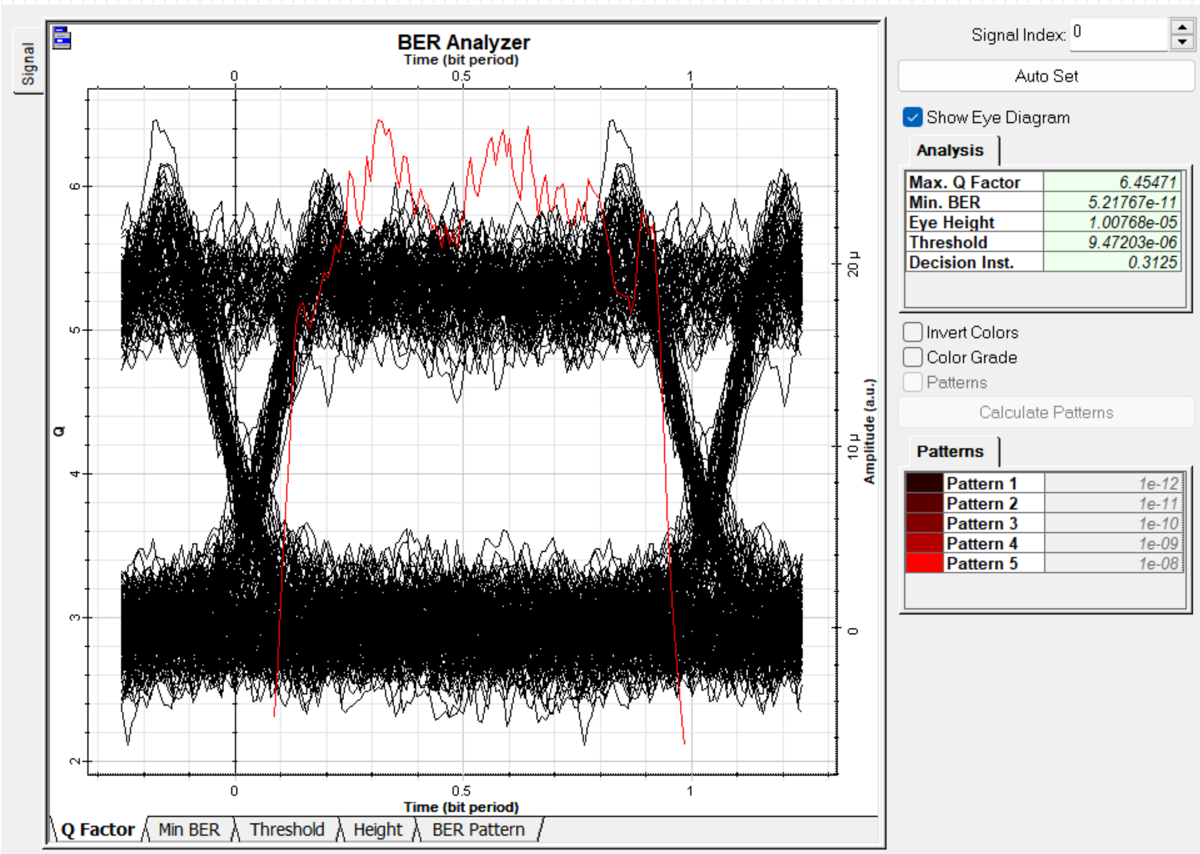
BER Analyzer
Pseudo-Random Bit SequencNRZ Pulse Generator
Bit rate = 2.5e+9 bit/s
CW Laser
Frequency = 193.1 THz
Power = 1 dBm
MZ Modulator Analytical
Extinction ratio = 30 dB
Optical Fiber
Length = 50 km
Fiber Bragg Grating
Frequency = 193.1 THz
PIN Photodiode
Low Pass Butterworth Filter
Cutoff frequency = 0.75 * Symbol rate Hz



Signal
BER Analyzer
Time (bit period)
Q
Amplitude (a.u.)
Signal Index: 0
Auto Set
Show Eye Diagram
Analysis
Max. Q Factor 6.59883
Min. BER 2.02717e-11
Eye Height 1.02007e-05
Threshold 1.01673e-05
Decision Inst. 0.445313
Invert Colors
Color Grade
Patterns
Calculate Patterns
Patterns
Pattern 1 1e-12
Pattern 2 1e-11
Pattern 3 1e-10
Pattern 4 1e-09
Pattern 5 1e-08
Q Factor
Min BER
Threshold
Height
BER Pattern

INLINE


BER Analyzer
Pseudo-Random Bit SequencNRZ Pulse Generator
Bit rate = 2.5e+9 bit/s
CW Laser
Frequency = 193.1 THz
Power = 1 dBm
MZ Modulator Analytical
Extinction ratio = 30 dB
Optical Fiber
Length = 25 km
Fiber Bragg Grating
Frequency = 193.1 THz
Optical Fiber 1
Length = 25 km
PIN Photodiode
Low Pass Butterworth Filter
Cutoff frequency = 0.75 * Symbol rate Hz


Signal
BER Analyzer
Time (bit period)
Q
Amplitude (a.u.)
Signal Index: 0
Auto Set
Show Eye Diagram
Analysis
Max. Q Factor 6.45471
Min. BER 5.21767e-11
Eye Height 1.00768e-05
Threshold 9.47203e-06
Decision Inst. 0.3125
Invert Colors
Color Grade
Patterns
Calculate Patterns
Patterns
Pattern 1 1e-12
Pattern 2 1e-11
Pattern 3 1e-10
Pattern 4 1e-09
Pattern 5 1e-08
Q Factor
Min BER
Threshold
Height
BER Pattern

Experiment - 7

Aim → To analyze the non-linear effects in an optical communication system and evaluate their effects on the signal quality

Components → optisystem 21.0.0.

Theory → Non-linear effect in optical fiber arise primarily due to the intensity of the transmitted optical signal and its interaction with the medium. These effects are significant in long distance and high power transmission and include:

① Self-phased modulation (SPM)

SPM occurs when the optical signal's intensity modulates its own phase due to the Kerr effect. This leads to spectral broadening and can impact pulse propagation, especially in high speed systems.

② Cross-phase modulation (XPM)

XPM occurs when the phase of one wavelength/channel is modulated by the intensity of another wavelength within a wavelength Division Multiplexed (WDM) system. This interaction distorts the signals and degrades overall system performance.

Date

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Page No.

Four wave mixing (FWM)

FWM is a non-linear effect where different frequency components mix, generating new frequency that interferences with the original signal. The effect is more prominent in WDM systems, causing crosstalks & crosses channels.

Procedure →

- First construct the FWM circuit then we will use the non-linear optical fiber which has 2 input and 2 outputs.
- There are 2 spectrum analyzer used to check the output.
- Construct the SPM circuit as given in the block diagram.
- The output of the spectrum analyzer is analysed before and after it passes through the non-linear fiber.
- Then construct the cross phased modulation circuit as shown in the diagram.
- This will have 2 inputs and a single output.
- There are 2 optical analyzers for input and 1 for the output.

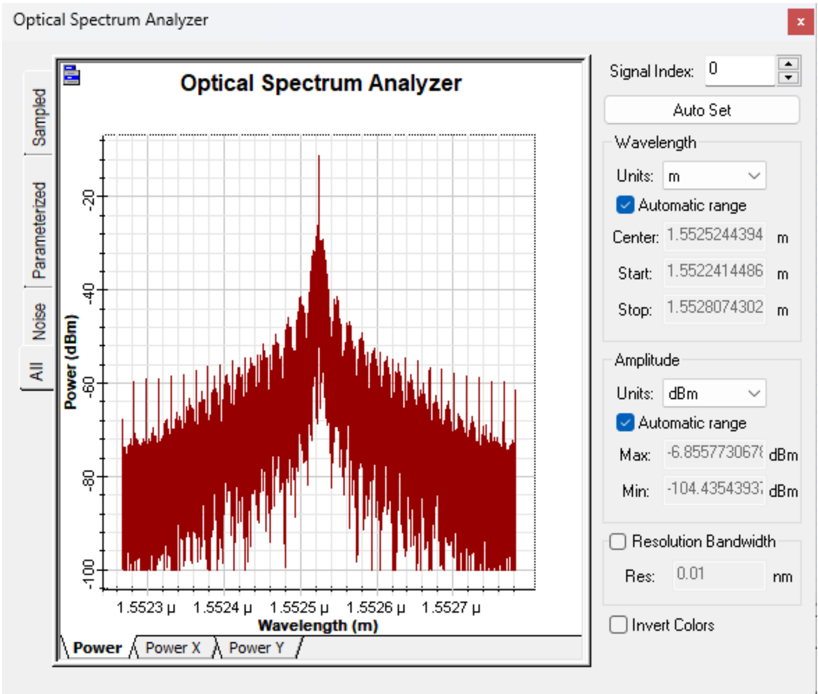
Results →

- The output of each modulation is always have a better maximum amplitude value.
- The cross phased modulation will have the output which is better than both the inputs.

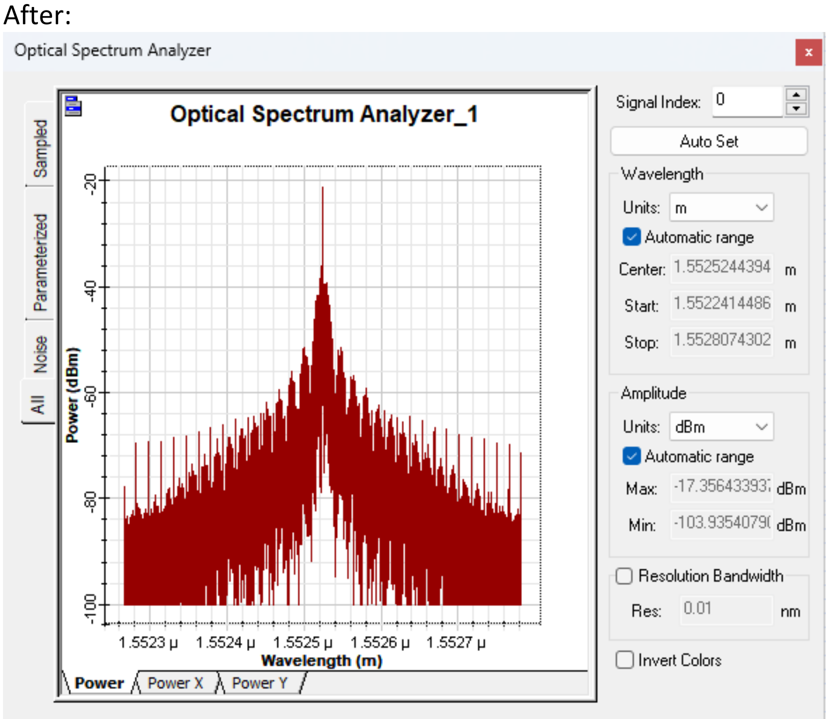
Teacher's Signature

Self- phase modulation:

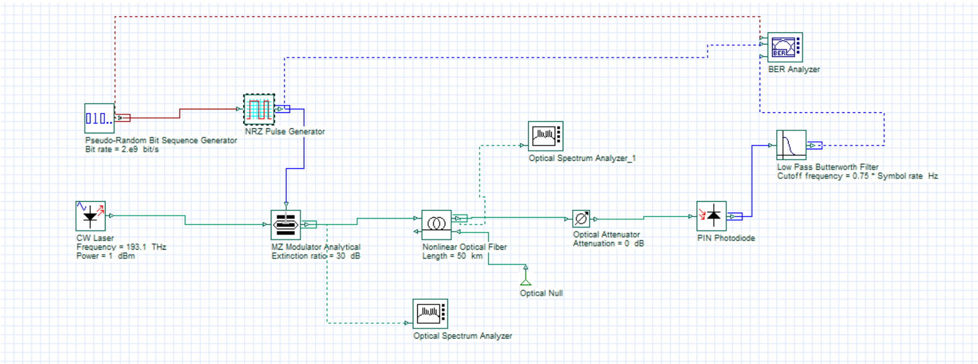
Before:



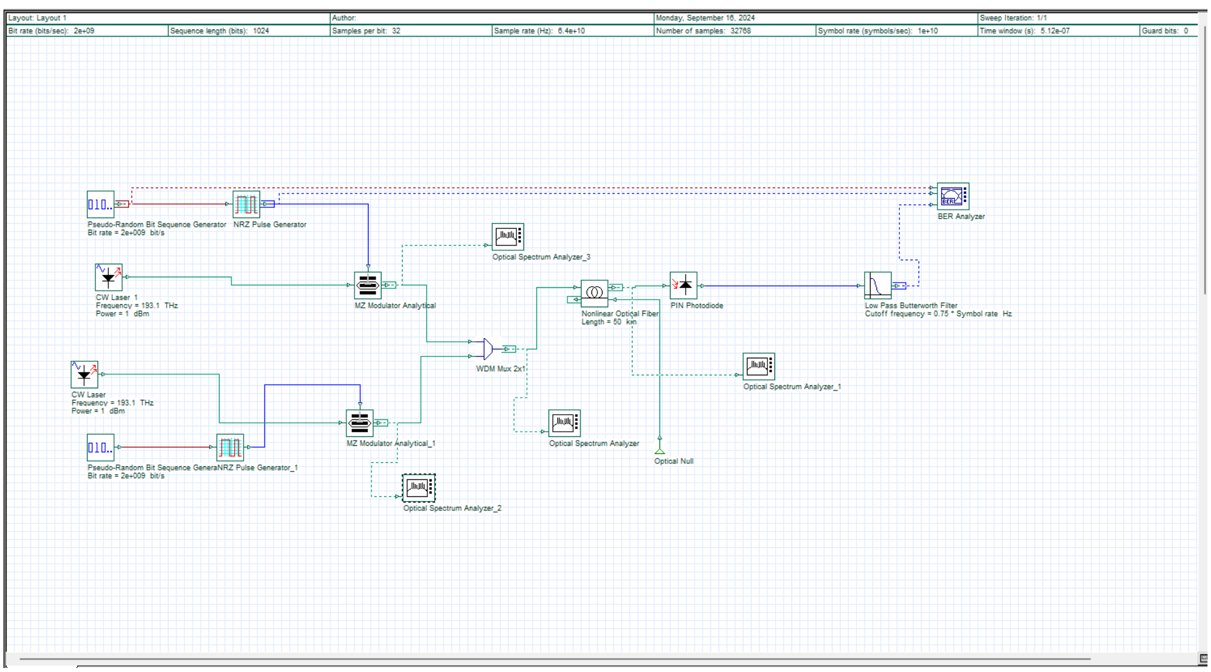
After:



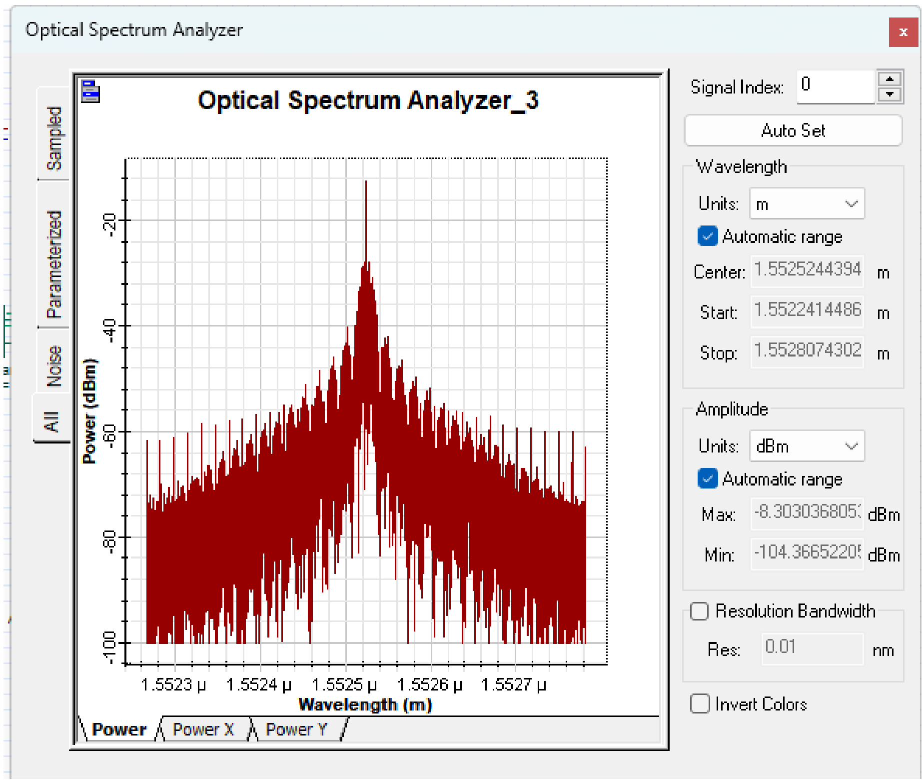
Block diagram:



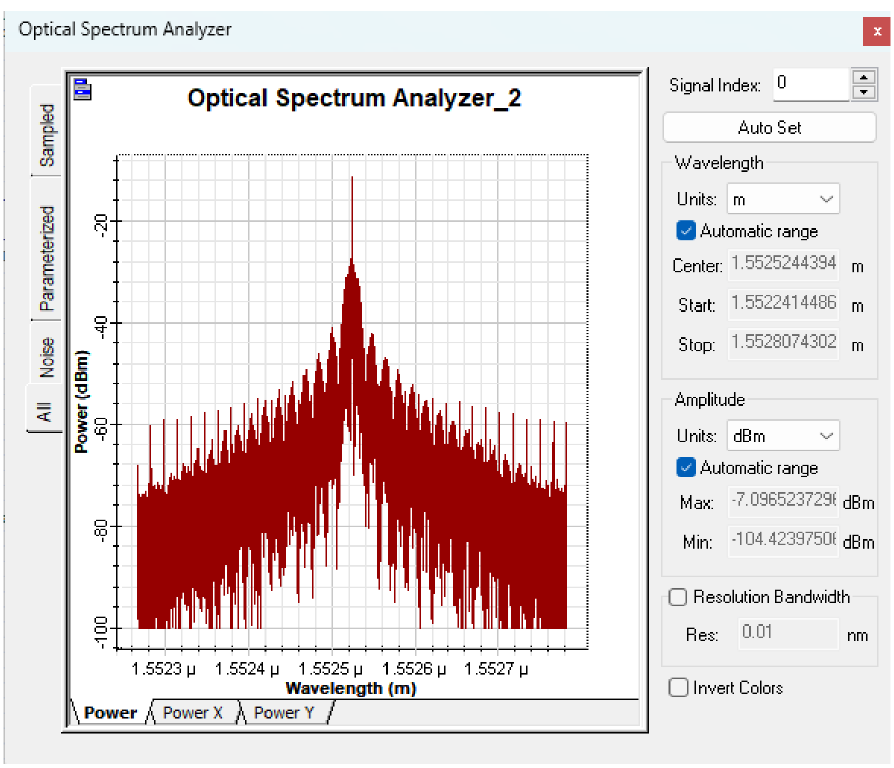
Cross phase modulation:



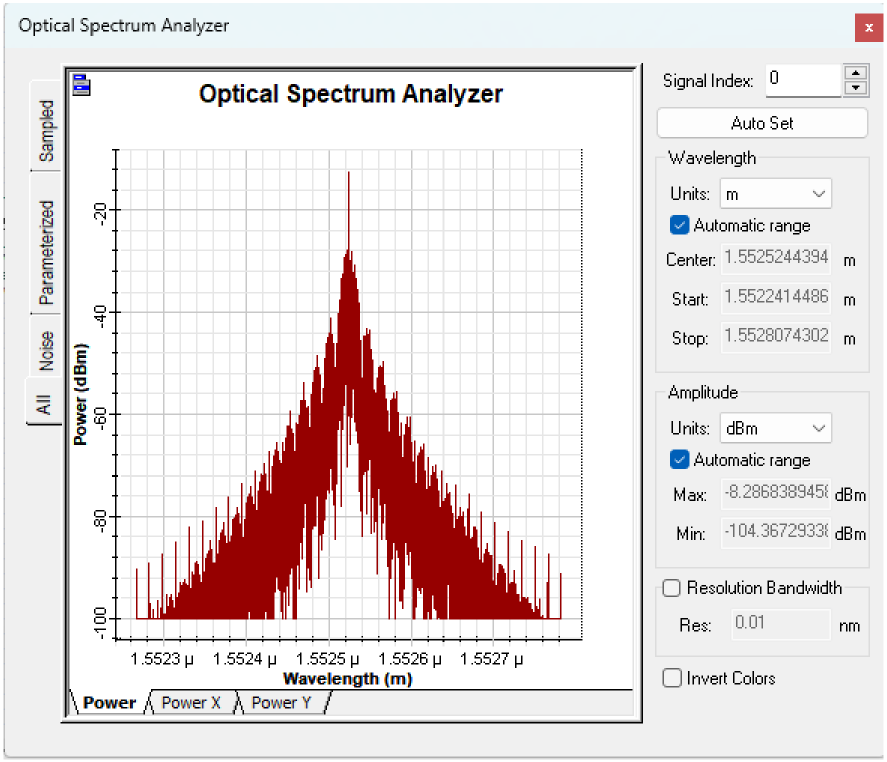
Input 1



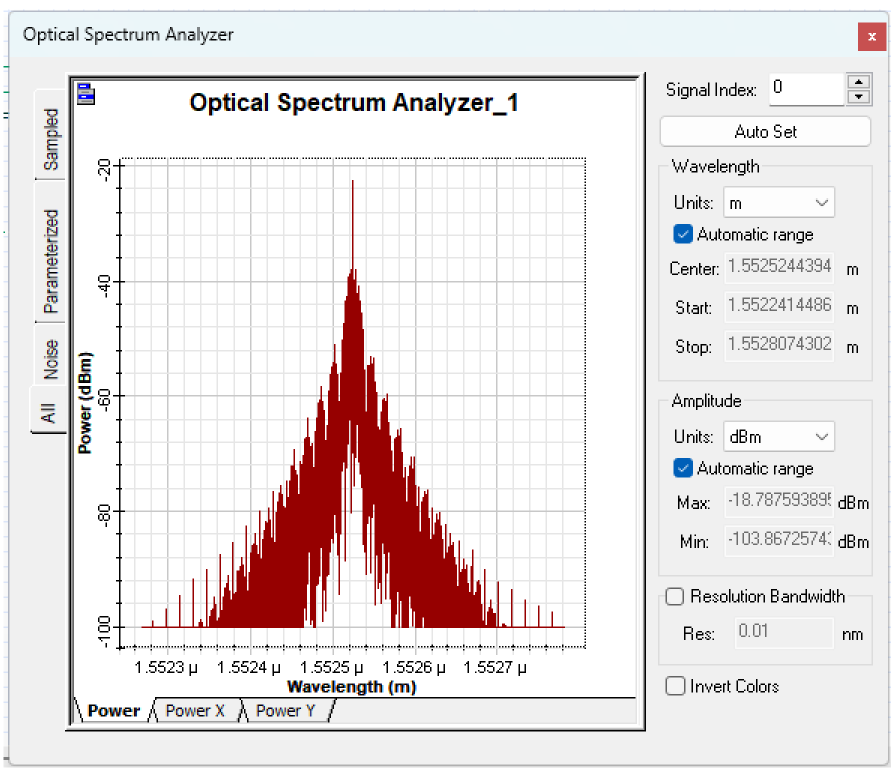
Input 2



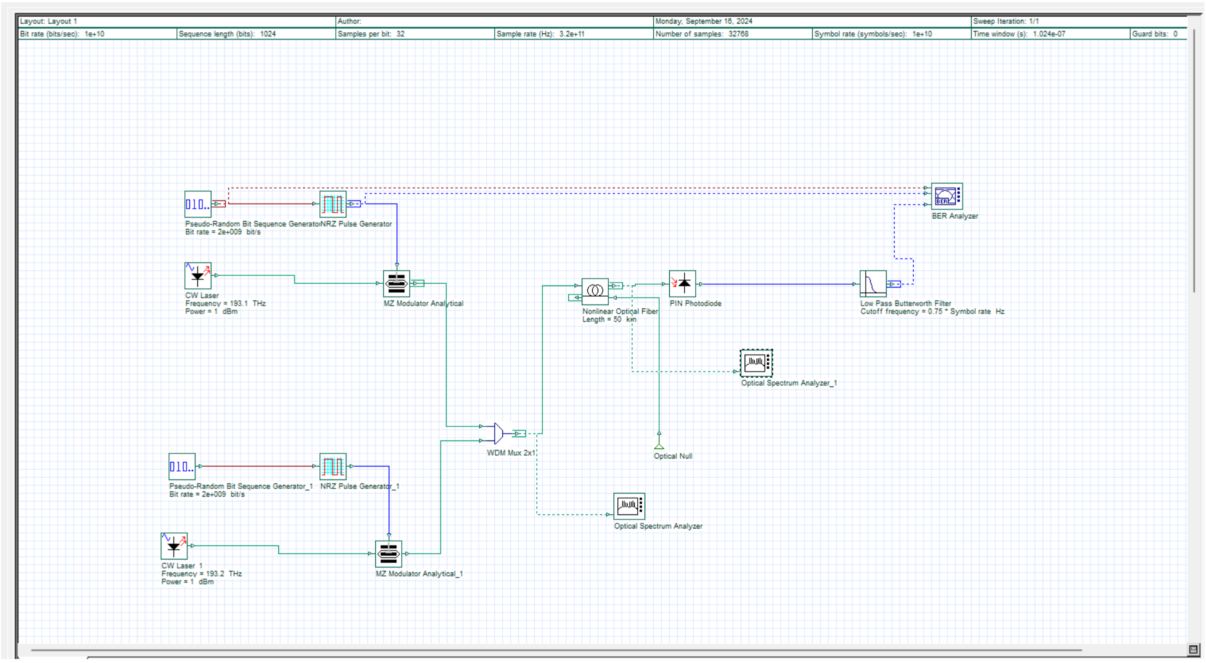
Output at MUX:

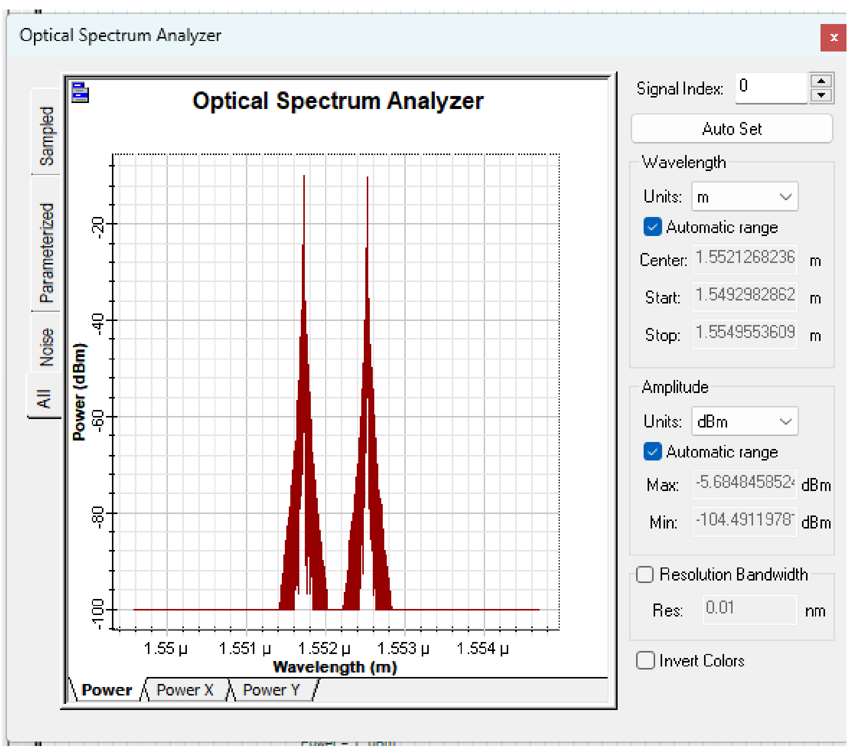


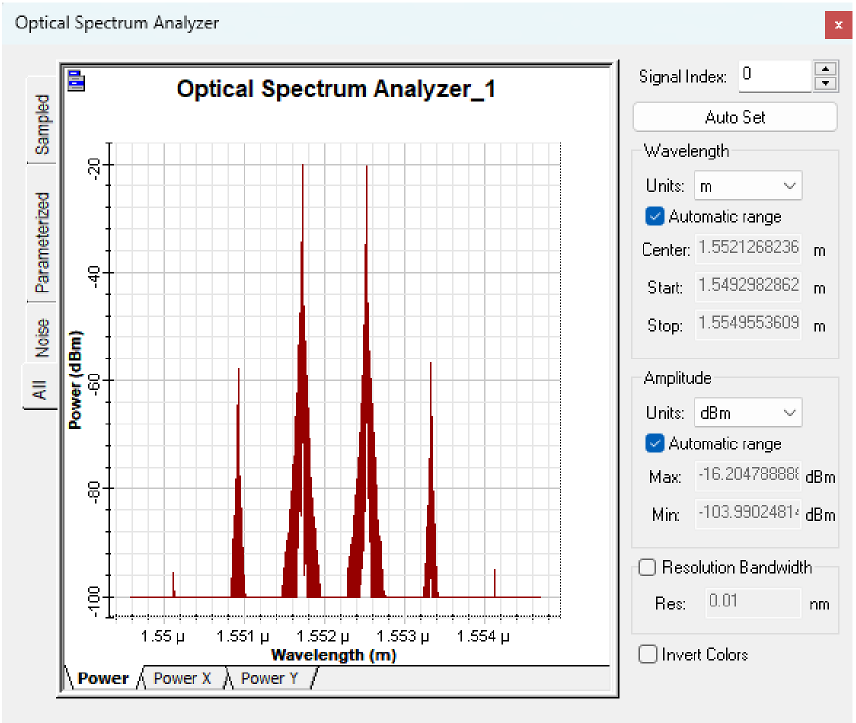
Output at non linear optical fiber:



Four wave mixing:






Optical Spectrum Analyzer
Optical Spectrum Analyzer_1
Sampled
Parameterized
Noise
All
Power (dBm)
-20
-40
-60
-80
-100
1.55 µ
1.551 µ
1.552 µ
1.553 µ
1.554 µ
Wavelength (m)
Power
Power X
Power Y
Signal Index:
0
Auto Set
Wavelength
Units:
m
Automatic range
Center:
1.5521268236
m
Start:
1.5492982862
m
Stop:
1.5549553609
m
Amplitude
Units:
dBm
Automatic range
Max:
-16.20478888
dBm
Min:
-103.9902481
dBm
Resolution Bandwidth
Res:
0.01
nm
Invert Colors

OPTICAL FIBER COMMUNICATIONS LAB-5

Vellore Institute of Technology
(Deemed to be University under section 3 of UGC Act, 1956)

NAME- Rahil Alawat

REGISTRATION NUMBER-21BEC2427

COURSE CODE-BECE308P

FACULTY – TANGUDU RAMJI

DATE OF SUBMISSION- 8/11/2024

Date ____

Expt. No. 8   Page No. ____

Design a point to point optical System

Aim → To design a point to point optical system & observe the transfer of system's signal from source to reciever.

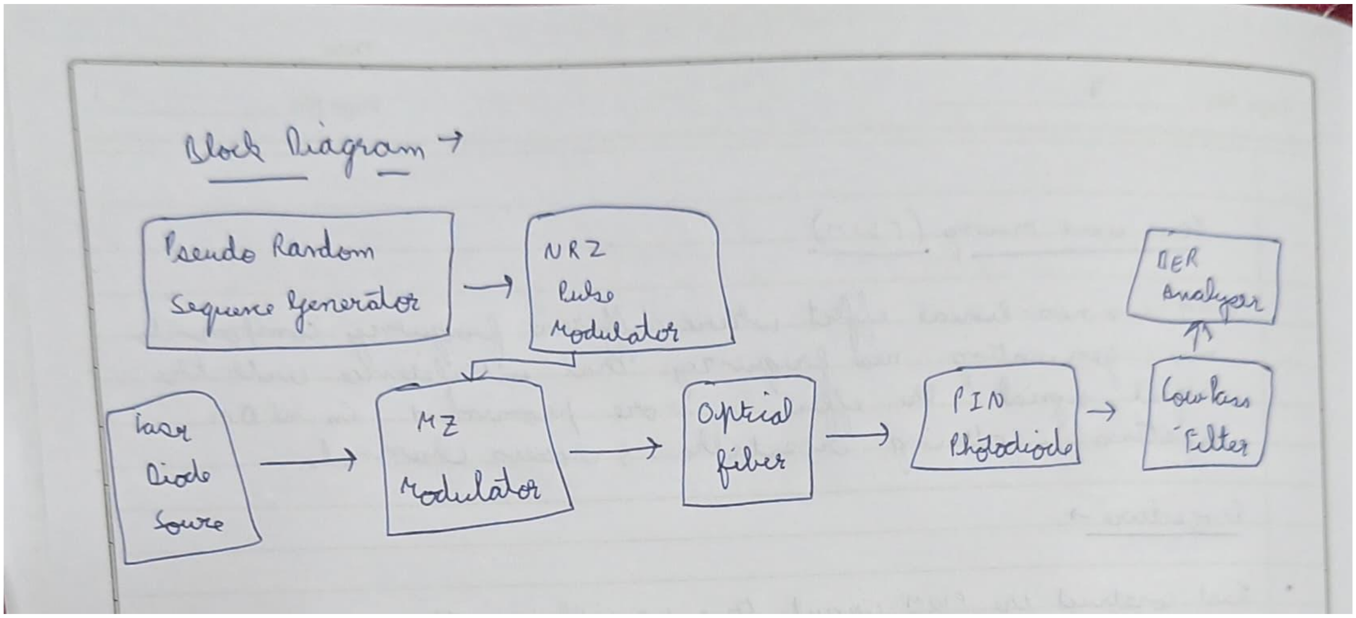
Apparatus Light Runner System

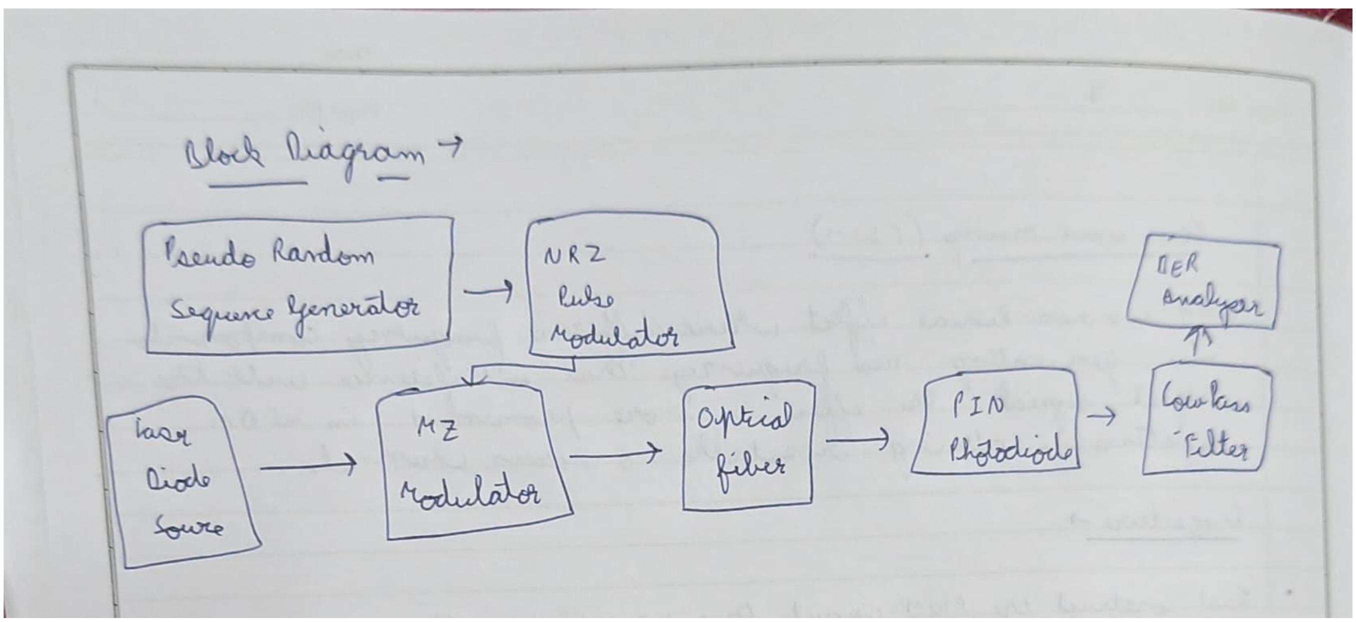
Theory → A point to point optical system includes a source, fiber & reciever, the signal will ~~leas~~ travel from the source point to the destination point

(a) Transmitter: This component converts electrical signal into optical signals. It uses a light source, such as laser diode of LED. The laser diode is preferred for a long distance communication due to its coherent & monochromatic light outputs which helps in reducing dispersion.

(b) Optical Fiber: This medium consists of core surrounded by cladding, both made of silica or plastic, with different refractive indices. The core carries the core using total internal reflection (TIR).
There are two main types of optical fiber
Single Mode Fiber (SMF)
Multi Mode Fiber (MMF)

Teacher's Signature ____


Block Diagram →
Pseudo Random Sequence Generator
NRZ Pulse Modulator
Laser Diode Source
MZ Modulator
Optical fiber
PIN Photodiode
Low pass Filter
BER Analyser


Block Diagram →
Pseudo Random Sequence Generator
NRZ Pulse Modulator
Laser Diode Source
MZ Modulator
Optical fiber
PIN Photodiode
Low pass Filter
BER Analyser

Date

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(c) Receiver: This component converts the optical signal back to an electrical signal. It uses a photo detector, such as a photodiode, which generate an electrical current when it absorbs light. The receiver might also often includes a transimpedance amplifier to convert the current to a voltage signal & an electric filter to remove noise

Procedure →

- → Connect the light runner's 1510 nm & 1550 nm source to the i/p of the inbuilt mux
- → Connect the mux output to fiber start.
- → Fiber is intially 1 km, then 2 & finally 3
- → End of fiber is connected to the demux i/p.
- → Demux o/p is send to the o/p viewport
- → We select Experiment → characterization of mux & demux
- → Duty cycle of all signal is 50%.
- → Laser power is 100% & 80%.

Result :-

We observe that as distance increases the o/p power will decrease.

Teacher's Signature

Date

Expt. No. 9

Page No.

Estimate Power & Rise Time Budget

Aim → (a) To designing a optical power loss model for a point to point link without considering dispersion.

(b) To estimating the link power budget for the above model.

(c) To measure the max^m distance.

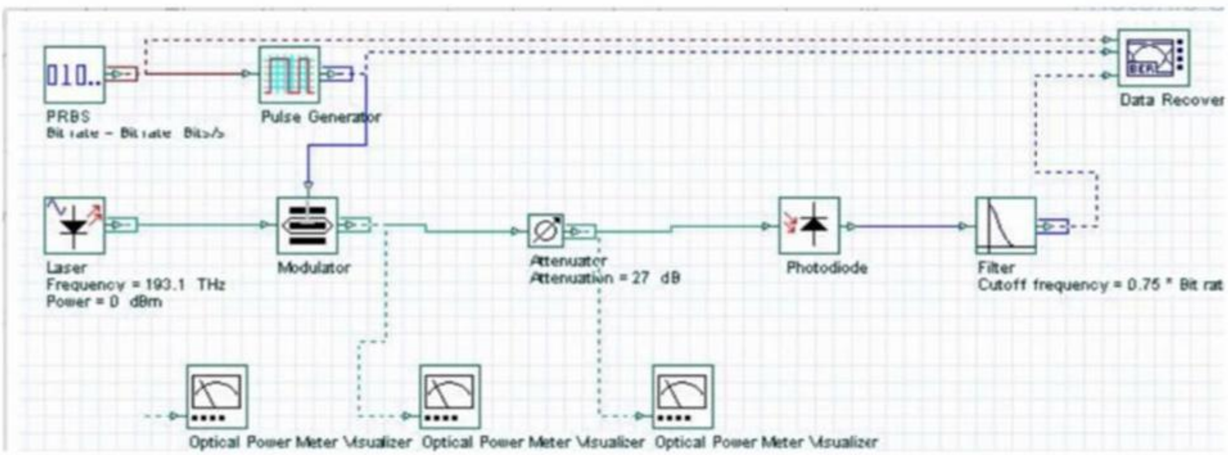
Apparatus Required → Optisystem Software 21.0.0

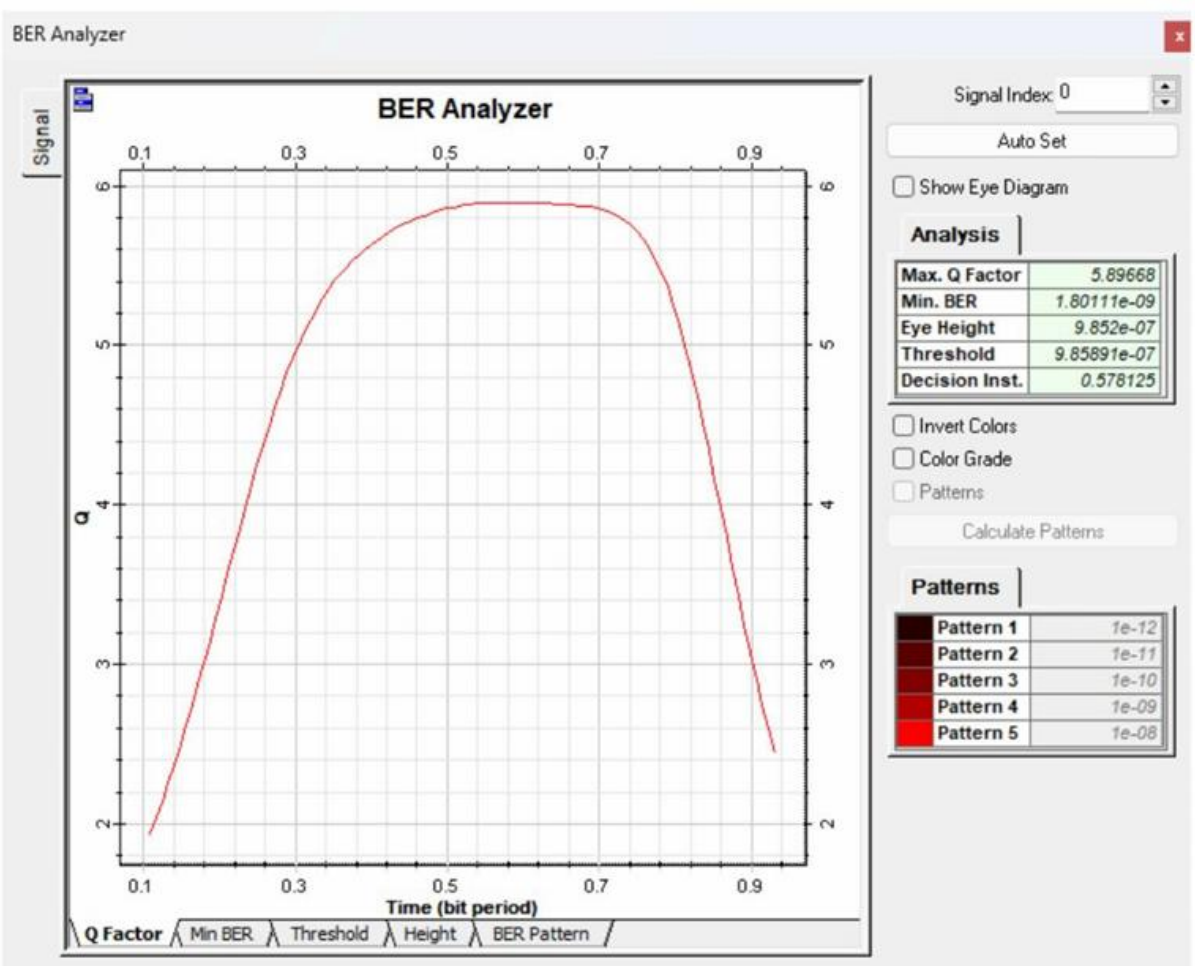
Theory →

The link power budget calculates the power margin between transmitter output & minimum receiver sensitivity needed to achieve a specific BER. This margin covers losses from a connector, splices fiber potential future components, and other impairments. If components don't support the desired distance, replacements or amplifiers may be needed. The optical link loss budget is based on the cummulative losses of each component, measurement made in decibels (dB) as Loss = 10 log (Po/Pin), where Po & Pin are the o/p & i/p power respectively. This budget allocates the Total allowable loss across connectors, splices, fibre & as system margin to ensure sufficient power reaches the receiver for reliable, long term performance. This reliability is for ~~used~~ maximising distance or bit rate at a min^m BER.

Teacher's Signature

Block Diagram





Date

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Procedure →

→ Draw the block diagram in Optisystem software.
→ Provide the i/p specification for each component.
→ Save & run the simulation.
→ obtain the reading
→ Draw the graph
→ Write the Result & inference

Inference →

The graph is observed which shows a plateau with a positive Q factor & a low BER.

Teacher's Signature

Date

Expt. No. 10

Page No.

Detect the faults of a fiber using OTDR

Aim → To detect & analyse faults in an optical fiber using an optical Time - Domain Reflectometer (OTDR)

Apparatus → Light Runner Equipment

Theory → An optical time domain reflectometer (OTDR) is an instrument used to characterise an optical fiber. It works by sending a series of light pulses into the fiber & measuring the light that is scattered & reflected back to the instrument from different points along the fiber. The returned signal provides information about the fiber length, attenuation, & the location of any faults, splices or breaks.

Key concepts related to OTDR:

(a) Rayleigh Scattering: Occurs due to small impurities in the fiber material which scatter the light in all directions. The intensity of the scattered light is used to determine the fiber's loss characteristics.

(b) Fresnel Reflection: Occurs in the refractive index, such as fiber connectors, splices or breaks. This reflection is used to locate faults or breaks in the fiber.

Teacher's Signature

Date

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(c) Backscatter: The scattered light that is returned to the OTDR. The strength & time delay of backscatter signal help determine the distance to events (faults, splices or connections) along the fibre.

(d) Dead zone: The distance from the i/p where the OTDR cannot detect events due to high intensity of the fresnel reflection. It is essential to use launch cable to minimise dead zone.

Procedure →

- → Turn on light runner, experiment OTDR
- → Make connections as shown in block diagram.
- → Input signal is connected to P1
- → Faulty wire is connected to P2.
- → Reflected signal is received in P3.
- → We calculate the length of the fiber from the formula.
- → If the length is equal then there is no fault in the line.

Inference →

The observed values are equal to the theoritical values and this shows there are little to no fault in the fibre.

Teacher's Signature

Formula :

$$\frac{c}{\eta} = \frac{3\times10^8}{1.46}$$

T (μs)	Length of fiber (original)	Length of fiber (calculated)
22.0125	2 Km	2.25 km
11.949	1 km	0.96 km